3.5 STRUCTURES AND STRUCTURAL COMPONENTS

Structures and their structural components and commodities that are within the scope of license renewal and subject to aging management reviews are discussed in Section 2.4 and summarized in Tables 3.5-2 through 3.5-16.

The determination of the aging effects applicable to structures and their structural components and commodities begins with the identification of the aging effects defined in industry literature. From this set of aging effects, the component and commodity materials and operating environments define the aging effects for each structural component or commodity that is subject to an aging management review. These aging effects are validated by a review of industry and St. Lucie Units 1 and 2 operating experiences to provide reasonable assurance that the full set of aging effects are established for the aging management review.

The Structures and Structural Components scoping and screening results were compared to the GALL Report [Reference 3.5-1]. The following component/commodity groups identified in the GALL Report do not require an aging management review for St. Lucie Units 1 and 2 for the reasons noted.

- Block walls at the Intake Structures (III.A6.3-a) - The St. Lucie design does not contain these components.
- Class 1 Support High Strength Bolting (III.B1.1.2-a) - The St. Lucie design does not contain these components.
- New Fuel Racks (VII.A.1) - These components do not perform or support any license renewal system intended function that satisfy the scoping criteria of 10 CFR 54.4 and therefore, are not within the scope of license renewal.

For components that require an aging management review that are also included in the GALL Report, differences in materials and environments are described in Subsections 3.5.1 and 3.5.2. Aging management programs that are consistent with the GALL Report and those that are plant specific are identified in Subsections 3.5.1 and 3.5.2 and detailed in the appropriate subsections of Appendix B. Component/commodity groups identified in Tables 3.5-2 through 3.5-16 provide a GALL Report reference in brackets, where applicable, indicating that the St. Lucie Units 1 and 2 component/commodity group, material, and environment are the same. If no GALL Report reference is included, the component/commodity group is plant specific.

Structural components inaccessible for inspection were evaluated for potential aging effects based on their environment as part of the aging management review. Several structural components that are inaccessible for visual inspection require aging management at St. Lucie. Examples include buried concrete, embedded steel, and structural components blocked by installed equipment or structures. Structural components inaccessible for inspection are managed by inspecting accessible structures with similar materials and environments for aging effects that may be indicative of aging effects for inaccessible structural components. The programs credited for managing aging effects of inaccessible structural components are the ASME Section XI, Subsection IWE Inservice Inspection

Program and the Systems and Structures Monitoring Program. These programs are discussed in Appendix B.

3.5.1 CONTAINMENTS

The Containment structures and structural components are grouped into four classifications:

- Containment steel in air structural components
- Containment steel in fluid structural components
- Containment concrete structural components
- Containment miscellaneous structural components

3.5.1.1 CONTAINMENT STEEL IN AIR STRUCTURAL COMPONENTS

Containment steel in air structural components include:

- containment vessels (including attachments)
- component supports
- maintenance, personnel, and escape hatches, including hinges, latches, and equalizing valves (Note that active components such as interlocks and operating mechanisms do not require an aging management review)
- penetrations (including mechanical, heating and ventilation, and steel pressure boundary portions of the electrical penetration assemblies)
- fuel transfer tube flanges and sleeves
- cranes and hoists
- conduits and cable trays
- electrical and instrument panels and enclosures
- supports (including conduit and cable tray, electrical and instrument panels and enclosures, HVAC ducts, safety-related and non-safety related piping, and tubing)
- non-safety related piping between class break and anchor
- pipe whip restraints
- sump screens
- structural steel (columns, beams, etc.)
- miscellaneous steel (radiation shielding, missile barriers, hatch frame covers)
- stairs, ladders, platforms, handrails, checkered plate, and grating

3.5.1.1.1 MATERIALS AND ENVIRONMENT

Containment steel in air structural components were designed and constructed in accordance with American Institute of Steel Construction (AISC) standards. The codes and standards used for the design and fabrication are identified in Unit 1 UFSAR Section 3.8, and Unit 2 UFSAR Section 3.8. Containment steel in air structural components are constructed of carbon steel, galvanized carbon steel, nickel alloy, and stainless steel. St. Lucie Containment steel in air structural components are exposed to environments of containment air, outdoor, indoor - not air conditioned, and potential borated water leaks (see Table 3.0-2). The specific materials and environments for steel in air structural components for Containments are contained in Table 3.5-2. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

Pipe segments beyond the safety-related/non-safety related boundaries are constructed of carbon steel and stainless steel and consist of piping and inline components. The external surfaces of these pipe segments are exposed to the Containment air environment and potential borated water leaks. Internal environments of the pipe segments are the same as the internal environments for the systems in which the pipe segments are installed.

3.5.1.1.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of the intended function(s) for Containment steel in air structural components are loss of material, cracking, and change in material properties. Each is discussed below.

<u>LOSS OF MATERIAL</u>

Aging mechanisms that can lead to loss of material of Containment steel in air structural components are mechanical wear, corrosion, and aggressive chemical attack. This may be seen as material dissolution, corrosion product buildup, and pitting. Loss of material may be uniform or localized.

Mechanical wear is associated with close-fitting mechanical components having relative motion and is not applicable to structural steel. Accordingly, mechanical wear is not an aging mechanism that can lead to loss of material in Containment steel in air structural components.

Loss of material in steel may be caused by corrosion. Carbon steel in an air environment is susceptible to corrosion except under the following conditions: steel located in an air conditioned environment, or steel which is galvanized and not wetted. Stainless steel structural components are not subject to corrosion in the containment air environments at St. Lucie Nuclear Plant. Accordingly, with the exceptions above, corrosion is an aging mechanism that can lead to loss of material in selected Containment steel in air structural components.

Aggressive chemical attack due to boric acid is an aging mechanism for Containment steel in air structural components. This form of corrosion is typically localized and is a result of leakage from borated water systems that can concentrate boric acid and lead to significant material loss of carbon steel and galvanized carbon steel components. Although this type of corrosion is event driven (boric acid leaks), boric acid corrosion was evaluated as an aging mechanism at St. Lucie.

Based on the above, loss of material due to corrosion and aggressive chemical attack is an aging effect requiring management for selected Containment steel in air structural components.

CRACKING

Aging mechanisms that can lead to cracking of Containment steel in air structural components are SCC and fatigue.

SCC is an age-related degradation mechanism that affects stainless steels but becomes significant only if tensile stresses and a corrosive environment exist. The stresses may be either applied (external) or residual (internal). The stress corrosion cracks themselves may be either transgranular or intergranular, depending upon the metal and the corrosive agent. As is normal in all cracking, the cracks are perpendicular to the tensile stress. Usually there is little or no obvious visual evidence of corrosion. In order for SCC to occur, an unfavorable environment, such as wetted surfaces, must be present. Since the only wetted surfaces are a result of event-driven incidents, such as boric acid leakage, SCC is not an aging mechanism that can lead to cracking for Containment steel in air structural components.

Fatigue is a progressive degradation problem for materials subjected to cyclic application of loads that are less than the maximum allowable static loads. For steel components, fatigue is the cumulative effect of microstructural localized plastic deformation in the material section that results each time a stress cycle of sufficient magnitude occurs. Cracking resulting from fatigue is typically controlled by design. The analyses of metal fatigue are discussed in Chapter 4 on Time-Limited Aging Analyses (TLAA). Fatigue of the Containment vessel is evaluated in Section 4.5. Fatigue of penetrations is evaluated as a TLAA in Subsection 4.5.2. Fatigue of various cranes is evaluated as a TLAA in Subsection 4.6.2. These evaluations conclude that fatigue is not an aging mechanism that can lead to cracking at St. Lucie Units 1 and 2.

Based on the above, cracking is not an aging effect requiring management for Containment steel in air structural components.

CHANGE IN MATERIAL PROPERTIES

Aging mechanisms that can cause change in material properties for Containment steel in air structural components are thermal embrittlement, irradiation embrittlement, creep, and stress relaxation.

Thermal embrittlement is a mechanism by which the mechanical property fracture toughness is affected as a result of exposure to elevated temperature. Cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement dependent upon material composition and the time at temperature. However, CASS materials are not used in the Containment steel in air structural components that could potentially be exposed to high temperatures. Therefore, thermal embrittlement is not an aging mechanism that can lead to change in material properties for Containment steel in air structural components.

Irradiation embrittlement was evaluated as an aging mechanism for Containment steel in air structural components that could lead to change in material properties. Shielding from the water in the reactor core and the reactor vessel reduces the neutron flux, resulting in levels of accumulated exposure that are far below the levels necessary to cause degradation. The maximum gamma dose evaluated through the period of extended operation is below the dose required for radiation degradation. Therefore, irradiation embrittlement is not an aging mechanism that can lead to change in material properties for Containment steel in air structural components.

The effects of low fracture toughness and lamellar tearing have been identified as an industry issue in NUREG-0577, "Potential for Low Fracture Toughness and Lamellar Tearing in PWR Steam Generator and Reactor Coolant Pump Supports." NUREG-0577 states that a risk evaluation was performed and the results are incorporated in a value-impact analysis. The NUREG concluded that requirements to certify the acceptability of material or design should not be imposed. Therefore, such actions would provide no safety benefit. FPL Letter L-77-349 [Reference 3.5-2] stated that the fracture toughness data for the St. Lucie Units 1 and 2 steam generator and reactor coolant pump support structure materials were conservatively compared to the fracture toughness properties identified in NUREG-0577 and deemed acceptable. St. Lucie was not required to demonstrate that steel components in the Reactor Coolant System supports have sufficient fracture toughness to perform their intended functions. Therefore, low fracture toughness and lamellar tearing is not an aging effect that can lead to change in material properties for Containment steel in air structural components.

Per Appendix C, creep and stress relaxation are not aging mechanisms that can lead to change in material properties for Containment steel in air structural components.

Based on the above, change in material properties is not an aging effect requiring management for Containment steel in air structural components.

3.5.1.1.3 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 Containment steel in air structural components includes the following:

- NRC Bulletin 88-05, "Nonconforming Materials Supplied by Piping Supplies, Inc. and West Jersey Manufacturing Company"
- NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to the Reactor Coolant System"
- NRC Generic Letter 80-08, "Examination of Containment Liner Penetration Welds"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Generic Letter 98-04, "Potential Degradation of the Emergency Core Cooling System and Containment Spray System after a Loss of Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in the Containment"
- NRC Information Notice 86-99, "Degradation of Steel Containments"

- NRC Information Notice 89-79, "Degraded Coatings and Corrosion of Steel Containment Vessels"
- NRC Information Notice 89-80, "Potential For Water Hammer, Thermal Stratification, and Steam Binding in High Pressure Coolant Injection Piping"
- NRC Information Notice 93-25, "Electrical Penetration Assembly Degradation"
- NRC Information Notice 97-10, "Liner Plate Corrosion in Concrete Containments"
- NRC Information Notice 97-13, "Deficient Conditions Associated with Protective Coatings at Nuclear Power Plants"
- NUREG-0577, Revision 1, "Potential for Low Fracture Toughness and Lamellar Tearing in PWR Steam Generator and Reactor Coolant Pump Supports"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal"
- NUREG/CR-6679, "Assessment of Age-Related Degradation of Structures and Passive Components for U.S. Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.1.1.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of Containment steel in air structural 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 3.5.1.1.2.

3.5.1.1.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.1.1.2. Table 3.5-2 contains the results of the aging management review for the Containments and summarizes the aging effects requiring management for Containment steel in air structural components.

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

St. Lucie programs consistent with the corresponding programs in the GALL Report:

- ASME Section XI, Subsection IWE Inservice Inspection Program
- ASME Section XI, Subsection IWF Inservice Inspection Program
- Boric Acid Wastage Surveillance Program

St. Lucie plant-specific programs:

- 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 Containment steel in air structural components listed in Table 3.5-2 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.1.2 CONTAINMENT STEEL IN FLUID STRUCTURAL COMPONENTS

This subsection includes Containment steel structural components that are exposed to fluids and those Containment steel structural components that are exposed to both fluids and air. Containment steel structural components that are exposed to only an air environment were discussed in Subsection 3.5.1.1 above. Containment steel in fluid structural components include:

- fuel transfer tubes and expansion bellows
- reactor cavity liner plates
- reactor cavity seal rings

3.5.1.2.1 MATERIALS AND ENVIRONMENT

Containment steel in fluid structural components were designed and constructed in accordance with AISC standards. The codes and standards used for the design and fabrication of the Containment steel in fluid structural components are identified in Unit 1 UFSAR Section 3.8, and Unit 2 UFSAR Section 3.8.

Containment steel in fluid structural components are constructed of stainless steel.

St. Lucie steel in fluid structural components are exposed to a fluid environment of treated water - borated, and an air environment of containment air (see Tables 3.0-1 and 3.0-2). The specific materials and environments for Containment steel in fluid structural components are contained in Table 3.5-2. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.1.2.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for Containment steel in fluid structural components are loss of material, cracking, and change in material properties. The aging mechanisms that could lead to these aging effects in Containment steel in fluid structural components were evaluated using the methodology provided in Appendix C. The results are provided below.

<u>LOSS OF MATERIAL</u>

Aging mechanisms that can lead to loss of material of Containment steel in fluid structural components are corrosion (general, galvanic, crevice, pitting, erosion-corrosion, microbiologically influenced corrosion, and leaching), wear, and aggressive chemical attack.

Based on the evaluation using the methodology described in Appendix C, wear, aggressive chemical attack, and corrosion due to general, galvanic, crevice, erosion-corrosion, microbiologically influenced corrosion, and leaching are not aging mechanisms that can lead to loss of material in Containment steel in fluid structural components exposed to treated water - borated. However, loss of material due to pitting corrosion is an aging effect requiring management for Containment steel in fluid structural components exposed to treated water - borated.

Based on the above, loss of material due to pitting corrosion is an aging effect requiring management for Containment steel in fluid structural components.

CRACKING

Aging mechanisms that can lead to cracking of Containment steel in fluid structural components are SCC, IGA, and fatigue.

Based on the evaluation using the methodology described in Appendix C, SCC, IGA, and fatigue were evaluated for Containment steel in fluid structural components at St. Lucie and determined not to lead to cracking requiring management. Accordingly, cracking is not an aging effect requiring management for Containment steel in fluid structural components.

CHANGE IN MATERIAL PROPERTIES

Aging mechanisms that can cause change in material properties of Containment steel in fluid structural components are thermal embrittlement and irradiation embrittlement.

Thermal embrittlement is a mechanism by which the mechanical property fracture toughness is affected as a result of exposure to elevated temperature. Cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement dependent upon material composition and the time at temperature. However, the Containment steel in fluid structural components are not exposed to high temperatures. Therefore, thermal embrittlement is not an aging mechanism that can lead to change in material properties for Containment steel in fluid structural components.

Irradiation embrittlement was evaluated as an aging mechanism for Containment steel in fluid structural components that could lead to change in material properties. Shielding from the water in the reactor core and the reactor vessel reduces the neutron flux, resulting in levels of accumulated exposure that are far below the levels necessary to cause degradation. The maximum gamma dose evaluated through the period of extended operation is below the dose required for radiation degradation. Therefore, irradiation embrittlement is not an aging mechanism that can lead to change in material properties for Containment steel in fluid structural components.

Based on the above, change in material properties is not an aging effect requiring management for Containment steel in fluid structural components.

3.5.1.2.3 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 Containment steel in fluid structural components includes the following:

- NRC Bulletin 94-01, "Potential Fuel Pool Draindown Caused by Inadequate Maintenance Practices at Dresden Unit 1"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal"
- NUREG/CR-6679, "Assessment of Age-Related Degradation of Structures and Passive Components for U.S. Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.1.2.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of Containment steel in fluid structural component aging, in addition to interviews with responsible engineering personnel. No additional aging effects requiring management were identified from this review beyond those identified in Subsection 3.5.1.2.2.

3.5.1.2.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.1.2.2. Table 3.5-2 contains the results of the aging management review for the Containments and summarizes the aging effects requiring management for Containment steel in fluid structural components.

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

St. Lucie program consistent with the corresponding program in the GALL Report:

- Chemistry Control Program

Based on the evaluation provided in Appendix B for the program listed above, aging effects are adequately managed so that the intended functions of the Containment steel in fluid structural components listed in Table 3.5-2 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.1.3 CONTAINMENT CONCRETE STRUCTURAL COMPONENTS

Containment concrete structural components include:

- exterior and interior walls
- beams, slabs, domes, and foundations
- missile shields

- equipment pads
- masonry block walls

Note: Reinforcing steel and embedded steel are evaluated with the concrete components.

3.5.1.3.1 MATERIALS AND ENVIRONMENT

Containment concrete structural components were designed and constructed in accordance with American Concrete Institute (ACI) and ASTM standards. The St. Lucie Units 1 and 2 containments do not have a porous concrete sub-foundation. The codes and standards used for the design and fabrication of the Containment concrete structural components are identified in Unit 1 UFSAR Section 3.8, and Unit 2 UFSAR Section 3.8.

St. Lucie Containment concrete structural components are exposed to environments of containment air, outdoor, and buried (see Table 3.0-2). The specific materials and environments for Containment concrete structural components for each structure are contained in Table 3.5-2. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.1.3.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for Containment concrete structural components are loss of material, cracking, and change in material properties. Each is discussed below.

LOSS OF MATERIAL

Loss of material is manifested in Containment concrete structural components as scaling, spalling, pitting, and erosion. Aging mechanisms that can lead to loss of material are freeze-thaw, abrasion and cavitation, elevated temperature, aggressive chemical attack, and corrosion of reinforcing and embedded/encased steel.

Freeze-thaw is considered an aging mechanism for Containment concrete structural components that are exposed to severe weather conditions of numerous freeze-thaw cycles with significant amounts of winter rainfall. St. Lucie Nuclear Plant is located in a subtropical climate with long, warm summers accompanied by abundant rainfall and mild, dry winters with negligible freeze-thaw cycles. Therefore, freeze-thaw is not an aging mechanism that can lead to loss of material for Containment concrete structural components.

Abrasion and cavitation is an aging mechanism that occurs only in concrete structures that are continually exposed to flowing water. The Containment concrete structural components are not subjected to flowing water. Therefore, abrasion and cavitation is not an aging mechanism that can lead to loss of material for Containment concrete structural components.

Elevated temperature was evaluated as an aging mechanism for Containment concrete structural components. Localized hotspots are limited in area and are designed to be maintained below the degradation threshold temperature limits of the ACI standards. Therefore, elevated temperature is not an aging mechanism that can lead to loss of material for Containment concrete structural components.

Aggressive chemical attack, leading to corrosion of reinforcing steel and embedded steel, was identified as an age-related degradation mechanism for Containment concrete structural components. At St. Lucie Units 1 and 2, this is applicable to Containment concrete structural components exposed to the groundwater.

Based on the above, loss of material due to aggressive chemical attack leading to corrosion of reinforcing and embedded steel is an aging effect that requires aging management for Containment concrete structural components below groundwater elevation.

CRACKING

Cracking is manifested in concrete structural components as complete or incomplete separation of the concrete into two or more parts. Aging mechanisms that can lead to cracking of Containment concrete structural components are freeze-thaw, reactions with aggregates, shrinkage, settlement, fatigue, and elevated temperature.

As discussed previously, freeze-thaw is not an aging mechanism that can lead to cracking for Containment concrete structural components at St. Lucie Nuclear Plant.

St. Lucie concrete components were constructed using non-reactive aggregates whose acceptability was based on established industry standards and ASTM tests. Therefore, reaction with aggregates is not an aging mechanism that can lead to cracking for Containment concrete structural components.

When concrete is exposed to air, large portions of the free water evaporate, causing shrinkage. At St. Lucie, low slump concrete was used and adequate steel reinforcement was provided, which minimize shrinkage. Based on industry information, 100% of concrete shrinkage occurs within 20 years. St. Lucie concrete structures and concrete components were constructed 18 to 25 years or more ago; therefore, concrete shrinkage is not an aging mechanism that can lead to cracking for Containment concrete structural components.

Settlement is based directly on the physical properties of a structure's foundation material. The most pronounced settlement is evidenced in the first several months after construction. St. Lucie concrete structures are founded on compacted Class I fill consisting of clean sand and gravel with a maximum of 12% fines. After initial settlement occurred, the settlement ceased, no further significant settlement has occurred, and no further significant structural settlement is expected. Therefore, settlement is not an aging mechanism that can lead to cracking for Containment concrete structural components.

Fatigue is a progressive degradation problem for materials subjected to cyclic application of loads that are less than the maximum allowable static loads. St. Lucie concrete components are designed in accordance with ACI standards and have good low-cycle fatigue properties. Although some concrete components are subject to high cycles of low-level repeated load, these components were designed in accordance with ACI standards, which limit the maximum design stress to less than 50% of the static stress of the concrete. Therefore, fatigue is not an aging mechanism that can lead to cracking for Containment concrete structural components.

As discussed previously, Containment concrete structural components are not exposed to elevated temperatures that exceed ACI threshold limits and, therefore, elevated temperature is not an aging mechanism that can lead to cracking for Containment concrete structural components.

Based on the above, cracking is not an aging effect requiring management for Containment concrete structural components.

CHANGE IN MATERIAL PROPERTIES

Change in material properties is manifested in concrete as increased permeability, increased porosity, reduction in pH, reduction in tensile strength, reduction in compressive strength, reduction in modulus of elasticity, and reduction in bond strength. Aging mechanisms that can lead to a change in material properties of Containment concrete structural components are leaching, creep, elevated temperature, irradiation embrittlement, and aggressive chemical attack.

Leaching of calcium hydroxide is observed on concrete that is alternately wetted and dried. White deposits that are left on the surface of the concrete are a solution of water, free lime from the concrete, and carbon dioxide that is readily seen on the surface of the concrete. St. Lucie concrete structures and concrete components are constructed of a dense, well-cured concrete with an amount of cement suitable for strength development, and achievement of a water-to-cement ratio that is characteristic of concrete having low permeability. This is consistent with the guidance provided by the ACI, and when implemented, degradation caused by leaching of calcium hydroxide is not significant. Therefore, leaching is not an aging mechanism that can lead to change in material properties for Containment concrete structural components.

Creep is significant when new concrete is subjected to load and decreases exponentially with time; and any degradation is noticeable in the first few years. In addition, creep proceeds at a decreasing rate with age, with 96% of creep occurring within 30 years. The concrete for the Containments was designed to ACI requirements that minimize the effects of creep. There has been no evidence of significant creep at St. Lucie Nuclear Plant. Therefore, concrete creep is not an aging mechanism that can lead to change in material properties for Containment concrete structural components.

As discussed previously, Containment concrete structural components are not exposed to elevated temperatures that exceed ACI threshold limits and, therefore, elevated temperature is not an aging mechanism that can lead to change in material properties for Containment concrete structural components.

Irradiation embrittlement was evaluated as an aging mechanism that could lead to change in material properties. Shielding from the water in the reactor core and the reactor vessel reduces the neutron flux, resulting in levels of accumulated exposure that are below the levels necessary to cause concrete degradation. The maximum gamma dose evaluated through the period of extended operation is below the dose required for concrete degradation. Therefore, irradiation embrittlement is not an aging mechanism that can lead to change in material properties for Containment concrete structural components.

Concrete structural components subject to loss of material due to aggressive chemical attack would also be subject to change in material properties due to the same aging mechanism.

Based on the above, change in material properties due to aggressive chemical attack is an aging effect requiring management for concrete structural components below groundwater elevation.

3.5.1.3.3 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 Containment concrete structural components includes the following:

- NRC Bulletin 80-11, "Masonry Wall Design"
- NRC Information Notice 97-11, "Cement Erosion from Containment Subfoundations at Nuclear Power Plants"
- NRC Information Notice 98-26, "Settlement Monitoring and Inspection of Plant Structures Affected by Degradation of Porous Concrete Subfoundations"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal"
- NUREG/CP-0100, Prasad, N., et al., "Concrete Degradation Monitoring and Evaluation," Proceedings of the International Nuclear Power Plant Aging Symposium, August 30 - September 1, 1998
- NUREG/CR-4652, "Concrete Component Aging and its Significance Relative to Life Extension of Nuclear Power Plants"
- NUREG/CR-6679, "Assessment of Age-Related Degradation of Structures and Passive Components for U.S. Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.1.3.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of Containment concrete structural component aging, in addition to interviews with responsible engineering personnel. No additional aging effects requiring management were identified from this review beyond those identified in Subsection 3.5.1.3.2.

3.5.1.3.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.1.3.2. Table 3.5-2 contains the results of the aging management review for the Containments and summarizes the aging effects requiring management for Containment concrete structural components.

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

St. Lucie plant-specific program:

- Systems and Structures Monitoring Program

Based on the evaluation provided in Appendix B for the program above, aging effects are adequately managed so that the intended functions of the Containment concrete structural components listed in Table 3.5-2 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.1.4 CONTAINMENT MISCELLANEOUS STRUCTURAL COMPONENTS

Containment miscellaneous structural components include:

- containment vessel moisture barriers
- containment hatch seals and gaskets
- door seals and gaskets
- fuel transfer tube penetration flexible membranes (in each annulus between the Containment vessels and the Reactor Containment Shield Buildings)
- sliding supports (Lubrite)

3.5.1.4.1 MATERIALS AND ENVIRONMENT

The Containment miscellaneous structural components consist of silicone, elastomers, and lubrite plates.

The Containment miscellaneous structural components are exposed to environments of containment air, indoor - not air conditioned, and outdoor (see Table 3.0-2). The specific materials and environments for Containment miscellaneous structural components are contained in Table 3.5-2. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.1.4.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for Containment miscellaneous structural components are loss of material and loss of seal. Each is discussed below.

<u>LOSS OF MATERIAL</u>

The only Containment miscellaneous structural components potentially subject to loss of material are the lubrite sliding plates. Aging mechanisms that can lead to loss of material for the lubrite sliding plates are wear and environmental degradation.

Lubrite plates were evaluated for loss of material due to wear and environmental degradation and determined not to require aging management. Lubrite products are solid, permanent, self-lubricating, and require no maintenance for the life of the product.

Accordingly, loss of material for Containment miscellaneous structural components is not an aging effect requiring management.

LOSS OF SEAL

The aging mechanisms that can lead to loss of seal are wear and environmental degradation.

The containment vessel moisture barriers were evaluated for loss of seal due to environmental degradation and determined to require aging management. The containment hatch seals and gaskets and door seals and gaskets were evaluated for loss of seal due to wear and determined to require aging management. The fuel transfer tube penetration flexible membrane was evaluated for loss of seal due to environmental degradation and determined not to require aging management. The flexible membrane is made from radiation resistant silicone rubber that will not age significantly enough to cause a loss of intended function.

Based on the above, loss of seal is an aging effect requiring management for selected Containment miscellaneous structural components.

3.5.1.4.3 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 Containment miscellaneous structural components includes the following:

- NRC Information Notice 88-61, "Control Room Habitability - Recent Reviews of OPE Rating Experience"
- NRC Information Notice 97-10, "Liner Plate Corrosion in Concrete Containments"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal"
- NUREG/CR-6679, "Assessment of Age-Related Degradation of Structures and Passive Components for U.S. Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.1.4.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of Containment miscellaneous structural 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 3.5.1.4.2.

3.5.1.4.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.1.4.2. Table 3.5-2 contains the results of the aging management review for the Containments and summarizes the aging effects requiring management for Containment miscellaneous structural components.

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

St. Lucie programs consistent with the corresponding program in the GALL Report:

- ASME Section XI, Subsection IWE Inservice Inspection Program

St. Lucie plant-specific program:

- Periodic Surveillance and Preventive Maintenance Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions for the Containment miscellaneous structural components listed in Table 3.5-2 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.2 OTHER STRUCTURES

This aging management review identifies and evaluates aging effects on St. Lucie passive, long-lived structures and structural components (other than the Containments and selected structural components). Structures and structural components within the scope of license renewal and subject to aging management reviews are discussed in Section 2.4 and include:

- Component Cooling Water Areas
- Condensate Polisher Building
- Condensate Storage Tank Enclosures
- Diesel Oil Equipment Enclosures
- Emergency Diesel Generator Buildings
- Fire Rated Assemblies
- Fuel Handling Buildings
- Intake, Discharge, and Emergency Cooling Canals
- Intake Structures
- Reactor Auxiliary Buildings
- Steam Trestle Areas
- Turbine Buildings
- Ultimate Heat Sink Dam
- Yard Structures

Tables 3.5-3 through 3.5-16 contain the specific structural component and commodity groups, materials, intended functions, environments, aging effects, and aging management programs for each of the structures listed above. Structural components are grouped by material and environment for each structure. The structural component groups are:

- Steel in air
- Steel in fluid
- Concrete
- Miscellaneous

3.5.2.1 STEEL IN AIR STRUCTURAL COMPONENTS

Steel in air structural components include:

- framing, bracing, and connections
- stairs, ladders, platforms, checkered plate, and grating
- supports (component, piping, ducts, and tubing)
- non-safety related piping between class break and anchor
- pipe whip restraints

- cranes, hoists, and trolleys
- cable trays, conduits, and electrical enclosures
- cable tray, conduit, and electrical enclosure supports
- instrumentation supports
- instrument racks and frames
- doors and louvers

3.5.2.1.1 MATERIALS AND ENVIRONMENT

Steel in air structural components were designed and constructed in accordance with AISC standards. The codes and standards used for the design and fabrication are identified in Unit 1 UFSAR Section 3.8, and Unit 2 UFSAR Section 3.8. Steel in air structural components is constructed of coated or galvanized carbon steel, and stainless steel.

St. Lucie steel in air structural components are exposed to environments of outdoor, indoor - not air conditioned, indoor - air conditioned, and potential borated water leaks (see Table 3.0-2). The specific materials and environments for steel in air structural components for each of the structures listed in Subsection 3.5.2 are contained in Tables 3.5-3 through 3.5-16. For corresponding component/commodity groups included in the GALL Report [Reference 3.5-1], there are no differences in environment.

Pipe segments beyond the safety-related/non-safety related boundaries are constructed of carbon and stainless steel and consist of piping and inline components. The external surfaces of these pipe segments are exposed to the Indoor - not air conditioned and outdoor environments and potential borated water leaks. Internal environments of the pipe segments are the same as the internal environments for the systems in which the piping segments are installed.

3.5.2.1.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of the intended function(s) of steel in air structural components are loss of material, cracking, and change in material properties. Each is discussed below.

<u>LOSS OF MATERIAL</u>

Aging mechanisms that can lead to loss of material are mechanical wear, corrosion, and aggressive chemical attack. This may be seen as material staining, corrosion product buildup, and pitting. Loss of material may be uniform or localized.

Mechanical wear is associated with close-fitting mechanical components having relative motion and is not applicable to structural steel. Accordingly, mechanical wear is not an aging mechanism that can lead to loss of material in steel in air structural components.

Loss of material in steel may be caused by corrosion. Carbon steel in an air environment is susceptible to corrosion except under the following conditions: steel located in an air conditioned environment, or steel which is galvanized and not wetted. Stainless steel structural components are not subject to corrosion in the air environments at St. Lucie

Nuclear Plant. Accordingly, with the exceptions above, corrosion is an aging mechanism that can lead to loss of material in selected steel in air structural components.

Aggressive chemical attack due to boric acid is an aging mechanism for steel in air structural components. This form of corrosion is typically localized and is a result of leakage from borated water systems that can concentrate boric acid and lead to significant material loss of carbon steel components. Although this type of corrosion is event driven (boric acid leaks), boric acid corrosion was evaluated as an aging mechanism at St. Lucie.

Based on the above, loss of material due to corrosion and aggressive chemical attack is an aging effect requiring management for selected steel in air structural components.

CRACKING

Aging mechanisms that can lead to cracking of steel in air structural components are SCC and fatigue.

SCC is an age-related degradation mechanism that affects stainless steels but becomes significant only if tensile stresses and a corrosive environment exist. The stresses may be either applied (external) or residual (internal). The stress corrosion cracks themselves may be either transgranular or intergranular, depending upon the metal and the corrosive agent. As is normal in all cracking, the cracks are perpendicular to the tensile stress. Usually there is little or no obvious visual evidence of corrosion. In order for SCC to occur an unfavorable environment, such as wetted surfaces must be present. Since the only wetted surfaces are a result of event-driven incidents, such as boric acid leakage, SCC is not an aging mechanism that can lead to cracking for steel in air structural components.

Fatigue is a progressive degradation problem for materials subjected to cyclic application of loads that are less than the maximum allowable static loads. For steel components, fatigue is the cumulative effect of microstructural localized plastic deformation in the material section that results each time a stress cycle of sufficient magnitude occurs. Since the steel in air structural components are not subject to stress reversals due to cyclic loading, fatigue is not an aging mechanism that can lead to cracking in steel in air structural components.

Based on the above, cracking is not an aging effect requiring management for steel in air structural components.

CHANGE IN MATERIAL PROPERTIES

Aging mechanisms that can cause change in material properties are thermal and irradiation embrittlement, and creep and stress relaxation. Steel in air structural components outside the Containment are not exposed to the elevated temperatures or fluences that would cause embrittlement. Per Appendix C, creep and stress relaxation are not aging mechanisms that can lead to change in material properties at St. Lucie Units 1 and 2. Accordingly, change in material properties is not an aging effect requiring management for steel in air structural components.

3.5.2.1.3 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 steel in air structural components includes the following:

- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- 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 89-80, "Potential For Water Hammer, Thermal Stratification, and Steam Binding in High Pressure Coolant Injection Piping"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.2.1.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of steel in air structural 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 3.5.2.1.2.

3.5.2.1.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.2.1.2. Tables 3.5-3 through 3.5-16 contain the results of the aging management review for the other structures and summarize the aging effects requiring management for steel in air structural components.

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

St. Lucie programs consistent with the corresponding programs in the GALL Report:

- ASME Section XI, Subsection IWF Inservice Inspection Program
- Boric Acid Wastage Surveillance Program

St. Lucie plant-specific programs:

- Systems and Structures Monitoring Program
- Periodic Surveillance and Preventive Maintenance 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 steel in air structural components listed in Tables 3.5-3 through 3.5-16 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.2.2 STEEL IN FLUID STRUCTURAL COMPONENTS

This subsection includes steel structural components that are exposed to fluids and those steel structural components that are exposed to both fluids and air. Steel structural components that are exposed to only an air environment were discussed in Subsection 3.5.2.1 above. Steel in fluid structural components include:

- spent fuel storage racks (including Boraflex)
- fuel transfer tubes and expansion bellows
- spent fuel pool liner plates
- fuel handling tools
- upenders
- fuel pool gates
- sheet piling

3.5.2.2.1 MATERIALS AND ENVIRONMENT

Steel in fluid structural components were designed and constructed in accordance with AISC standards. The codes and standards used for the design and fabrication of the steel in fluid structural components are in Unit 1 UFSAR Section 3.8, and Unit 2 UFSAR Section 3.8.

Steel in fluid structural components are constructed of carbon steel or stainless steel. In addition, the Unit 1 spent fuel storage racks contain Boraflex panels.

St. Lucie Units 1 and 2 steel in fluid structural components are exposed to a fluid environment of treated water - borated and air environments of indoor - not air conditioned, outdoor, buried, and embedded/encased in concrete (see Tables 3.0-1 and 3.0-2). The specific materials and environments for steel in fluid structural components for each structure listed in Subsection 3.5.2 are contained in Tables 3.5-3 through 3.5-16. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.2.2.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for steel in fluid structural components are loss of material, cracking, and change in material properties. The aging mechanisms that could lead to these aging effects in steel in fluid structural components were evaluated using the methodology provided in Appendix C. The results are provided below.

LOSS OF MATERIAL

The aging mechanism that can lead to loss of material for steel in fluid structural components is corrosion.

Corrosion of carbon steel in fluid structural components exposed to raw water is prevented by an impressed current cathodic protection system. Since sheet piling is not exposed to flowing water, erosion-corrosion is an not aging mechanism that can lead to loss of material for steel in fluid structural components exposed to raw water.

Based on the evaluation using the methodology described in Appendix C, corrosion (general, galvanic, crevice, erosion-corrosion, and microbiologically influenced corrosion) is not an aging mechanism that can lead to loss of material in steel in fluid structural components exposed to treated water - borated. Loss of material due to pitting corrosion for stainless steel in fluid structural components exposed to treated water - borated is an aging effect requiring management.

Based on the above, loss of material due to corrosion is an aging effect requiring management for selected steel in fluid structural components.

CRACKING

Aging mechanisms that can lead to cracking of steel in fluid structural components are SCC and fatigue.

Based on the evaluation using the methodology described in Appendix C, SCC and fatigue were evaluated for steel in fluid structural components at St. Lucie and determined not to lead to cracking requiring management. Accordingly, cracking is not an aging effect requiring management for steel in fluid structural components.

CHANGE IN MATERIAL PROPERTIES

Aging mechanisms that can cause change in material properties are irradiation and thermal embrittlement and Boraflex degradation (i.e., shrinkage, dissolution, and gap formation).

Steel in fluid structural components outside the Containments are not exposed to the elevated temperatures or fluences that would cause embrittlement. Accordingly, change in material properties is not an aging effect requiring management for steel in fluid structural components.

Boraflex is a neutron absorber inserted between the Unit 1 fuel storage cells in high-density fuel storage racks. Irradiation results in degradation of the Boraflex.

Based on the above, change in material properties due to irradiation of fuel storage rack Boraflex is an aging effect requiring management.

3.5.2.2.3 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 steel in fluid structural components includes the following:

- NRC Bulletin 94-01, "Potential Fuel Pool Draindown Caused by Inadequate Maintenance Practices at Dresden Unit 1"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment"
- NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks"
- NRC Information Notice 87-43, "Gaps in Neutron-Absorbing Material in High Density Spent Fuel Storage Racks"
- 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 89-80, "Potential For Water Hammer, Thermal Stratification, and Steam Binding in High Pressure Coolant Injection Piping"
- NRC Information Notice 93-70, "Degradation of Boraflex Neutron Absorber Coupons"
- NRC Information Notice 95-38, "Degradation of Boraflex Neutron Absorber in Spent Fuel Storage Racks"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.2.2.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of steel in fluid structural component aging, in addition to interviews with responsible engineering personnel. No additional aging effects requiring management were identified from this review beyond those identified in Subsection 3.5.2.2.2.

3.5.2.2.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.2.2.2. Tables 3.5-3 through 3.5-16 contain the results of the aging management review for the other structures and summarize the aging effects requiring management for steel in fluid structural components.

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

St. Lucie programs consistent with the corresponding programs in the GALL Report:

- Boraflex 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 steel in fluid structural components listed in Tables 3.5-3 through 3.5-16 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.2.3 CONCRETE STRUCTURAL COMPONENTS

Concrete structural components include:

- foundations and columns
- walls, floors, and roofs
- equipment pads
- electric duct banks
- manholes
- trenches
- masonry block walls
- hatches
- retaining walls

Note: Reinforcing steel and embedded steel are evaluated with the concrete components.

3.5.2.3.1 MATERIALS AND ENVIRONMENT

Concrete structural components were designed and constructed in accordance with ACI and ASTM standards. The codes and standards used for the design and fabrication of the concrete structural components are identified in Unit 1 UFSAR Section 3.8 and Unit 2 UFSAR Section 3.8.

St. Lucie Units 1 and 2 concrete structural components are exposed to environments of outdoor, indoor - not air conditioned, indoor - air conditioned, buried, and raw water - salt water (see Table 3.0-2). The specific materials and environments for concrete structural components for each structure listed in Subsection 3.5.2 are contained in Tables 3.5-3 through 3.5-16. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.2.3.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for concrete structural components are loss of material, cracking, and change in material properties. Each is discussed below.

LOSS OF MATERIAL

Loss of material is manifested in concrete structural components as scaling, spalling, pitting, and erosion. Aging mechanisms that can lead to loss of material are freeze-thaw, abrasion and cavitation, elevated temperature, aggressive chemical attack, and corrosion of reinforcing and embedded/encased steel.

Freeze-thaw is considered an aging mechanism for concrete structural components that are exposed to severe weather conditions of numerous freeze-thaw cycles with significant amounts of winter rainfall. St. Lucie Nuclear Plant is located in a subtropical climate with long, warm summers accompanied by abundant rainfall and mild, dry winters with negligible freeze-thaw cycles. Therefore, freeze-thaw is not an aging mechanism that can lead to loss of material for concrete structural components.

Abrasion and cavitation is an aging mechanism that occurs only in concrete structures that are continually exposed to flowing water. The Intake Structures concrete components located below the intake canal water level are the only concrete components exposed to flowing water. The velocity of the intake water is significantly less than the threshold limits at which abrasion and cavitation degradation occurs. Therefore, abrasion and cavitation is not an aging mechanism that can lead to loss of material for concrete structural components.

Concrete structural components outside the Containments are not exposed to elevated temperatures that exceed ACI threshold limits and, therefore, elevated temperature is not an aging mechanism that can lead to loss of material for concrete structural components.

Aggressive chemical attack, leading to corrosion of reinforcing steel and embedded steel, was identified as an age-related degradation mechanism for concrete structural components. At St. Lucie Units 1 and 2, this is applicable to concrete structural components exposed to the groundwater, salt water flow, or salt water splash (Intake Cooling Water System discharge). The structures with concrete structural components located below groundwater elevation are the Intake Structures, the Intake, Discharge, and Emergency Cooling Canals, the Reactor Auxiliary Buildings, and the Steam Trestle Areas. The Intake Structures and the Intake, Discharge, and Emergency Cooling Canals concrete structural components are also exposed to high chlorides due to the flow of salt water.

Based on the above, loss of material due to aggressive chemical attack leading to corrosion of reinforcing and embedded steel is an aging effect that requires aging management for concrete structural components below groundwater elevation, exposed to salt water flow, or exposed to salt water splash.

CRACKING

Cracking is manifested in concrete structural components as complete or incomplete separation of the concrete into two or more parts. Aging mechanisms that can lead to cracking are freeze-thaw, reactions with aggregates, shrinkage, settlement, fatigue, and elevated temperature.

As discussed previously, freeze-thaw is not an aging mechanism that can lead to cracking for concrete structural components at St. Lucie Nuclear Plant.

St. Lucie Unit 1 and 2 concrete components were constructed using non-reactive aggregates whose acceptability was based on established industry standards and ASTM tests. Therefore, reaction with aggregates is not an aging mechanism that can lead to cracking for concrete structural components.

When concrete is exposed to air, large portions of the free water evaporate, causing shrinkage. At St. Lucie, low slump concrete was used, and adequate steel reinforcement was provided, which all minimize shrinkage. Based on industry information, 100% of concrete shrinkage occurs within 20 years. St. Lucie Unit 1 and 2 concrete structures and concrete structural components were constructed 18 to 25 years or more ago; therefore, concrete shrinkage is not an aging mechanism that can lead to cracking for concrete structural components.

Settlement is based directly on the physical properties of a structure's foundation material. The most pronounced settlement is evidenced in the first several months after construction. St. Lucie concrete structures are founded on compacted Class I fill consisting of clean sand and gravel with a maximum of 12% fines. After initial settlement occurred, the settlement ceased, no further significant settlement has occurred, and no further significant structural settlement is expected. Therefore, settlement is not an aging mechanism that can lead to cracking for concrete structural components.

Shrinkage and settlement of supporting structures can cause cracking of unreinforced masonry block walls. Cracking could reduce the structural strength of the walls. Any cracks that affected the structural integrity and could consequently impact the intended function(s) of the masonry block walls were identified in response to NRC Bulletin 80-11 and associated inspections.

Fatigue is a progressive degradation problem for materials subjected to cyclic application of loads that are less than the maximum allowable static loads. St. Lucie Unit 1 and 2 concrete structural components are designed in accordance with ACI standards and have good low-cycle fatigue properties. Although some concrete structural components are subject to high cycles of low-level repeated load, these components were designed in accordance with ACI standards, which limit the maximum design stress to less than 50% of the static stress of the concrete. Therefore, fatigue is not an aging mechanism that can lead to cracking for concrete structural components.

Concrete structural components outside the Containments are not exposed to elevated temperatures that exceed ACI threshold limits and, therefore, elevated temperature is not an aging mechanism that can lead to cracking for concrete structural components.

Based on the above, cracking due to shrinkage and settlement of unreinforced masonry block walls is an aging effect requiring management for concrete structural components.

<u>CHANGE IN MATERIAL PROPERTIES</u>

Change in material properties is manifested in concrete as increased permeability, increased porosity, reduction in pH, reduction in tensile strength, reduction in compressive strength, reduction in modulus of elasticity, and reduction in bond strength. Aging mechanisms that can lead to a change in material properties are leaching, creep, elevated temperature, irradiation embrittlement, and aggressive chemical attack.

Leaching of calcium hydroxide is observed on concrete that is alternately wetted and dried. White deposits that are left on the surface of the concrete are a solution of water, free lime from the concrete, and carbon dioxide that is readily seen on the surface of the concrete. St. Lucie Unit 1 and 2 concrete structures and concrete structural components are constructed of a dense, well-cured concrete with an amount of cement suitable for strength development, and achievement of a water-to-cement ratio that is characteristic of concrete having low permeability. This is consistent with the guidance provided by the ACI, and when implemented, degradation caused by leaching of calcium hydroxide is not significant. Therefore, leaching is not an aging mechanism that can lead to change in material properties for concrete structural components.

Creep is significant when new concrete is subjected to load and decreases exponentially with time; and any degradation is noticeable in the first few years. In addition, creep proceeds at a decreasing rate with age, with 96% of creep occurring within 30 years. The concrete structural components were designed to ACI requirements that minimize the effects of creep. There has been no evidence of significant creep at St. Lucie. Therefore, concrete creep is not an aging mechanism that can lead to change in material properties for concrete structural components.

As discussed previously, concrete structural components are not exposed to elevated temperatures that exceed ACI threshold limits and, therefore, elevated temperature is not an aging mechanism that can lead to change in material properties for concrete structural components.

Irradiation embrittlement was evaluated as an aging mechanism that could lead to change in material properties. Neutron fluence levels and maximum integrated gamma doses were evaluated for the period of extended operation and determined to be below the threshold levels necessary to cause degradation of concrete. Therefore, irradiation embrittlement is not an aging mechanism that can lead to change in material properties for concrete structural components.

Concrete structural components subject to loss of material due to aggressive chemical attack would also be subject to change in material properties due to the same aging mechanism.

Based on the above, change in material properties due to aggressive chemical attack is an aging effect requiring management for concrete structural components below groundwater elevation, exposed to salt water flow, or exposed to salt water splash.

3.5.2.3.3 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 concrete structural components includes the following:

- NRC Bulletin 80-11, "Masonry Wall Design"
- NRC Information Notice 97-11, "Cement Erosion from Containment Subfoundations at Nuclear Power Plants"

- NRC Information Notice 85-25, "Consideration of Thermal Conditions in the Design and Installation of Supports for Diesel Generator Exhaust Silencers"
- NRC Information Notice 98-26, "Settlement Monitoring and Inspection of Plant Structures Affected by Degradation of Porous Concrete Subfoundations"
- NUREG-1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures"
- NUREG/CP-0100, Prasad, N., et al., "Concrete Degradation Monitoring and Evaluation," Proceedings of the International Nuclear Power Plant Aging Symposium, August 30 - September 1, 1998
- NUREG/CR-4652, "Concrete Component Aging and its Significance Relative to Life Extension of Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.2.3.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of concrete structural component aging, in addition to interviews with responsible engineering personnel. No additional aging effects requiring management were identified from this review beyond those identified in Subsection 3.5.2.3.2.

3.5.2.3.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.2.3.2. Tables 3.5-3 through 3.5-16 contain the results of the aging management review for the other structures and summarize the aging effects requiring management for concrete structural components.

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

St. Lucie plant-specific program:

- Systems and Structures Monitoring Program

Based on the evaluation provided in Appendix B for the program above, aging effects are adequately managed so that the intended functions of the concrete structural components listed in Tables 3.5-3 through 3.5-16 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.2.4 MISCELLANEOUS STRUCTURAL COMPONENTS

Miscellaneous structural components include:

- fire rated assemblies (fire barriers, fire doors, penetration seals, etc.)
- door seals and gaskets
- non-metallic conduit

- earthen canal dikes
- weatherproofing (structures and sealants)

3.5.2.4.1 MATERIALS AND ENVIRONMENT

The miscellaneous structural components consist of a variety of materials, depending on their location and function. Materials used include, carbon steel, stainless steel, galvanized carbon steel, earth fill, polyvinyl chloride (PVC), silicone, elastomers, weatherproofing materials (caulking and sealants), and fire protection materials (marinite board, durablanket, silicone gel, Quelpyre, ethafoam, dymeric sealant, ceramic fiber, Thermo-Lag, and fire retardant coatings).

The miscellaneous structural components are exposed to different environments, depending on their location and function. Environments include outdoor, indoor - not air conditioned, indoor - air conditioned, containment air, and raw water - salt water (see Table 3.0-2). The specific materials and environments for miscellaneous structural components for each structure listed in Subsection 3.5.2 are contained in Tables 3.5-3 through 3.5-16. For corresponding component/commodity groups included in the GALL Report, there are no differences in environment.

3.5.2.4.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects that could cause loss of intended function(s) for miscellaneous structural components are loss of material, loss of seal, and cracking. Each is discussed below.

<u>LOSS OF MATERIAL</u>

Aging mechanisms that can lead to loss of material for miscellaneous structural components are corrosion, wear, and environmental degradation.

Fire doors were evaluated for loss of material due to corrosion and determined to require aging management unless in an air conditioned environment. Fire barriers and earthen canal dikes were evaluated for loss of material due to environmental degradation. Fire barriers were determined not to age because they are exposed to benign indoor environments. Earthen canals were determined not to age because they are protected by concrete erosion protection.

Based on the above, loss of material due to general corrosion is an aging effect requiring management for select miscellaneous structural components.

<u>LOSS OF SEAL</u>

The aging mechanisms that can lead to loss of seal for miscellaneous structural components are wear and environmental degradation.

Door seals and gaskets were evaluated for loss of seal due to wear and determined to require aging management. Weatherproofing features were evaluated for loss of seal due to environmental degradation and determined to require aging management.

Based on the above, loss of seal is an aging effect requiring management for select miscellaneous structural components.

CRACKING

Aging mechanisms that can lead to cracking of miscellaneous structural components are shrinkage and environmental degradation.

Fire barrier penetration seals were evaluated for cracking due to shrinkage and determined not to require aging management since the seal material becomes a monolithic solid when cured that takes the form of the system to which each is injected or applied. In addition, SECY 96-146 "Technical Assessment of Fire Barrier Penetration Seals in Nuclear Power Plants" concludes that penetration seals are not subjected to aging effects.

Non-metallic conduits were evaluated for cracking due to environmental degradation and determined not to require aging management because they are not exposed to ultraviolet light.

Based on the above, cracking is an aging effect requiring management for miscellaneous structural components.

3.5.2.4.3 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 miscellaneous structural components includes the following:

- NRC Bulletin 92-01, "Failure Of Thermo-Lag 330 Fire Barrier System To Maintain Cabling In Wide Cable Trays And Small Conduits Free From Fire Damage"
- NRC Bulletin 92-01, Supplement 1, "Failure of Thermo-Lag 330 Fire Barrier System to Perform Its Specified Fire Endurance Function"
- NRC Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers"
- NRC Information Notice 88-04, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals"
- NRC Information Notice 88-56, "Potential Problems with Silicone Foam Fire Barrier Penetration Seals"
- NRC Information Notice 88-61, "Control Room Habitability - Recent Reviews of OPE Rating Experience"
- NRC Information Notice 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test"
- NRC Information Notice 91-79, "Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials"
- NRC Information Notice 91-79, Supplement 1, "Deficiencies Found in Thermo-Lag Fire Barrier Installation"

- NRC Information Notice 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Tests, And Ampacity"
- NRC Information Notice 92-55, "Current Fire Endurance Test Results For Thermo-Lag Fire Barrier Material"
- NRC Information Notice 92-82, "Results of Thermo-Lag 330-1 Combustibility Testing"
- NRC Information Notice 94-22, "Fire Endurance and Ampacity Derating Test Results for 3-hour Fire-Rated Thermo-Lag 330-1 Fire Barriers"
- NRC Information Notice 94-28, "Potential Problems With Fire-Barrier Penetration Seals"
- NRC Information Notice 94-34, "Thermo-Lag 330-660 Flexi-Blanket Ampacity Derating Concerns"
- NRC Information Notice 95-32, "Thermo-Lag 330-1 Flame Spread Test Results"
- NRC Information Notice 95-49 and Supplement 1, "Seismic Adequacy of Thermo-Lag Panels"
- NRC Information Notice 97-70, "Potential Problems with Fire Barrier Penetration Seals"
- NUREG-1552, "Fire Barrier Penetration Seals in Nuclear Power Plants"
- SECY-96-146, "Technical Assessment of Fire Barrier Penetration Seals in Nuclear Power Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.2.4.2.

PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of miscellaneous structural 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 3.5.2.4.2.

3.5.2.4.4 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.2.4.2. Tables 3.5-3 through 3.5-16 contain the results of the aging management review for the other structures and summarize the aging effects requiring management for miscellaneous structural components.

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

St. Lucie plant-specific programs:

- Fire Protection 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 for the miscellaneous structural components listed in Tables 3.5-3 through 3.5-16 are maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.5.3 REFERENCES

3.5-1 NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," U.S. Nuclear Regulatory Commission, April 2001.

3.5-2 FPL Letter to U. S. Nuclear Regulatory Commission, "Steam Generator and Reactor Coolant Pump Support Materials," L-77-349, November 18, 1977.

TABLE 3.5-1
STRUCTURAL COMPONENT INTENDED FUNCTIONS

1. Provide pressure boundary.
2. Provide structural support to safety-related components.
3. Provide shelter/protection to safety-related components (including radiation shielding).
4. Provide fire barriers to retard spreading of a fire.
5. Provide a source of cooling water for plant shutdown.
6. Provide missile barriers.
7. Provide structural support to non-safety related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions.
8. Provide flood protection barriers.
9. Provide boundary for safety-related ventilation.
10. Provide structural support and/or shelter to components required for FP, ATWS, and/or SBO events. (NOTE: Although not credited in the analyses for these events, these components have been conservatively included in the scope of license renewal.)
11. Provide pipe whip restraint and/or jet impingement protection.

TABLE 3.5-2
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Containment vessels [II A2.1-a]	1, 2, 7, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Containment vessels	1, 2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Structural steel framing (columns, beams, connections, etc.) [III A1.2-a, A4.2-a]	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Structural steel framing (columns, beams, connections, etc.)	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Stairs Ladders Platforms Handrails Checkered plate Grating	7	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-b]	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Reactor vessel supports [III B1.1.1-a]	2, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Reactor vessel supports [III B1.1.1-b]	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Pressurizer supports [III B1.1.1-a]	2, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Pressurizer supports [III B1.1.1-b]	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Reactor coolant pump supports [III B1.1.1-a]	2, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Reactor coolant pump supports [III B1.1.1-b]	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Steam generator supports [III B1.1.1-a]	2, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Steam generator supports [III B1.1.1-b]	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

**TABLE 3.5-2 (continued)
CONTAINMENTS**

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Airtight bulkhead doors (shield building)	3, 9	Carbon steel	Containment air Outdoor	Loss of material	Systems and Structures Monitoring Program
Maintenance hatch outside doors	3, 6, 9	Carbon steel Concrete	Containment air Outdoor	Loss of material	Systems and Structures Monitoring Program
Equipment and personnel hatches (maintenance hatches, personnel hatches, and escape hatches) including hinges, latches, and equalizing valves [II A3.2]	1, 4	Carbon steel	Containment air Indoor - not air conditioned Outdoor	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Equipment and personnel hatches (maintenance hatches, personnel hatches, and escape hatches) including hinges, latches, and equalizing valves	1, 4	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Piping and spare penetrations (includes bellows) [II A3.1]	1, 2, 4	Carbon steel	Containment air Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
		Stainless steel Nickel alloy	Indoor - not air conditioned Containment air	None	None required

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Piping and spare penetrations (includes bellows)	1, 2, 4	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Fuel transfer tube penetration sleeves [II A3.1-a, -b, -c]	1, 2, 4	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Fuel transfer tube penetration sleeves	1, 2, 4	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Reactor cavity seal rings	1	Stainless steel	Containment air	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Fuel transfer tubes and expansion bellows [II A3.1-b, -c, -d]	1, 2 , 4	Stainless steel	Containment air	None	None required
Fuel transfer tubes and expansion bellows	1, 2 , 4	Stainless steel	Treated water - borated	Loss of material	Chemistry Control Program
Refueling pool liner plates	1	Stainless steel	Containment air	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Fuel transfer flange supports	2	Stainless steel	Containment air	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Fuel transfer system (Unit 2 only)	2, 7	Stainless steel	Containment air	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical penetrations [II A3.1-a]	1, 2, 4	Carbon steel	Containment air Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Electrical penetrations	1, 2, 4	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Heating and ventilation penetrations [II A3.1-a, -b, -c]	1, 2, 4	Carbon steel	Containment air Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Heating and ventilation penetrations	1, 2, 4	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Fuel transfer flanges for fuel transfer tube isolation	1, 4	Stainless steel	Containment air	None	None required
Polar cranes (passive components) [VII B.1.1, B.2.1]	7	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Telescoping jib cranes (passive components) [VII B.1.1]	7	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Telescoping jib cranes (passive components)	7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Other cranes and hoists (passive components)	7	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Refueling machines (passive components)	2, 7	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Conduits and cable trays	2, 3, 7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Containment air	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Conduit and cable tray supports [III B2.1-b]	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Conduit and cable tray supports	2, 7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Containment air	None	None required

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports [III B3.1-b]	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Containment air	None	None required
HVAC duct supports [III B2.1-a]	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
HVAC duct supports [III B2.1-b]	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC duct supports	2, 7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-b]	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Trisodium phosphate (TSP) baskets (Unit 2 only)	2, 3	Stainless steel	Containment air	None	None required
Safety-related pipe supports and component supports [III B1.1.1-a, B1.2.1-a]	2, 10	Carbon steel	Containment air	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Safety-related pipe supports and component supports [III B1.1.1-b, B1.2.1-b]	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Containment air Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe supports [III B2.1-b]	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Containment air	None	None required
Pipe whip restraints [III B5.1-a]	11	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
Pipe whip restraints [III B5.1-b]	11	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Recirculation sump screens	2, 3	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Containment air	None	None required
Miscellaneous steel (i.e., radiation shielding, missile barriers, hatch frame covers, etc.)	2, 4, 6, 7, 10	Carbon steel	Containment air	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Carbon steel - galvanized	Containment air	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Reinforced concrete above groundwater (exterior walls and roofs)	2, 3, 4, 6, 7, 8, 9, 10	Concrete Carbon steel	Outdoor Containment air	None	None required
Reinforced concrete below groundwater (exterior walls and foundation) [III A1.1-e,-g]	2, 3, 7, 10	Concrete Carbon steel	Buried	Loss of material Change in material properties	Systems and Structures Monitoring Program
Reinforced concrete (interior shield walls, beams, slabs, missile shields, equipment pads, etc.)	2, 3, 6, 7, 10	Concrete Carbon steel	Containment air	None	None required
Reinforced concrete masonry block walls	2, 3	Concrete Carbon steel	Containment air	None	None required

TABLE 3.5-2 (continued)
CONTAINMENTS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Containment vessel moisture barriers [II A3.3-a]	3	Elastomer	Containment air Indoor - not air conditioned	Loss of seal	ASME Section XI, Subsection IWE Inservice Inspection Program
Reactor cavity seal ring seals	1	Elastomer	Containment air Treated water - borated	Loss of seal	Periodic Surveillance and Preventive Maintenance Program
Containment hatch seals and gaskets [II A3.3-a]	1	Elastomer	Containment air Indoor - not air conditioned	Loss of seal	ASME Section XI, Subsection IWE Inservice Inspection Program
Airtight bulkhead door seals [II A3.3-a]	9	Elastomer	Outdoor Indoor - not air conditioned	Loss of seal	Periodic Surveillance and Preventive Maintenance Program
Fuel transfer tube penetration flexible membranes (in annulus) [II A3.3-a]	9	Silicone	Containment air	None	None required
Lubrite sliding supports [III B1.1.3-a]	2, 10	Lubrite plate	Containment air	None	None required

TABLE 3.5-3
COMPONENT COOLING WATER AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Steel framing (columns, beams, and connections) [III A3.2-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Stairs Ladders Platforms Checkered plate Grating	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program

TABLE 3.5-3 (continued)
COMPONENT COOLING WATER AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Missile barriers (Unit 1 only)	3, 6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Missile protection doors (Unit 2 only)	3, 6	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduits	2, 3, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Indoor - not air conditioned Outdoor	None	None required
Conduit supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-3 (continued)
COMPONENT COOLING WATER AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduit supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
HVAC duct supports [III B2.1-a]	7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-3 (continued)
COMPONENT COOLING WATER AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Trolley hoists (passive components) [VII B.1.1]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater (external surfaces of foundation slab and walls below grating, walls and roofs above grating)	2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Buried Outdoor Indoor - not air conditioned	None	None required
Reinforced concrete (equipment pedestals and internal surfaces of walls and foundation slabs below grating) [III A3.1-d,-f]	2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Indoor - not air conditioned Outdoor	Loss of material[1] Change in material properties[1]	Systems and Structures Monitoring Program

NOTES 1. Plant experience shows a history of loss of material and change in material properties for these concrete components.

TABLE 3.5-4
CONDENSATE POLISHER BUILDING

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Component supports (non-safety related)	10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Pipe supports (non-safety related)	10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater	10	Concrete Carbon steel	Indoor - not air conditioned Outdoor	None	None required

TABLE 3.5-5
CONDENSATE STORAGE TANK ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Stairs Ladders Platforms Handrails Checkered plate Grating	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-5 (continued)
CONDENSATE STORAGE TANK ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduits	2, 3, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Conduit supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-5 (continued)
CONDENSATE STORAGE TANK ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Outdoor Indoor - not air conditioned	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-5 (continued)
CONDENSATE STORAGE TANK ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Missile protection hood (Unit 2 only)	6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater	2, 3, 4, 6, 7, 10	Concrete Carbon steel	Outdoor	None	None required

TABLE 3.5-6
DIESEL OIL EQUIPMENT ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Stairs Ladders Platforms Handrails Checkered plate Grating	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-6 (continued)
DIESEL OIL EQUIPMENT ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduits	2, 3, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Indoor - not air conditioned Outdoor	None	None required
Conduit supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-6 (continued)
DIESEL OIL EQUIPMENT ENCLOSURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Miscellaneous steel (i.e., missile barrier doors) (Unit 2 only)	4, 6	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Diesel oil storage tanks foundations	2, 7, 10	Concrete Carbon steel	Outdoor Buried	None	None required
Reinforced concrete above groundwater	2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Outdoor	None	None required

TABLE 3.5-7
EMERGENCY DIESEL GENERATOR BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Stairs Ladders Platforms Checkered plate Grating	7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned	None	None required
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Conduits	2, 3, 7, 10	Carbon steel - galvanized Stainless steel	Indoor - not air conditioned	None	None required
Conduit supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Conduit supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned	None	None required

TABLE 3.5-7 (continued)
EMERGENCY DIESEL GENERATOR BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panels and enclosures	2, 7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
Tubing supports	2, 7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Miscellaneous steel	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Missile protection doors	6, 8	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Missile protection exhaust hoods (Unit 2 only)	3, 6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required

TABLE 3.5-7 (continued)
EMERGENCY DIESEL GENERATOR BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Exterior louvers (for ventilation and missile protection) (Unit 1 only)	3, 6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Trolley hoists (passive components) [VII B.1.1]	7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater (slabs, walls, roofs, trenches)	2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Outdoor Indoor - not air conditioned	None	None required

TABLE 3.5-8[1, 2]
FIRE RATED ASSEMBLIES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Fire Barriers					
Conduit caps	1[3], 4	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
Fire wrap (conduit and steel supports)	4	Thermo-lag 330-1	Indoor - air conditioned Indoor - not air conditioned Containment air	None	None required
Conduit plugs	4	Ceramic fiber Quelpyre mastic 703B Fire retardant coating	Indoor - air conditioned Indoor - not air conditioned	None	None required
Miscellaneous barriers	1[3], 4	Thermo-lag 330-1 (panels, wrap, spray, or troweled) Thermo-lag 770-1 (panels) Ceramic fiber/stainless steel sheet metal (panels)	Indoor - air conditioned Indoor - not air conditioned	None	None required

NOTES
1. Concrete and steel structural components that serve as fire barriers are addressed with each structure.
2. Hose stations are included in component/commodity groups "Hose station-fittings" and "Hose station - nozzles," and are evaluated with Fire Protection (Table 3.3-6) and Primary Makeup Water (Table 3.3-11). Hose racks are included in the component /commodity group "Component supports (non-safety related)."
3. Selected structural components in this group provide a pressure boundary for the Halon system for the Unit 1 cable spreading room.

TABLE 3.5-8 (continued)
FIRE RATED ASSEMBLIES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Fire Barriers (continued)					
Fire doors (Appendix R barriers) [VII G.3.3, G.4.3]	1[1], 4	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned Outdoor	Loss of material	Fire Protection Program
Fire doors - airtight [VII G.3.3]	4, 9	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Fire Protection Program
Fire doors - watertight [VII G.3.3]	4, 8	Carbon steel	Indoor - not air conditioned	Loss of material	Fire Protection Program
Flame impingement shields	4	Insulating blankets (B&B or Mecatiss)	Containment air	None	None required
Radiant energy shields	4	Stainless steel	Containment air	None	None required
Fire sealed isolation joint [VII G.3.1]	4	Cerablanket Dymeric sealant Ethafoam Carbon steel plate	Indoor - not air conditioned	None	None required

NOTES 1. Selected structural components in this group provide a pressure boundary for the Halon system for the Unit 1 cable spreading room.

TABLE 3.5-8 (continued)
FIRE RATED ASSEMBLIES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Fire Seals					
Mechanical penetrations: (Type M-1, M-2, M-3, M-4, M-6, M-7, M-9) [VII G.3.1, G.4.1]	1[1], 4	Silicone Aluminum Carbon steel - galvanized Stainless steel Durablanket Ceramic fiber	Indoor - air conditioned Indoor - not air conditioned	None	None required
Cable tray penetrations [VII G.3.1]	1[1], 4	Marinite board Ceramic fiber Fire retardant coating.	Indoor - air conditioned Indoor - not air conditioned	None	None required

NOTES 1. Selected structural components in this group provide a pressure boundary for the Halon system for the Unit 1 cable spreading room.

TABLE 3.5-9
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Structural steel framing (columns, beams, connections, etc.)	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Stairs Ladders Platforms Handrails Checkered plate Grating	7	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
		Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Safety-related pipe supports and component supports [III B1.2.1-a]	2	Carbon steel	Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Safety-related pipe supports and component supports	2	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe supports	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe segments between class break and seismic anchor	2, 7	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
		Stainless steel	Indoor - not air conditioned	None	None required
Miscellaneous steel (i.e., radiation shielding, missile barriers, hatch frame covers, etc.)	6, 7	Carbon steel	Outdoor Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - not air conditioned	None	None required

**TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS**

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Airtight doors (Unit 2 only)	9	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduits	2, 3, 7	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - not air conditioned	None	None required
Conduit supports [III B2.1-a]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Conduit supports	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Conduit supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panels and enclosures	2, 3, 7	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
		Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - not air conditioned	None	None required

TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panel and enclosure supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - not air conditioned	None	None required
HVAC duct supports [III B2.1-a]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
HVAC duct supports	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC duct supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC louver (Unit 2 only)	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Tubing supports	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Tubing supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Fuel transfer tube penetration sleeve	3	Carbon steel	Embedded/encased	None	None required
			Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWE Inservice Inspection Program
Trolley hoists and cranes (passive components) [VII B.1.1]	7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Spent fuel cask handling cranes (passive components) [VII B.1.1, B2.1]	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Spent fuel handling machines (passive components) [VII B.1.1]	2, 7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Fuel pool gates	1	Stainless steel	Indoor - not air conditioned	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Fuel transfer tubes and expansion bellows [II A3.1-d]	1	Stainless steel	Indoor - not air conditioned	None	None required
Fuel transfer tubes and expansion bellows	1	Stainless steel	Treated water - borated	Loss of material	Chemistry Control Program

TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Pool liner plates [III A5.2-b]	1	Stainless steel	Indoor - not air conditioned	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Fuel handling tools (Unit 2 only)	2, 7	Stainless steel	Indoor - not air conditioned	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Upender - passive components (Unit 2 only)	2, 7	Stainless steel	Indoor - not air conditioned	None	None required
			Treated water - borated	Loss of material	Chemistry Control Program
Spent fuel storage racks [VII A2.1.2]	2, 3	Stainless steel	Treated water - borated	Loss of material	Chemistry Control Program
Boraflex (Unit 1 only) [VII A2.1.1]	3	Boron impregnated polymer	Treated water - borated	Change in material properties	Boraflex Surveillance Program
Reinforced concrete above groundwater	2, 3, 6, 7, 8, 10	Concrete Carbon steel	Indoor - not air conditioned Outdoor	None	None required
Unreinforced concrete masonry block walls [III A5.3-a]	7	Concrete	Indoor - not air conditioned	Cracking	Systems and Structures Monitoring Program

TABLE 3.5-9 (continued)
FUEL HANDLING BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Cask removal L-shape hatches	3, 6	Concrete Carbon steel	Indoor - not air conditioned Outdoor	None	None required
Airtight door seals	9	Elastomers	Indoor - not air conditioned Outdoor	Loss of seal	Periodic Surveillance and Preventive Maintenance Program
Weatherproofing	3	Caulking and sealants	Outdoor	Loss of seal	Systems and Structures Monitoring Program

TABLE 3.5-10
INTAKE, DISCHARGE, AND EMERGENCY COOLING CANALS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Concrete erosion protection (concrete paving and grout filled fabric between Intake Structures and Ultimate Heat Sink dam)	5, 10	Concrete Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Concrete erosion protection (concrete paving and grout filled fabric between Intake Structures and Ultimate Heat Sink dam) [III A6.1-d,-e]	5, 10	Concrete Carbon steel	Raw water - salt water	Loss of material	Systems and Structures Monitoring Program
				Change in material properties	Systems and Structures Monitoring Program
Earthen canal dikes [III A6.4-a]	5, 10	Earth fill	Raw water - salt water Outdoor	None	None required

TABLE 3.5-11
INTAKE STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	2, 6, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Structural steel framing (columns, beams, connections, etc.)	2, 6, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Miscellaneous steel (i.e., missile barriers, hatch frame covers, etc.)	2, 3, 6, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-11 (continued)
INTAKE STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduits	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Conduit supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-11 (continued)
INTAKE STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Cranes (passive components) [VII B1.1, B2.1]	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Cranes (passive components)	7	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete (slabs, walls, roofs) [III A6.1-d,-e]	2, 3, 5, 6, 7, 10	Concrete Carbon steel	Raw water - salt water	Loss of material Change in material properties	Systems and Structures Monitoring Program
Reinforced concrete (slabs, walls, roofs)	2, 3, 5, 6, 7, 10	Concrete Carbon steel	Outdoor	None	None required
Reinforced concrete (pump pedestals) [III A6.1-d,-e]	2	Concrete Carbon steel	Outdoor	Loss of material Change in material properties	Systems and Structures Monitoring Program
Retaining walls [III A6.1-d,-e]	2	Concrete Carbon steel	Raw water - salt water	Loss of material Change in material properties	Systems and Structures Monitoring Program
Conduits (non-metallic)	2, 3, 7, 10	PVC	Outdoor[1]	None	None required
Intake level recorders (PVC pipe)	7	PVC	Embedded	None	None required
Weatherproofing	3	Caulking and sealants	Outdoor	Loss of seal	Systems and Structures Monitoring Program

NOTES: 1. Located in pump missile enclosures and not exposed to direct sunlight.

TABLE 3.5-12
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	2, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Structural steel framing (columns, beams, connections, etc.)	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Stairs Ladders Platforms Handrails Checkered plate Grating	7	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
		Carbon steel - galvanized	Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Indoor - not air conditioned	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Safety-related pipe supports and component supports	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe supports	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	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
		Stainless steel	Indoor - not air conditioned	None	None required
Miscellaneous steel (i.e., radiation shielding, missile barriers, hatch frame covers, etc.)	2, 3, 4, 6, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Missile protection doors	6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Watertight doors	8, 9	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Airtight doors	7, 9	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Conduits and cable trays	2, 3, 7, 10	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - air conditioned Indoor - not air conditioned	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Conduit and cable tray supports	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduit and cable tray supports	2, 7, 10	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Indoor - air conditioned Indoor - not air conditioned	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC duct supports [III B2.1-a]	2, 7	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
HVAC duct supports	2, 7	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC duct supports	2, 7	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Indoor - air conditioned	None	None required
			Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Tubing supports	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Indoor - air conditioned Indoor - not air conditioned	None	None required
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
HVAC louvers	3, 7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Pipe whip restraints [III B5.1-a]	11	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Pipe whip restraints	11	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Trolleys and hoists (passive components) [VII B1.1]	7	Carbon steel	Indoor - not air conditioned	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater	1[1], 2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Outdoor Indoor - not air conditioned Indoor - air conditioned	None	None required

NOTES 1. Selected structural components in this group provide a pressure boundary for the Halon system for the Unit 1 cable spreading room.

TABLE 3.5-12 (continued)
REACTOR AUXILIARY BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Reinforced concrete below groundwater (exterior) [III A3.1-e,-g]	2, 3, 7, 10	Concrete Carbon steel	Buried	Loss of material Change in material properties	Systems and Structures Monitoring Program
Reinforced concrete below groundwater (interior)	2, 3, 4, 6, 7, 8, 10	Concrete Carbon steel	Indoor - not air conditioned	None	None required
Reinforced concrete masonry block walls	1[1], 2, 3, 4, 7, 10	Concrete Carbon steel	Indoor - air conditioned Indoor - not air conditioned	None	None required
Unreinforced concrete masonry block walls [III A3.3-a]	4, 7	Concrete	Indoor - air conditioned Indoor - not air conditioned	Cracking	Systems and Structures Monitoring Program
Airtight door seals	9	Elastomers	Indoor - air conditioned Indoor - not air conditioned Outdoor	Loss of seal	Periodic Surveillance and Preventive Maintenance Program
Watertight door seals	8, 9	Elastomers	Indoor - air conditioned Indoor - not air conditioned Outdoor	Loss of seal	Periodic Surveillance and Preventive Maintenance Program
Weatherproofing	3	Caulking and sealants	Outdoor	Loss of seal	Systems and Structures Monitoring Program

NOTES 1. Selected structural components in this group provide a pressure boundary for the Halon system for the Unit 1 cable spreading room.

TABLE 3.5-13
STEAM TRESTLE AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	2, 6, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Stairs Ladders Platforms Handrails Checkered plate	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (Non-safety related)	7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-13 (continued)
STEAM TRESTLE AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Non-safety related pipe segments between class break and seismic anchor	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Miscellaneous steel (i.e., missile barriers, steel grating, etc.)	3, 4, 6, 7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Conduits and cable trays	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit and cable tray supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required

TABLE 3.5-13 (continued)
STEAM TRESTLE AREAS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater	2, 3, 4, 7, 10	Concrete Carbon steel	Outdoor Buried	None	None required
Reinforced concrete below groundwater (exterior) [III A3.1-e,-g]	2, 7, 10	Concrete Carbon steel	Buried	Loss of material Change in material properties	Systems and Structures Monitoring Program
Pipe whip restraints	11	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-14
TURBINE BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Structural steel framing (columns, beams, connections, etc.) [III A3.2-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe segments between the class break and the seismic anchor	2, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe supports (including the pipe hangers that indirectly support the Unit 1 safety-related main feedwater isolation valve motors) [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduits and cable trays	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-14 (continued)
TURBINE BUILDINGS

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduit and cable tray supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Gantry cranes (passive components) [VII B1.1, B2.1]	7	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Turbine generator casings (covers)	6	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Reinforced concrete above groundwater	7, 10	Concrete Carbon steel	Outdoor Buried	None	None required

TABLE 3.5-15
ULTIMATE HEAT SINK DAM

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Stairs Ladders Platforms Handrails Checkered plate Grating	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related) [III B2.1-a]	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Non-safety related pipe supports [III B2.1-a]	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-15 (continued)
ULTIMATE HEAT SINK DAM

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Non-safety related pipe segments between class break and seismic anchor	2, 7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Indoor - not air conditioned Outdoor	None	None required
Miscellaneous steel (i.e., missile barriers, hatch covers, etc.)	3, 6	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduits and cable trays	2, 3, 7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Indoor - not air conditioned Outdoor	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit and cable tray supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program

TABLE 3.5-15 (continued)
ULTIMATE HEAT SINK DAM

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panels and enclosures	2, 3, 7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Indoor - not air conditioned Outdoor	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Electrical and instrument panel and enclosure supports	2, 7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Tubing supports [III B2.1-a]	7	Carbon steel	Indoor - not air conditioned Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	7	Carbon steel - galvanized	Indoor - not air conditioned Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
Steel sheet piling (beneath dam) [III A6.2-a]	3	Carbon steel	Buried	None	None required

TABLE 3.5-15 (continued)
ULTIMATE HEAT SINK DAM

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Reinforced concrete (walls, slabs, roofs) [III A6.1-b,-d,-e]	2, 3, 6	Concrete Carbon steel	Raw water - salt water	Loss of material Change in material properties	Systems and Structures Monitoring Program

TABLE 3.5-16
YARD STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Component supports (non-safety related) [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Component supports (non-safety related)	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Component supports (non-safety related)	7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Safety-related pipe supports and component supports [III B1.2.1-a]	2, 10	Carbon steel	Outdoor	Loss of material	ASME Section XI, Subsection IWF Inservice Inspection Program
Safety-related pipe supports and component supports	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe supports [III B2.1-a]	7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Non-safety related pipe supports	7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Non-safety related pipe segments between class break and seismic anchor	2, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
		Stainless steel	Outdoor	None	None required

TABLE 3.5-16 (continued)
YARD STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Conduits and cable trays	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Outdoor	None	None required
Conduit and cable tray supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Conduit and cable tray supports	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Conduit and cable tray supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panels and enclosures	2, 3, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
		Stainless steel	Outdoor	None	None required
Electrical and instrument panel and enclosure supports [III B3.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program

**TABLE 3.5-16 (continued)
YARD STRUCTURES**

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Electrical and instrument panel and enclosure supports	2, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Electrical and instrument panel and enclosure supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports [III B2.1-a]	2, 7, 10	Carbon steel	Outdoor	Loss of material	Systems and Structures Monitoring Program
Tubing supports	2, 7, 10	Carbon steel	Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Tubing supports	2, 7, 10	Carbon steel - galvanized	Outdoor	None	None required
			Outdoor (wetted)	Loss of material	Systems and Structures Monitoring Program
			Borated water leaks	Loss of material	Boric Acid Wastage Surveillance Program
Steel missile shield for diesel oil pipe (Unit 2 only)	6	Carbon steel	Buried	Loss of material	Systems and Structures Monitoring Program
Discharge canal nose wave protection (sheet piling) [III A6.2-a]	8	Carbon steel	Buried Embedded/encased	None	None required

TABLE 3.5-16 (continued)
YARD STRUCTURES

Component/ Commodity Group [GALL Reference]	Intended Function (See Table 3.5-1)	Material	Environment	Aging Effects Requiring Management	Program/Activity
Foundations (fire pumps, pipe supports, city water tanks, refueling water tanks, and Unit 2 primary water tank)	2, 10	Concrete Carbon steel	Outdoor	None	None required
Concrete missile shield for diesel oil pipe	6	Concrete Carbon steel	Buried	None	None required
Discharge canal nose wave protection (concrete cap)	8	Concrete Carbon steel	Outdoor	None	None required
Electrical duct banks and manholes	2, 3, 7, 10	Concrete Carbon steel	Buried	None	None required
Reinforced concrete pipe trenches	2, 3, 7, 10	Concrete Carbon steel	Buried	None	None required

3.6 ELECTRICAL AND INSTRUMENTATION AND CONTROLS

Section 2.5 provides a description of the electrical/I&C components requiring aging management review for license renewal. This section provides the results of the aging management review of the electrical/I&C components. The results of this section are also summarized in Table 3.6-5.

As stated in Section 2.5, the only electrical/I&C component commodity group subject to an aging management review is Cables and Connections (including insulated cables and connections, uninsulated ground conductors, splices, and terminal blocks) not included in the Environmental Qualification Program.

3.6.1 AGING EFFECTS REQUIRING MANAGEMENT

3.6.1.1 NON-ENVIRONMENTALLY QUALIFIED INSULATED CABLES AND CONNECTIONS

An evaluation published by the U. S. Department of Energy (DOE), "Aging Management Guideline (AMG) for Commercial Nuclear Power Plants - Electrical Cable and Terminations" [Reference 3.6-1, (DOE Cable AMG)], provides a comprehensive compilation and evaluation of information on the topics of insulated cables and connections, spliced connections, and terminal blocks. The electrical/I&C non-metallic materials are evaluated with the cable and connector materials in this evaluation. The DOE Cable AMG evaluated the stressors acting on cable and connection components, industry data on aging and failure of these components, and the maintenance activities performed on cable systems. Also evaluated were the main subsystems within cables, including the conductors, insulation, shielding, tape wraps, and jacketing, as well as all subcomponents associated with each type of connection.

The principal aging mechanisms and anticipated effects resulting from environmental and operating stresses were identified, evaluated, and correlated with plant experience to determine whether the predicted effects are consistent with field experience. As such, the information, evaluations, and conclusions contained in the DOE Cable AMG are used for the evaluation of aging effects in this subsection.

The most significant and observed aging mechanisms for insulated cables and connections are listed in the DOE Cable AMG, Table 4-18. The aging mechanisms from that table are used in this subsection as the starting point for identifying aging effects for insulated cables and connections. The potential aging effects along with the applicable stressors that are evaluated for insulated cables and connections are presented in Table 3.6-1 and are discussed in the following subsections.

3.6.1.1.1 LOW-VOLTAGE METAL CONNECTOR CONTACT SURFACES — MOISTURE AND OXYGEN

The DOE Cable AMG, Section 3.7.2.1.3, states that 3% of all low-voltage metal connector failures were identified as being caused by moisture intrusion. In each case, the source of moisture was precipitation. Based on the total number of reported connector failures in the DOE Cable AMG, moisture intrusion accounted for only 10 failures in all of the operating plants in the United States.

St. Lucie Units 1 and 2 structures where electrical/I&C components may be exposed to moisture are indicated in Table 3.6-2. From the potential moisture sources identified in Table 3.6-2, precipitation and potential boric acid leaks require consideration for low-voltage connectors. All low-voltage metal connectors are located in enclosures or protected from the environment with qualified splices. Thus, aging effects related to moisture and oxygen, and boric acid leakage do not require management for low-voltage connectors at St. Lucie.

Note: Electrical enclosures are treated as structural components and are discussed with each structure, as applicable, in Section 3.5.

3.6.1.1.2 LOW-VOLTAGE METAL COMPRESSION FITTINGS — VIBRATION AND TENSILE STRESS

The aging mechanism of mechanical stress will not result in aging effects requiring management for the following reasons:

- Damage to cables during installation at St. Lucie Units 1 and 2 is unlikely due to standard installation practices, which include limitations on cable pulling tension and bend radius. Even though installation damage is unlikely, most (including all safety related) cables are tested after installation and before operation. Failures induced by installation damage generally occur within a short time after the damaged cable is energized.
- NRC resolution of License Renewal Issue No. 98-0013 [Reference 3.6-2], which states, "Based on the above evaluation, the staff concludes that the issue of degradation induced by human activities need not be considered as a separate aging effect and should be excluded from an aging management review."
- Mechanical stress due to forces associated with electrical faults is mitigated by the fast action of circuit protective devices at high currents. However, mechanical stress due to electrical faults is not considered an aging mechanism since such faults are infrequent and random in nature.
- Vibration is generally induced in cables and connections by the operation of external equipment, such as compressors, fans, and pumps. Vibration can affect cable connections at a running motor by producing fatigue damage of the metallic cable or termination components in the immediate vicinity of the connection point. Normally, there has to be some physical damage as well to have an effect (e.g., a nicked connector). Terminations at equipment are part of the equipment and are inspected and maintained along with the equipment. These terminations are not within the evaluation boundary for insulated cable and connections and are not included in the insulated cable and connection review.
- Manipulation of cables is not considered an aging mechanism since such manipulation occurs during maintenance activities. Such activities require post-maintenance testing to detect any deficiencies in the cables. Any evidence of cable abnormalities would result in the condition being addressed under the corrective action program.

3.6.1.1.3 MEDIUM-VOLTAGE INSULATION (CABLE AND CONNECTIONS) — MOISTURE AND VOLTAGE STRESS

The DOE Cable AMG, Section 3.7.4, describes a survey of 25 fossil and nuclear power plants that was conducted to determine the number and types of medium-voltage cable failures that have occurred. The survey identified only 27 failures in almost 1000 plant-years of experience. The failures that occurred, other than moisture-produced water trees, were related to wetting in conjunction with manufacturing defects or damaged terminations due to improper installation, and were not related to aging effects.

St. Lucie structures where electrical/I&C cable and components may be exposed to moisture are indicated in Table 3.6-2. From the potential moisture sources identified in

Table 3.6-2, precipitation and standing water in duct banks require further consideration for medium-voltage insulation. The effects of moisture-produced water trees on medium-voltage cable were examined in Section 4.1.2.5 of the DOE Cable AMG. Water trees occur when the insulating materials are exposed to long-term, continuous electrical stress and moisture. These trees eventually result in breakdown of the dielectric materials and ultimate failure. The growth and propagation of water trees is somewhat unpredictable and few occurrences have been noted for cables operated below 15kV. Water treeing is a long-term degradation and failure phenomenon that is documented for medium-voltage electrical cable with cross-linked polyethylene (XLPE) or high molecular weight polyethylene (HMWPE) insulation. However, some cables are located in structures exposed to outside ambient conditions and are evaluated for the potential of moisture-produced water trees.

St. Lucie Units 1 and 2 medium-voltage applications, defined as 2kV to 15kV, use lead sheath cable to prevent the effects of moisture on the cables. The FPL cable specification for lead sheath power cables states that lead sheath cables are designed to be installed in wet environments for extended periods. In addition, the cable manufacturer's specification for lead sheath cables states that "...EPR/lead sheath cable is designed for applications in which liquid contamination is present and reliability is paramount. The sheath combined with the overall jacket provides a virtually impenetrable barrier against hostile environments - liquids, fire, hydrocarbons, acids, caustic, sewage, etc." As an additional level of protection, underground medium-voltage cables are only routed in concrete-encased duct banks. Therefore, aging effects related to cable exposed to moisture and voltage stress do not require management at St. Lucie.

3.6.1.1.4 MEDIUM- AND LOW-VOLTAGE INSULATION (CABLE AND CONNECTIONS) - RADIATION AND OXYGEN

The DOE Cable AMG, Section 4.1.4, Table 4-7, provides a threshold value and a moderate dose for various insulating materials. The threshold value is the amount of radiation that causes incipient to mild insulation damage. Once this threshold is exceeded, damage to the insulation increases from mild to moderate to severe as the total dose increases. The moderate damage value indicates the value at which the insulating material has been damaged but is still functional. St. Lucie Units 1 and 2 evaluations use the moderate damage dose from the DOE Cable AMG as the limiting radiation value shown in Table 3.6-3, unless otherwise noted in the table.

The maximum operating dose shown in Table 3.6-3 includes the maximum 60-year normal exposure inside Containment. This is conservative, especially for cables located outside Containment.

A comparison of the maximum operating dose and the moderate damage doses in Table 3.6-3 shows that all of the insulation materials included in this aging management review will not exceed the moderate damage doses. Therefore, aging effects caused by radiation exposure will not adversely affect the intended function of insulated cables and connections and electrical/I&C penetrations during the extended period of operation. Therefore, aging effects related to radiation do not require management for cables and connections and electrical/I&C penetrations included in the aging management review.

3.6.1.1.5 MEDIUM- AND LOW-VOLTAGE INSULATION (CABLE AND CONNECTIONS) - HEAT AND OXYGEN

A maximum operating temperature was developed for each insulation type based on cable applications at St. Lucie Units 1 and 2. The maximum operating temperature indicated in Table 3.6-4 incorporates a conservative value for self-heating for power applications combined with the maximum design ambient temperature.

The Arrhenius method, as described in EPRI NP-1558, "A Review of Equipment Aging Theory and Technology" [Reference 3.6-3], was used to determine the maximum continuous temperature to which the insulation material can be exposed so that the material has an indicated "endpoint of 60 years." These limiting temperatures for 60 years of service are provided in Table 3.6-4.

A comparison of the maximum operating temperature to the maximum 60-year continuous use temperature for the various insulation materials indicates that all of the insulation materials used in low- and medium-voltage power cables and connections can withstand the maximum operating temperatures for at least 60 years.

HYPALON, EPR, AND EPDM CABLE INSULATION

The maximum cable temperature, including self-heating, for Hypalon, EPR, and EPDM is 162.0°F. The calculated maximum temperature for a 60-year life is 154.0°F for Hypalon and 154.9°F for EPR and EPDM. Thus, the difference between the maximum cable temperature and the maximum temperature for a 60-year life is 8.0°F for Hypalon and 7.1°F for EPR and EPDM. This difference is very small and is considered to be within the conservatisms incorporated in the maximum cable temperature and the maximum 60-year continuous use temperatures, as discussed below.

Research funded by the NRC and published in NUREG/CR-6384, "Literature Review of Environmental Qualification of Safety-Related Electric Cables" [Reference 3.6-4], determined that the retention-of-elongation of most cable insulation materials can be reduced to 0% and the insulation will still be capable of withstanding a postulated LOCA and remain functional.

The maximum temperature for 60-year life listed in Table 3.6-4 is based on a 50% retention-of-elongation for Hypalon, a 40% retention-of-elongation for EPR, and a 40% loss-of-elongation for EPDM. Since the cables and connections subject to an aging management review either will not be subjected to accident conditions or are not required to remain functional during or after an accident, these values can be reduced much further without a loss of function. The Hypalon maximum temperature for 60 year life using 21% retention-of-elongation is 167.0°F, which is greater than the maximum cable temperature of 162.0°F. The EPR and EPDM maximum temperatures for 60 year life using 15% retention-of-elongation are 167.0°F and 189°F, respectively, which are also greater than the 162.0°F maximum cable temperature.

Given these conservatisms, there is reasonable assurance that Hypalon, EPR, and EPDM insulated cables will not thermally age through the extended period of operation to the point that they will not be able to perform their intended function.

3.6.1.1.6 MEDIUM- AND LOW-VOLTAGE INSULATION (CABLE AND CONNECTIONS) — ADVERSE LOCALIZED ENVIRONMENTS

An extensive review of St. Lucie Nuclear Plant operating experience associated with cables and connections (connectors, splices, and terminal blocks) was performed, in part to determine the existence of adverse localized environments. This review did not identify any adverse localized environments caused by heat or radiation that might be detrimental to cables and connections.

In addition, walkdowns of accessible non-EQ cables and connections within the scope of license renewal found no adverse localized environments caused by heat or radiation.

The potential sources of adverse localized heat environments at St. Lucie Units 1 and 2 are from high temperature Reactor Coolant, Main Steam, Feedwater and Blowdown System piping and components. Most areas of the St. Lucie Nuclear Plant are not likely to have adverse localized heat environments because of the following:

1. The Intake Structures, Steam Trestle Areas, Component Cooling Water Area - Unit 1, Condensate Storage Tank Enclosure - Unit 1, Ultimate Heat Sink Dam, and Yard Structures are outdoor areas where cable and connections are not subject to adverse localized temperature and radiation effects.
2. The Turbine Buildings are outdoor areas with no external walls or roofs.
3. The Reactor Auxiliary Buildings, Component Cooling Water Area - Unit 2, Condensate Storage Tank Enclosure - Unit 2, Emergency Diesel Generator Buildings, and Fuel Handling Buildings do not contain any high temperature Reactor Coolant, Main Steam, and Feedwater System piping and components. The Reactor Auxiliary Buildings contain Steam Generator Blowdown System piping and components in limited areas.
4. With regard to radiation, the only buildings with any appreciable radiation levels are the Containments, the Reactor Auxiliary Buildings, and the Fuel Handling Buildings. However, non-EQ cables and connections in the Reactor Auxiliary Buildings and Fuel Handling Buildings are not located in areas that would be subject to adverse localized radiation environments during plant operation, including those postulated based on the conservative assumption of 1% failed fuel (see further discussion below).

Containment temperatures are monitored continuously and an average containment temperature is recorded daily, regardless of plant operating mode. For Unit 1 this average is taken from the containment fan cooler inlet temperature detectors (3 of the 4 detectors are used). These detectors are located on the 45- and 62-foot elevations of the Containment. For Unit 2 the average of the two containment air temperature detectors is used. These detectors are located on the 70-foot elevation of the Containment. Per plant operating procedures, the recorded average temperature is required to be less than or equal to 115°F. Since these temperature detectors are located at elevations that are greater than or equal to that of the electrical equipment within the scope of license renewal, the monitored temperatures are considered bounding.

Containment area radiation levels are monitored continuously by four radiation monitors located in various locations throughout each Containment (these monitors are in addition to the safety-related high range radiation, particulate, and gas monitors). Unit 1 UFSAR Section 12.1.4 and Unit 2 UFSAR Section 12.3.4 describe the Area Radiation Monitoring Systems. High radiation activity in the vicinity of any of these containment monitors is indicated, recorded, and alarmed in the control room. Note that all cable and connection insulation materials that are located within the Containments are the same as cable and connection insulation materials already included in the Environmental Qualification Program at St. Lucie. The Area Radiation Monitoring Systems have 59 monitors (26 in Unit 1 and 33 in Unit 2) located throughout the Reactor Auxiliary Buildings and Fuel Handling Buildings; these monitors are indicated, recorded, and alarmed in the appropriate control room.

Changes to the plant environment may be identified by routine operator walkdowns and periodic Health Physics radiation monitoring (surveys of areas in the Reactor Auxiliary Buildings and Fuel Handling Buildings are conducted at least monthly, and in some cases daily or weekly). Additionally, all plant personnel are trained to use the plant's corrective action program if conditions adverse to quality, which would include abnormal environmental conditions, are observed. Any change in temperature that could adversely affect non-EQ cables and connections would be readily noticed. The same applies for radiation. The normal 40-year radiation doses are based on the assumption of operation with 1% failed fuel. This is conservative because St. Lucie Units 1 and 2 have never operated with more than 0.1% failed fuel. Therefore, changes in local dose rates that would affect the life of equipment would have to be so significant that they would be readily identified.

In addition, the 60-year life maximum temperature and radiation values for non-EQ cable and connection insulation materials are also conservative. The typical "endpoint" for cable thermal aging data is 40% to 60% retention-of-elongation. Research funded by the NRC and published in NUREG/CR-6384 determined that the retention-of-elongation of most cable insulation materials can be reduced to 0% and the insulation will still be capable of withstanding a LOCA and remain functional. As the insulated cables and connections subject to an aging management review will either not be subjected to an accident environment or are not required to function after being subjected to an accident environment, the endpoints chosen for this review are extremely conservative. The insulated cable and connection materials could be aged a great deal more, possibly to the point where retention-of-elongation reaches 0%, without loss of intended function.

Preliminary results of the EQ research on low-voltage electrical cables were presented by Brookhaven National Laboratories at an NRC public meeting March 19, 1999. As added indication that there is margin in the thermal aging, preliminary conclusions from LOCA tests 1, 2, and 3 of the NRC research program indicate that, "Electric cables with insulation EAB (elongation-at-break) values as low as 5% performed acceptably under accident conditions."

Therefore, the useable 60-year life temperature for a typical cable insulation is significantly higher than the values shown in Table 3.6-4.

Table 3.6-3 shows that the radiation values that non-EQ cable and connection insulation materials can withstand are much greater than actual design values for the 60-year life of the plant.

Based on the original St. Lucie Units 1 and 2 cable routing designs, plant-specific operating experience, and periodic walkdowns that have been performed, there are no adverse localized environments caused by heat or radiation present in areas where non-EQ cables and connections are located.

3.6.1.2 UNINSULATED GROUND CONDUCTORS

The ground cable material used at St. Lucie Units 1 and 2 is copper. Copper is a good choice for this application because of its high electrical conductivity, high fusing temperature, and high corrosion resistance. Copper is also relatively strong, and it is easy to join by welding, compression, or clamping. Ground connections are commonly made with welds or mechanical type connectors, which include compression-, bolted-, and wedge-type devices.

Review of available industry technical information regarding material aging revealed that there are no aging effects requiring management for copper grounding materials. In addition, a review of industry and plant operating experiences did not identify any failures of copper ground systems due to aging effects. Therefore, based on industry and plant-specific experiences, no aging effects requiring management were identified for the plant grounding system.

3.6.2 OPERATING EXPERIENCE

3.6.2.1 INDUSTRY EXPERIENCE

The DOE Cable AMG review includes an industry-wide operating experience review of failures and aging effects of electrical cables and terminations. No aging effects were identified from the DOE Cable AMG beyond those already identified in Subsection 3.6.1.

An incident occurred at the Davis-Besse Nuclear Generating Station, October 2, 1999. A component cooling water pump tripped as a result of a phase-to-ground fault on a medium-voltage 3-phase power cable. The cable was installed in a 4-inch PVC conduit, which runs partially underground, and had been in service for about 23 years.

As noted above, all medium-voltage applications (2kV to 15kV) at St. Lucie Nuclear Plant use lead sheath cable to prevent the effects of moisture on the cables. Based on St. Lucie's medium-voltage cable design, this incident is not applicable to medium-voltage cables at St. Lucie Units 1 and 2.

3.6.2.2 PLANT-SPECIFIC EXPERIENCE

St. Lucie Units 1 and 2 operating experience was reviewed to validate the identified aging effects requiring management. This review included a survey of St. Lucie non-conformance reports, licensee event reports, and condition reports for any documented instances of electrical/I&C component aging, in addition to interviews with responsible engineering personnel. No aging effects were identified from this review beyond those identified in Subsection 3.6.1. In particular, the review did not identify any instances where insulated cables or connections have failed due to heat-, radiation-, or moisture-related aging effects.

3.6.3 CONCLUSION

The review of industry information, NRC generic communications, and St. Lucie Units 1 and 2 operating experience identified no additional aging effects beyond those discussed in Subsection 3.6.1. Table 3.6-5 contains the results of the aging management review for electrical/I&C components and summarizes that there are no aging effects requiring management for electrical/I&C components. Based on the aging management review, the intended functions of electrical/I&C components will be maintained consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

3.6.4 REFERENCES

3.6-1 SAND 96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations," Sandia National Laboratories for the U. S. Department of Energy, September 1996.

3.6-2 C. I. Grimes (NRC) letter to D. J. Walters (NEI), "License Renewal Issue No. 98-0013, Degradation Induced Human Activities," June 5, 1998.

3.6-3 EPRI NP-1558, "A Review of Equipment Aging Theory and Technology," Electric Power Research Institute, September 1980.

3.6-4 NUREG/CR-6384, "Literature Review of Environmental Qualification of Safety-Related Electric Cables," Vol. 1, Brookhaven National Laboratory for the U.S. Nuclear Regulatory Commission, April 1996.

TABLE 3.6-1
POTENTIAL AGING EFFECTS
ADAPTED FROM DOE CABLE AMG, TABLE 4-18

Voltage Category[1]	Component	Applicable Stressor	Potential Aging Effects
Low voltage	Metal connector contact surfaces	Moisture and oxygen	Increased resistance and heating; loss of circuit continuity
	Compression fitting	Vibration Tensile stress	Loss of circuit continuity High resistance
Medium voltage	Insulation (cable and connections)	Moisture and voltage stress	Electrical failure (breakdown of insulation)
Medium and low voltages	Insulation (cable and connections)	Radiation and oxygen	Reduced insulation resistance; electrical failure
		Heat and oxygen	Reduced insulation resistance; electrical failure

NOTE: 1. Low voltage: less than 2kV; medium voltage: 2kV to 15kV

TABLE 3.6-2
MOISTURE EXPOSURE SOURCES

Structure	Environment	Potential Moisture Exposure Source
Turbine Buildings Intake Structures Steam Trestle Areas Unit 1 Component Cooling Water Area Yard Structures Ultimate Heat Sink Dam Unit 1 Condensate Storage Tank Enclosure	Outdoor	Precipitation
Yard Structures	Indoor - not air conditioned (wetted)	Standing water in duct banks
Containments Auxiliary Buildings Fuel Handling Buildings Yard Structures	Borated water leaks	Systems containing boric acid

TABLE 3.6-3
INSULATION MATERIAL
RADIATION EXPOSURE COMPARISON

Insulation Material	Maximum Operating Dose	Moderate Damage Dose	Additional Information
EP	4.5×10^5 rads	5×10^7 rads	
EPR, EPDM, FR-EP	1.05×10^6 rads	5×10^7 rads	
Fiberglass (mineral insulated)	1.05×10^6 rads	None	Fiberglass is spun glass and, except for some changes in color, is not affected by radiation.
Glass	1.05×10^6 rads	None	Glass is spun glass and, except for some changes in color, is not affected by radiation.
Kerite-FR3	1.05×10^6 rads	1×10^8 rads	Although no value for Kerite is listed in DOE Cable AMG, Table 4-7, the insulation material has been tested many times for the nuclear power industry at total doses in excess of 1×10^8 rads. This value is used as the moderate damage dose.
Kerite-HTK, Kerite-FR, Kerite-FR2	2.7×10^6 rads	1×10^8 rads	Although no value for Kerite is listed in DOE Cable AMG, Table 4-7, the insulation material has been tested many times for the nuclear power industry at total doses in excess of 1×10^8 rads. This value is used as the moderate damage dose.
Melamine	1.05×10^6 rads	5×10^7 rads	
Phenolic	1.05×10^6 rads	$\sim 4 \times 10^7$ rads	The radiation resistance of phenolic varies depending on what it is "filled" with (e.g., glass, asbestos). The values for "unfilled" phenolic are chosen since it is the least resistent.
Silicon rubber	1.05×10^6 rads	3×10^6 rads	
FR-XLPE	4.5×10^5 rads	1×10^8 rads	
XLPE, XLP, Vulkene	1.05×10^6 rads	1×10^8 rads	
Butyl	4.5×10^5 rads	5×10^6 rads	
Hypalon	1.05×10^6 rads	2×10^6 rads	
Kapton	1.05×10^6 rads	2×10^8 rads	
Nylon	1.05×10^6 rads	2×10^6 rads	There are many formulations of nylon, a material originally developed by the DuPont Company. The values used here are for the most common formulation (general purpose) of nylon that is referred to as Nylon 66 and is designated Zytel 101. Zytel is the DuPont trademark for many different nylon resins.
PE	4.5×10^5 rads	2×10^7 rads	
PVC	4.5×10^5 rads	2×10^7 rads	
Tefzel	1.05×10^6 rads	3×10^7 rads	

TABLE 3.6-4
INSULATION MATERIAL
TEMPERATURE EXPOSURE COMPARISON

Insulation Material	Maximum Cable Temperature [1]	Maximum Temperature For 60-Year Life	60-Year Endpoint
Phenolic	162.0°F (72.0°C)	220.5°F (104.7°C)	50% Retention of Impact Strength
Vulkene	120.0°F (48.9°C)	188.1°F (86.7°C)	60% Retention-of-Elongation
XLPE	162.0°F (72.0°C)	188.1°F (86.7°C)	60% Retention-of-Elongation
Kapton	162.0°F (72.0°C)	248.0°F (120.0°C)	Failure
EP, FR-EP	120.0°F (48.9°C)	154.9°F (68.3°C)	40% Retention-of-Elongation
EPDM	162.0°F (72.0°C)	154.9°F (68.3°C)	40% Loss-of-Elongation
EPR	162.0°F (72.0°C)	154.9°F (68.3°C)	40% Retention-of-Elongation
Kerite-FR3	120.0°F (48.9°C)	166.6°F (74.8°C)	20% Retention-of-Elongation
Kerite-HTK	162.0°F (72.0°C)	185.4°F (85.2°C)	20% Retention-of-Elongation
Melamine	162.0°F (72.0°C)	205.0°F (96.2°C)	25% Reduction in Cross Breaking Strength
PE	104.0°F (40.0°C)	131.0°F (55.0°C)	T_{75} Induction Period
Butyl	104.0°F (40.0°C)	125.1°F (51.7°C)	40% Retention-of-Elongation
Kerite-FR	120.0°F (48.9°C)	141.5°F (60.8°C)	50% Retention-of-Elongation
Silicon rubber	162.0°F (72.0°C)	273.0°F (133.9°C)	50% Retention-of-Elongation
Tefzel	162.0°F (72.0°C)	226.0°F (108.0°C)	50% Retention-of-Elongation
Kerite-FR2	162.0°F (72.0°C)	192.5°F (89.2°C)	20% Retention-of-Elongation
XLP, FR-XLPE	120.0°F (48.9°C)	185.4°F (85.2°C)	60% Retention-of-Elongation
Nylon	120.0°F (48.9°C)	129.9°F (54.4°C)	28% Retention of Tensile Strength
PVC	104.0°F (40.0°C)	112.0°F (44.4°C)	Mean-Time-To-Failure
Hypalon	162.0°F (72.0°C)	154.0°F (67.8°C)	50% Retention-of-Elongation
Glass, Fiberglass (mineral insulated)	Not required	Does not age from heat	Not applicable

NOTE: 1. Maximum Cable Temperature includes self-heating temperature rise for cable insulation in power applications.

TABLE 3.6-5
ELECTRICAL/I&C COMPONENTS AGING MANAGEMENT REVIEW SUMMARY

Component / Commodity Group	Intended Function	Insulation Material	Environment [1]	Aging Effect Requiring Management	Program/Activity
Non-environmentally qualified cables and connections (electrical power circuits)	To electrically connect specified sections of an electrical circuit to deliver voltage, current, or signal	EPR, EPDM, Kerite-FR2, Kapton, Kerite-HTK, XLPE, phenolic, Melamine, glass, Tefzel, Hypalon, and silicone rubber	Moisture Temperature Elevated temperature Ohmic heating Radiation	None	None required
Non-environmentally qualified cables and connections (I&C circuits)	To electrically connect specified sections of an electrical circuit to deliver voltage, current, or signal	Butyl, EP, EPR, EPDM, Kerite-FR, Kerite-FR2, Kerite-FR3, FR-EP, Melamine, nylon, fiberglass, Hypalon, Kapton, PE, Kerite-HTK, phenolic, PVC, XLP, XLPE, Vulkene, FR-XLPE, Tefzel, and silicone rubber	Moisture Temperature Elevated temperature Radiation	None	None required
Uninsulated ground conductors	To electrically connect specified sections of an electrical circuit to deliver voltage, current, or signal	Uninsulated copper	Moisture Temperature Elevated temperature Radiation	None	None required

NOTE 1: All environments are external except ohmic heating, which is considered an internal environment.

4.0 TIME-LIMITED AGING ANALYSES

Two areas of technical review are required to support an application for a renewed operating license. The first area of technical review is the St. Lucie Integrated Plant Assessment, which is described in Chapters 2 and 3. The second area of technical review required for license renewal is the identification and evaluation of plant-specific TLAAs and exemptions, which are provided in this chapter. The evaluations included in this chapter meet the requirements contained in 10 CFR 54.21(c) and allow the NRC to make the finding contained in 10 CFR 54.29(a)(2).

4.1 IDENTIFICATION OF TIME-LIMITED AGING ANALYSES

10 CFR 54.21(c) requires an evaluation of TLAAs be provided as part of the application for a renewed license. TLAAs are defined in 10 CFR 54.3 as those licensee calculations and analyses that:

- Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a);
- Consider the effects of aging;
- Involve time-limited assumptions defined by the current operating term, for example, 40 years;
- Were determined to be relevant by the licensee in making a safety determination;
- Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended functions, as delineated in 10 CFR 54.4(b); and
- Are contained or incorporated by reference in the current licensing basis.

4.1.1 TIME-LIMITED AGING ANALYSES IDENTIFICATION PROCESS

The process used to identify the St. Lucie-specific TLAAs is consistent with the guidance provided in NEI 95-10 [Reference 4.1-1]. Analyses and evaluations that meet the six criteria of 10 CFR 54.3 were identified from the Technical Specifications, UFSARs, and docketed licensing correspondence. The analyses and evaluations that meet all six criteria of 10 CFR 54.3 are the St. Lucie-specific TLAAs listed in Table 4.1-1.

As required by 10 CFR 54.21(c)(1), an evaluation of St. Lucie-specific TLAAs must be performed to demonstrate that:

(i) the analyses remain valid for the period of extended operation;

(ii) the analyses have been projected to the end of the period of extended operation; or

(iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

The results of these evaluations are provided in Table 4.1-1 and discussed in Sections 4.2 through 4.6.

4.1.2 IDENTIFICATION OF EXEMPTIONS

The requirements of 10 CFR 54.21(c) also stipulate that the application for a renewed license include a list of plant-specific exemptions, granted pursuant to 10 CFR 50.12 and in effect, that are based on TLAAs as defined in 10 CFR 54.3. The identification was performed by evaluating the basis for each active 10 CFR 50.12 exemption to determine whether the exemption was based on a time-limited aging analysis. No 10 CFR 50.12 exemptions involving a TLAA as defined in 10 CFR 54.3 were identified for St. Lucie Units 1 and 2.

4.1.3 REFERENCES

4.1-1 NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule," Revision 3, Nuclear Energy Institute, March 2001.

TABLE 4.1-1
TIME-LIMITED AGING ANALYSES

TLAA Category	Analysis	Resolution [10 CFR 54.21(c)(1) Section]	Section
Reactor Vessel Neutron Embrittlement	Upper-Shelf Energy	(ii) projected to the end of the period of extended operation	4.2.1
	Pressurized Thermal Shock	(ii) projected to the end of the period of extended operation	4.2.2
	Pressure-Temperature Limits	(ii) projected to the end of the period of extended operation[1]	4.2.3
Metal Fatigue	ASME Section III, Class 1 Components	(i) remains valid for the period of extended operation	4.3.1
	ASME Section III, Class 2 and 3 and ANSI B31.1 Components	(i) remains valid for the period of extended operation	4.3.2
	ASME Section III, Class 2 and 3 and ANSI B31.1 Components - Unit 1 and Unit 2 Reactor Coolant System Sample Lines	(ii) projected to the end of the period of extended operation	4.3.2
Environmental Qualification of Electric Equipment	Alpha Wire and Cable	(ii) projected to the end of the period of extended operation	4.4.1.1
	Amerace Terminal Blocks	(ii) projected to the end of the period of extended operation	4.4.1.2
	Anchor Darling Valve Operators	(ii) projected to the end of the period of extended operation	4.4.1.3
	ASCO Normally De-Energized Solenoid Valves; Models 206-381 and NP-8320	(ii) projected to the end of the period of extended operation	4.4.1.4
	ASCO Normally De-Energized Solenoid Valves; Models NP-8316, NP-8321, and NP-8344	(ii) projected to the end of the period of extended operation	4.4.1.5
	Boston Insulated Wire Cables	(ii) projected to the end of the period of extended operation	4.4.1.6
	Cerro (Rockbestos) Cables	(ii) projected to the end of the period of extended operation	4.4.1.7
	Cerro (Rockbestos) Coaxial/Triaxial Cables	(ii) projected to the end of the period of extended operation	4.4.1.8
	Combustion Engineering Mineral Insulated Cables and Connectors	(ii) projected to the end of the period of extended operation	4.4.1.9
	Conax Conduit Seals	(ii) projected to the end of the period of extended operation	4.4.1.10
	Conax Penetrations	(ii) projected to the end of the period of extended operation	4.4.1.11

NOTE: 1. Although 60-year pressure-temperature limits are not being submitted as part of this application, updated pressure-temperature limits will be submitted prior to entering the period of extended operation.

TABLE 4.1-1 (continued)
TIME-LIMITED AGING ANALYSES

TLAA Category	Analysis	Resolution [10 CFR 54.21(c)(1) Section]	Section
Environmental Qualification of Electric Equipment (continued)	Conax Thermocouples	(ii) projected to the end of the period of extended operation	4.4.1.12
	Continental Cables	(ii) projected to the end of the period of extended operation	4.4.1.13
	CVI Heaters	(ii) projected to the end of the period of extended operation	4.4.1.14
	EGS Grayboot Connectors	(ii) projected to the end of the period of extended operation	4.4.1.15
	Fluid Control Incorporated Level Sensors	(ii) projected to the end of the period of extended operation	4.4.1.16
	General Atomic Radiation Monitors	(ii) projected to the end of the period of extended operation	4.4.1.17
	General Cable Cables	(ii) projected to the end of the period of extended operation	4.4.1.18
	General Electric Cables	(ii) projected to the end of the period of extended operation	4.4.1.19
	General Electric High Pressure Safety Injection (Unit 1) and Auxiliary Feedwater Pump Motors	(ii) projected to the end of the period of extended operation	4.4.1.20
	General Electric High Pressure Safety Injection (Unit 2) Pump Motors	(ii) projected to the end of the period of extended operation	4.4.1.21
	General Electric Terminal Blocks	(ii) projected to the end of the period of extended operation	4.4.1.22
	Gordon Thermocouples	(ii) projected to the end of the period of extended operation	4.4.1.23
	Gulf General Atomic Electrical Penetrations	(ii) projected to the end of the period of extended operation	4.4.1.24
	IMO Industries Level Sensors	(ii) projected to the end of the period of extended operation	4.4.1.25
	Indeeco Heaters	(ii) projected to the end of the period of extended operation	4.4.1.26
	Kerite Cables (HTK/FR/FR2 Insulation)	(ii) projected to the end of the period of extended operation	4.4.1.27
	Limitorque Valve Operators	(ii) projected to the end of the period of extended operation	4.4.1.28
	Magnetrol Level Switches	(ii) projected to the end of the period of extended operation	4.4.1.29
	Micro Switch Limit Switches	(ii) projected to the end of the period of extended operation	4.4.1.30

TABLE 4.1-1 (continued)
TIME-LIMITED AGING ANALYSES

TLAA Category	Analysis	Resolution [10 CFR 54.21(c)(1) Section]	Section
Environmental Qualification of Electric Equipment (continued)	Okonite Cables (EPR Insulation)	(ii) projected to the end of the period of extended operation	4.4.1.31
	Okonite Cables (X-Olene FMR Insulation)	(ii) projected to the end of the period of extended operation	4.4.1.32
	Raychem Cables	(ii) projected to the end of the period of extended operation	4.4.1.33
	Raychem Splices	(ii) projected to the end of the period of extended operation	4.4.1.34
	RdF Resistance Temperature Detectors	(ii) projected to the end of the period of extended operation	4.4.1.35
	Reliance Electric Containment Fan Cooler Motors	(ii) projected to the end of the period of extended operation	4.4.1.36
	Rome Cables	(ii) projected to the end of the period of extended operation	4.4.1.37
	Siemens Allis Containment Spray Pump Motors	(ii) projected to the end of the period of extended operation	4.4.1.38
	Target Rock Normally De-Energized Solenoid Valves; Series 80B	(ii) projected to the end of the period of extended operation	4.4.1.39
	Target Rock Normally De-Energized Solenoid Valves; Series 74Q, 76R, 78E, 84V, 89Q, and 98K	(ii) projected to the end of the period of extended operation	4.4.1.40
	TEC Acoustic Flow Monitor - Accelerometer and Cable Assembly	(ii) projected to the end of the period of extended operation	4.4.1.41
	Teledyne Thermatics Cable	(ii) projected to the end of the period of extended operation	4.4.1.42
	3M Tape Splices	(ii) projected to the end of the period of extended operation	4.4.1.43
	Valcor Normally De-Energized Solenoid Valves	(ii) projected to the end of the period of extended operation	4.4.1.44
	Weed Resistance Temperature Detectors	(ii) projected to the end of the period of extended operation	4.4.1.45
	Westinghouse Charging Pump Motors	(ii) projected to the end of the period of extended operation	4.4.1.46
	Westinghouse Containment Fan Cooler Motors	(ii) projected to the end of the period of extended operation	4.4.1.47
	Westinghouse Hydrogen Recombiner	(ii) projected to the end of the period of extended operation	4.4.1.48

TABLE 4.1-1 (continued)
TIME-LIMITED AGING ANALYSES

TLAA Category	Analysis	Resolution [10 CFR 54.21(c)(1) Section]	Section
Environmental Qualification of Electric Equipment (continued)	Westinghouse Low Pressure Safety Injection Pump Motors	(ii) projected to the end of the period of extended operation	4.4.1.49
	Westinghouse Ventilation Fan Motors	(ii) projected to the end of the period of extended operation	4.4.1.50
	United Control International Silicone Tape	(ii) projected to the end of the period of extended operation	4.4.1.51
Metal Containment and Penetration Fatigue	Penetration Fatigue	(i) remains valid for the period of extended operation	4.5.2
Other Plant-Specific TLAAs	Leak-Before-Break for Reactor Coolant System Piping	(i) remains valid for the period of extended operation	4.6.1
	Crane Load Cycle Limit	(i) remains valid for the period of extended operation	4.6.2
	Unit 1 Core Support Barrel Repair Fatigue	(i) remains valid for the period of extended operation	4.6.3
	Unit 1 Core Support Barrel Repair Plug Preload Relaxation	(ii) projected to the end of the period of extended operation	4.6.3
	Alloy 600 Instrument Nozzle Repairs	(i) remains valid for the period of extended operation	4.6.4

4.2 REACTOR VESSEL NEUTRON EMBRITTLEMENT

This group of TLAAs concerns the effect of irradiation embrittlement on the beltline regions of the St. Lucie Units 1 and 2 reactor vessels, and how this mechanism affects analyses that provide operating limits or address regulatory requirements. The calculations discussed in this section use predictions of the cumulative effects on the reactor vessels from irradiation embrittlement. The calculations are based on periodic assessment of the neutron fluence and resultant changes in the reactor vessel material fracture toughness.

The intermediate and lower shells and the welds that join them in the beltline region (adjacent to the reactor core) of the reactor vessels are fabricated from low alloy steels. These ferritic steels exhibit a ductile-brittle transition that results in fracture toughness property changes as a function of both temperature and irradiation. The material property of particular importance in assessing reactor vessel integrity is fracture toughness, which can be defined as the capability of a material to resist sudden failure caused by crack propagation. Fracture toughness is reduced by neutron irradiation. The measure of fracture toughness of the reactor vessel materials when the reactor vessel is above the brittle fracture/ductile failure transition temperature is referred to as upper-shelf energy. Upper-shelf energy is related to the ability of a material to resist ductile tearing. In addition, the temperature at which the brittle fracture/ductile failure transition occurs increases with increasing radiation.

This shift in the transition temperature is referred to as the shift in reference nil ductility transition temperature (RT_{NDT}). The effect of embrittlement due to neutron bombardment is evaluated for reactor vessel temperatures throughout the range of normal operating values. Heatup and cooldown curves consider normal, relatively slow thermal transients. PTS transients are characterized by a rapid and significant decrease in reactor coolant temperature with high pressure in the reactor vessel. The high reactor vessel thermal stresses, when combined with the pressure stresses, are assumed to initiate the propagation of a small flaw that is postulated to exist in the reactor vessel beltline. Postulated high pressures could cause propagation of the flaw through the reactor vessel wall.

The welds in the reactor vessels are basically the same material as the parts being joined and may be considered to be included in the preceding discussions. The chemistry differences between weld metal and base metal affect the material properties that are degraded by embrittlement; therefore, the welds are evaluated separately when considering the aforementioned aging effect.

The best estimate maximum projected fast (>1.0 MeV) neutron fluence for the St. Lucie Units 1 and 2 reactor vessels has been calculated for the period of extended operation assuming 54 effective full power years (EFPY) or greater, which is a conservative estimate of plant operation for a 60 year end-of-life (EOL). These fluence projections will be used to address the ability of the reactor vessels to meet the requirements of NRC Regulatory Guide 1.99, Revision 2, " Radiation Embrittlement of Reactor Vessel Materials."

The St. Lucie Units 1 and 2 reactor vessel materials irradiation surveillance program is described in Unit 1 UFSAR Section 5.4.4, and Unit 2 UFSAR Section 5.3.1.6. Irradiation surveillance programs are utilized on both Units to assess the irradiation-induced changes in the strength and toughness properties of the reactor vessel beltline materials and to determine if the requirements of 10 CFR 50, Appendices G and H, are met. Changes in the reactor vessel material properties are evaluated by comparing pre- and post-irradiation specimens. Revisions to the capsule surveillance schedules for Units 1 and 2, consistent with 10 CFR 50, Appendix H, will be required for the period of extended operation. These changes are discussed in Subsection 3.2.12.1 of Appendix B.

Irradiation surveillance capsules attached to the inner reactor vessel walls contain specimens representative of the limiting vessel beltline materials under conditions that represent the approximate irradiation conditions of the reactor vessel. The capsules also contain neutron dosimetry for monitoring the time-integrated neutron fluence. Presently, reactor vessel toughness, as measured by the Adjusted Reference Temperature (ART), is predicted by the methods in NRC Regulatory Guide 1.99, Revision 2.

4.2.1 UPPER-SHELF ENERGY

The requirements on reactor vessel Charpy upper-shelf energy (USE) are included in 10 CFR 50, Appendix G. Specifically, 10 CFR 50, Appendix G, requires licensees to submit an analysis at least 3 years prior to the time that the USE of any of the reactor vessel material is predicted to drop below 50 ft-lbs, as measured by Charpy V-notch specimen testing. The lower USE concern is associated with the determination of acceptable reactor vessel toughness during the license renewal period when the vessel is exposed to additional irradiation.

Only the intermediate- and lower-shell plates and connecting welds (beltline materials) need to be evaluated for embrittlement since the fluence drops off rapidly with distance from the core midplane.

The USE values of the vessel beltline materials presented in Tables 4.2-1 and 4.2-2 demonstrate that St. Lucie Units 1 and 2 reactor vessel beltline materials remain acceptably above the 10 CFR 50, Appendix G, USE limit of 50 ft-lbs.

The analyses associated with USE have been projected to the end of the period of extended operation, in accordance with the requirements of 10 CFR 54.21(c)(1)(ii).

4.2.2 PRESSURIZED THERMAL SHOCK

The requirements in 10 CFR 50.61 provide rules for protection against PTS events for PWRs. Licensees are required to perform an assessment of the projected values of the maximum nil ductility reference temperature (RT_{PTS}) whenever a significant change occurs in projected values of RT_{PTS} or upon request for a change in the expiration date for the operation of the facility.

The methods for calculating RT_{PTS} values are given in 10 CFR 50.61 and are consistent with the methods in Regulatory Guide 1.99, Revision 2, " Radiation Embrittlement of Reactor Vessel Materials." These accepted methods were used to calculate the RT_{PTS} for the St. Lucie Units 1 and 2 reactor vessel limiting materials at the end of the 60 year period of operation using a conservatively bounding fluence. Only the intermediate- and lower-shell plates and connecting welds (beltline materials) need to be evaluated for embrittlement since the fluence drops off rapidly with distance from the core midplane. The calculated RT_{PTS} values for the St. Lucie reactor vessels at the end of the period of extended operation are presented in Tables 4.2-3 and 4.2-4.

The calculated RT_{PTS} values at the 60-year EOL for the St. Lucie Units 1 and 2 reactor vessels are less than the 10 CFR 50.61(b)(2) screening criteria of 270°F for the intermediate and lower shells and 300°F for the circumferential welds. Based upon the revised calculations, additional measures will not be required for the St. Lucie reactor vessels during the license renewal period.

The analyses associated with PTS have been projected to the end of the period of extended operation, in accordance with the requirements of 10 CFR 54.21(c)(1)(ii).

4.2.3 PRESSURE-TEMPERATURE LIMITS

The requirements in 10 CFR 50, Appendix G, stipulate that heatup and cooldown of the reactor vessels be accomplished within established pressure-temperature limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor vessels become embrittled and their fracture toughness is reduced, the allowable pressure is reduced. Therefore, in order to heatup and cooldown, the reactor coolant temperature and pressure must be maintained within the limits of Appendix G defined by the reactor vessel fluence.

The fluence and material properties were used to determine the limiting material and calculate the current pressure-temperature limits for St. Lucie Units 1 and 2 at 23.6 EFPY and 21.7 EFPY, respectively. The resulting heatup and cooldown pressure-temperature limits are presented in the Units 1 and 2 Technical Specifications. The pressure-temperature limits for St. Lucie Units 1 and 2 will be updated to bound the operating periods as the operating schedules require. In addition, the low temperature overpressure protection system and overpressure mitigation system requirements will be updated to ensure that the pressure-temperature limits are not exceeded for postulated plant transients.

In accordance with NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" [Reference 4.2-1], Section 4.2.2.1.3.3 updated pressure-temperature limits for the period of extended operation must be available prior to entering the period of extended operation. It is not necessary to implement pressure-temperature limits to carry the reactor vessels through 60 years at the time of application.

The analyses associated with reactor vessel pressure-temperature limits for St. Lucie Units 1 and 2 will be available prior to entering the period of extended operation, in accordance with the requirements of the Reactor Vessel Integrity Program and consistent with 10 CFR 54.21(c)(1)(ii).

4.2.4 REFERENCES

4.2-1 NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," U. S. Nuclear Regulatory Commission, April 2001.

TABLE 4.2-1
ST. LUCIE UNIT 1 - 60-YEAR EOL USE VALUES FOR THE BELTLINE MATERIALS
(USE Method: Reg. Guide 1.99, Rev. 2, Position 1.2, Graph)

Location	Weight % of Cu	Transverse Initial USE (ft-lbs)	EOL 1/4T Fluence ($x10^{19}$ n/cm^2)	Projected % USE Decrease	EOL 1/4T USE (ft-lbs)
Lower shell plate (C-8-1)	0.15	82	2.79	31	56.5
Lower shell plate (C-8-2)	0.15	103	2.79	31	71.1
Lower shell plate (C-8-3)	0.12	88	2.79	27	64.5
Intermediate shell plate (C-7-1)	0.11	82	2.79	26	60.6
Intermediate shell plate (C-7-2)	0.11	82	2.79	26	60.6
Intermediate shell plate (C-7-3)	0.11	76	2.79	26	56.3
Lower shell axial welds (3-203A,B,C)	0.27	112	1.84	47	59.4
Intermediate shell axial welds (2-203A,B,C)	0.19	102	1.84	38	63.4
Intermediate to lower girth welds (9-203)	0.27	144	2.79	49	73.4

TABLE 4.2-2
ST. LUCIE UNIT 2 - 60-YEAR EOL USE VALUES FOR THE BELTLINE MATERIALS
(USE Method: Reg. Guide 1.99, Rev. 2, Position 1.2, Graph)

Location	Weight % of Cu	Transverse Initial USE (ft-lbs)	EOL 1/4T Fluence ($x10^{19}$ n/cm^2)	Projected % USE Decrease	EOL 1/4T USE (ft-lbs)
Lower shell plate (M-4116-1)	0.06	91	2.91	24	69.2
Lower shell plate (M-4116-2)	0.07	105	2.91	24	79.8
Lower shell plate (M-4116-3)	0.07	100	2.91	24	76.0
Intermediate shell plate (M-605-1)	0.11	105	2.91	26	77.7
Intermediate shell plate (M-605-2)	0.13	113	2.91	28	81.4
Intermediate shell plate (M-605-3)	0.11	113	2.91	26	83.6
Intermediate shell axial welds (101-124A,B,C)	0.05	116	2.91	24	88.2
Intermediate shell axial welds (101-124C Repair)	0.05	136	2.91	24	103.4
Lower shell axial welds (101-142A,B,C)	0.05	136	2.91	24	103.4
Intermediate to lower girth welds (101-171)	0.07	96	2.91	27	70.1
Intermediate to lower girth welds (101-171)	0.05	115	2.91	24	87.4
Intermediate to lower girth welds (101-171)	0.07	96	2.91	27	70.1

TABLE 4.2-3
ST. LUCIE UNIT 1 - 60 YEAR EOL RT_{PTS} VALUES FOR THE BELTLINE MATERIALS

Location	Chemistry Factor	Initial RT_{NDT} (°F)	Margin	EOL Peak Fleunce ($x10^{19}$ n/cm^2)	Fluence Factor	Delta RT_{PTS} (°F)	EOL RT_{PTS} (°F)
Lower shell plate (C-8-1)	78.3 (Note 1)	20	17	4.68	1.39	109	146
Lower shell plate (C-8-2)	78.7 (Note 1)	20	17	4.68	1.39	109	146
Lower shell plate (C-8-3)	60.0 (Note 1)	0	17	4.68	1.39	83	100
Intermediate shell plate (C-7-1)	74.6	0	34	4.68	1.39	104	138
Intermediate shell plate (C-7-2)	74.6	-10	34	4.68	1.39	104	128
Intermediate shell plate (C-7-3)	73.8	10	34	4.68	1.39	103	147
Lower shell axial welds (3-203A,B,C)	188.8	-60	56	3.08	1.30	245	241
Intermediate shell axial welds (2-203A,B,C)	90.7	-56	65	3.08	1.30	118	127
Intermediate to lower girth weld (9-203)	69.9 (Note 1)	-60	28	4.68	1.39	97	65

NOTES: 1. Calculated chemistry factors used for these locations, other locations utilize chemistry factors from 10 CFR 50.61 tables.

TABLE 4.2-4
ST. LUCIE UNIT 2 - 60 YEAR EOL RT_{PTS} VALUES FOR THE BELTLINE MATERIALS

Location	Chemistry Factor (Note 1)	Initial RT_{NDT} (°F)	Margin	EOL Peak Fluence ($x10^{19}$ n/cm^2)	Fluence Factor	Delta RT_{PTS} (°F)	EOL RT_{PTS} (°F)
Lower shell plate (M-4116-1)	37.0	20	34	4.89	1.40	52	106
Lower shell plate (M-4116-2)	44.0	20	34	4.89	1.40	62	116
Lower shell plate (M-4116-3)	44.0	20	34	4.89	1.40	62	116
Intermediate shell plate (M-605-1)	74.2	30	34	4.89	1.40	104	168
Intermediate shell plate (M-605-2)	91.5	10	34	4.89	1.40	128	172
Intermediate shell plate (M-605-3)	74.2	0	34	4.89	1.40	104	138
Intermediate shell axial welds (101-124A,B,C)	36.4	-56 (Note 2)	51	4.89	1.40	51	46
Intermediate shell axial welds (101-124C Repair)	34.1	-50	48	4.89	1.40	48	45
Lower shell axial welds (101-142A,B,C)	34.1	-50	48	4.89	1.40	48	45
Intermediate to lower girth welds (101-171)	40.1	-50 (Note 3)	56	4.89	1.40	56	62

NOTES:
1. Chemistry factors from 10 CFR 50.61 tables.
2. Generic RT_{NDT} value.
3. The RT_{NDT} of –50°F represents the highest value from surveillance weld data.

4.3 METAL FATIGUE

The thermal and mechanical fatigue analyses of plant mechanical components have been identified as TLAAs for St. Lucie Units 1 and 2. Specific components have been designed considering transient cycle assumptions, as listed in vendor specifications and the St. Lucie Units 1 and 2 UFSARs.

4.3.1 ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, CLASS 1 COMPONENTS

The reactor vessels (including control element drive mechanisms), reactor vessel internals, pressurizers, steam generators, reactor coolant pumps, and Unit 2 reactor coolant piping have been designed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III. The St. Lucie Unit 1 reactor coolant piping was originally designed in accordance with ANSI B 31.7, "Nuclear Power Piping." The St. Lucie Units 1 and 2 pressurizer surge lines were reanalyzed in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section III in response to NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification." These design codes require a design analysis to address fatigue and establish limits such that initiation of fatigue cracks is precluded.

St. Lucie Unit 1 reactor vessel internals fatigue is addressed in Subsection 4.6.3.

Fatigue usage factors for critical locations in the St. Lucie Units 1 and 2 Nuclear Steam Supply System Class 1 components were determined using design cycles that were specified in the plant design process or as a result of industry fatigue issues (e.g., thermal stratification). These design cycles were intended to be conservative and bounding for all foreseeable plant operational conditions. The design cycles were subsequently utilized in the design stress reports for the Class 1 components satisfying ASME fatigue usage design requirements.

Experience has shown that actual plant operation is often very conservatively represented by these design cycles. The use of actual operating history data allows the quantification of these conservatisms in the existing fatigue analyses. To demonstrate that the Class 1 component fatigue analyses remain valid for the period of extended operation, the design cycles applicable to the Class 1 components were assembled.

The actual frequency of occurrence for the fatigue-sensitive design cycles was determined and compared to the design cycle set. The severity of the actual plant cycles was also compared to the severity of the design cycles. This comparison was performed in order to demonstrate that on an event-by-event basis the design cycle profiles envelope actual plant operation. In addition, a review of the applicable administrative and operating procedures was performed to verify the effectiveness of the Fatigue Monitoring Program. The reviews described above concluded that the existing design cycles and cycle frequencies are conservative and bounding for the period of extended operation.

The analyses associated with verifying the structural integrity of the Class 1 components have been evaluated and determined to remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

For license renewal, continuation of the Fatigue Monitoring Program into the period of extended operation will assure that the design cycle limits are not exceeded. If 80% of a design cycle limit is reached, this program will require plant management review to determine appropriate actions. The Fatigue Monitoring Program is considered a confirmatory program.

Flaws in Class 1 components that exceed the size of allowable flaws defined in Subsection IWB-3500 of the ASME Code need not be repaired if they are analytically evaluated to the criteria in Subsection IWB-3600. Currently the only identified flaws in Class 1 components that exceed the allowable flaw limits defined in Subsection IWB-3500 are specific Alloy 600 instrument nozzles. These instrument nozzles are described in Subsection 4.6.4.

4.3.2 ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, CLASS 2 AND 3, AND ANSI B31.1 COMPONENTS

St. Lucie Units 1 and 2 have a number of piping systems within the scope of license renewal that were designed to the requirements of the ASME Boiler and Pressure Vessel Code, Section III, ANSI B31.7, "Nuclear Power Piping," or ANSI B31.1, "Power Piping." Subsequently, St. Lucie piping systems originally designed to the requirements of ANSI B31.7, Class 2 and 3 were reconciled to ASME Section III, Class 2 and 3. Piping systems designed to these requirements include a stress range reduction factor to provide conservatism in the design to account for cyclic conditions due to plant operation. The stress range reduction factor is 1.0 as long as the location does not exceed 7000 full temperature thermal cycles during its operation. This represents a condition where a piping system would have to be cycled approximately once every 3 days over the extended plant life of 60 years.

A review of ASME Section III, Class 2 and 3, and ANSI B31.1 piping within the scope of license renewal was undertaken in order to establish the cyclic operating practices of those systems that operate at elevated temperatures. Based on the guidance from EPRI [Reference 4.3-1] and industry working groups, any piping system with operating temperature less than 220°F (carbon steel) or 270°F (stainless steel) may be conservatively excluded from further consideration of thermal fatigue.

Under current plant operating practices, piping systems within the scope of license renewal are generally only occasionally subjected to cyclic operation. Typically these systems are subjected to continuous steady-state operation and operating temperatures vary only during plant heatup and cooldown, during plant transients, or for periodic testing. The results of the calculations determined that, except for the Reactor Coolant System hot leg sample piping on each Unit, components will not exceed 7000 equivalent full temperature thermal cycles during the period of extended operation. Therefore, the current piping analyses remain valid for the period of extended operation.

The Reactor Coolant System hot leg sample lines on each Unit could exceed the 7000 equivalent full temperature thermal cycles during the period of extended operation based on St. Lucie's current sampling practices. The sample piping and tubing were re-evaluated to consider the projected number of cycles and the analyses were found acceptable for the period of extended operation.

Therefore, except for the Reactor Coolant System hot leg sample lines, the ASME Section III, Class 2 and 3 and ANSI B31.1 piping fatigue analyses within the scope of license renewal remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i). The Reactor Coolant System hot leg sample lines fatigue analyses have been projected to the end of the period of extended operation in accordance with 10CFR54.21(c)(1)(ii).

4.3.3 ENVIRONMENTALLY ASSISTED FATIGUE

Generic Safety Issue (GSI) 190 [Reference 4.3-2] was initiated by the NRC staff because of concerns about the potential effects of reactor water environments on Reactor Coolant System component fatigue life during the period of extended operation. GSI-190 was closed in December 1999 [Reference 4.3-3], and the NRC concluded that environmental effects have a negligible impact on core damage frequency, and as such, no generic regulatory action is required. However, as part of the closure of GSI-190, the NRC concluded that licensees who apply for license renewal should address the effects of coolant environment on component fatigue life as part of their aging management programs [Reference 4.3-4].

Fatigue calculations that include consideration of environmental effects to establish cumulative usage factors could be treated as TLAAs under 10 CFR 54 or they could be utilized to establish the need for an aging management program. In other words, the determination of whether a particular component location is to be included in a program for managing the effects of fatigue, and the characteristics of that program, should incorporate reactor water environmental effects.

An analysis must satisfy all six criteria defined in 10 CFR 54.3 to qualify as a TLAA. Failure to satisfy any one of these criteria eliminates the analysis from further consideration as a TLAA. Fatigue design analysis for St. Lucie Units 1 and 2 has been determined to be a TLAA, even though the design limits are based on cycles rather than an explicit time period. However, reactor water environmental effects, as described in GSI-190, are not included in the St. Lucie Units 1 and 2 CLBs, such that the criterion specified in 10 CFR 54.3(a)(6) is not satisfied. Nevertheless, environmental effects on Class 1 component fatigue have been evaluated separately for St. Lucie to determine if any additional actions are required for the period of extended operation.

The FPL approach to address reactor water environmental effects at St. Lucie Units 1 and 2 accomplishes two objectives, as illustrated in Figure 4.3-1. First, the TLAA on fatigue design has been resolved by confirming that the original design cycles remain valid for the 60-year operating period (see Subsection 4.3.1 on Class 1 metal fatigue). Confirmation by the Fatigue Monitoring Program will ensure these design cycles are not exceeded. Second, reactor water environmental effects on fatigue life are examined using the most recent data from laboratory simulation of the reactor coolant environment. These two aspects of fatigue design are kept separate, since fatigue design is part of the St. Lucie Units 1 and 2 CLBs and a TLAA, while the consideration of reactor water environmental effects on fatigue life, as described in GSI-190, is not considered part of the St. Lucie Units 1 and 2 CLBs.

Three areas of margin included in the St. Lucie Fatigue Monitoring Program are margins resulting from actual cycle experience, cycle severity, and moderate environmental effects.

<u>Margin Due to Actual Cycles</u>: As discussed in Subsection 4.3.1, the original 40-year design cycle set for Class 1 components is valid for the 60-year extended operating period. Conservative projections conclude that the design cycle limits will not be exceeded. Additional margin is available in the current Class 1 component fatigue analyses since the cumulative fatigue usage factors (CUFs) for all Class 1 components remain below the acceptance criterion of 1.0.

Margin Due to Cycle Severity: Much of the conservatism in the fatigue analysis methodology is due to design cycle definitions. As discussed in Subsection 4.3.1, the severity of the original St. Lucie design cycles bound actual plant operation. Additional industry fatigue studies [References 4.3-5 through 4.3-8] conclude that the fatigue impact of conservative design basis cycle definitions by themselves overwhelms the contributing impact of reactor water environmental effects.

Margin Due to Moderate Environmental Effects: A portion of the safety factors applied to the ASME Section III fatigue design curves includes moderate environmental effects. While there is debate over exactly the amount of margin this represents, it is noteworthy to recognize this safety factor in this qualitative discussion of margin.

Considering the three margins above, the St. Lucie Fatigue Monitoring Program is conservative from an overall perspective. Nevertheless, specific assessments of potential environmental effects have been addressed.

Idaho National Engineering Laboratories (INEL) evaluated, in NUREG/CR-6260 [Reference 4.3-9], fatigue-sensitive component locations at plants designed by all four U. S. nuclear steam supply system (NSSS) vendors, as a part of the industry effort to address environmental effects for operating nuclear power plants during the current 40-year licensing term. The PWR calculations included in NUREG/CR-6260, especially the "Older Vintage Combustion Engineering Plant," closely match St. Lucie with respect to the design codes used. Additionally, the evaluated design cycles considered in the evaluation match or bound the St. Lucie designs.

The fatigue-sensitive component locations chosen in NUREG/CR-6260 for the "Older Vintage Combustion Engineering Plant" were:

1. Reactor vessel shell and lower head
2. Reactor vessel inlet nozzle
3. Reactor vessel outlet nozzle
4. Surge line
5. Charging system nozzle
6. Safety injection system nozzle
7. Shutdown cooling system Class 1 piping

NUREG/CR-6260 calculated fatigue usage factors for these locations utilizing the interim fatigue curves provided in NUREG/CR-5999 [Reference 4.3-10]. However, because the fatigue usage factors evaluated in NUREG/CR-6260 were based on a plant different than St. Lucie, plant-specific usage factor evaluations were performed for St. Lucie. In addition, the data included in more recent industry studies [References 4.3-11 and 4.3-12] need to be considered in the evaluations of environmental effects.

Environmental fatigue calculations have been performed for St. Lucie Units 1 and 2 for those component locations included in NUREG/CR-6260 using the appropriate methods contained in NUREG/CR-6583 [Reference 4.3-11] for carbon/low alloy steel material or NUREG/CR-5704 [Reference 4.3-12] for stainless steel material, as appropriate. Based on these results, all component locations were determined to be acceptable for the period of extended operation, with the exception of the pressurizer surge lines (specifically the surge line elbows below the pressurizers). The pressurizer surge line elbows require further evaluation for the period of extended operation.

FPL has selected aging management to address pressurizer surge line fatigue at St. Lucie Units 1 and 2 during the period of extended operation, in lieu of performing additional analyses to refine the fatigue usage factors. In particular, the potential for crack initiation and growth, including reactor water environmental effects, will be adequately managed during the extended period of operation by the continued performance of the St. Lucie ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program. Additionally, specific requirements will be included to evaluate pressurizer surge line flaws (if identified) with regard to environmentally assisted fatigue (see Appendix B, Subsection 3.2.2.1).

The St. Lucie Units 1 and 2 surge lines are 12-inch schedule 160 lines connected to the pressurizer surge nozzles and to the hot leg surge nozzles. The surge lines contain nine welds. A sample of these surge line welds is currently examined every ten years in accordance with the requirements of ASME Section XI, Subsection IWB. Surge line welds selected for the inservice examinations, by nature of their size, require a volumetric examination in addition to a surface examination. A number of the surge line welds have been examined ultrasonically during inservice examination intervals at St. Lucie. A total of 14 Unit 1 pressurizer surge line weld examinations and 17 Unit 2 pressurizer surge line weld examinations have been performed ultrasonically to date as part of the current ASME Section XI program, including a total of seven inspections on the pressurizer surge line elbow welds (three on Unit 1 and four on Unit 2). No indications were identified.

The limiting pressurizer surge line welds will continue to be inspected during the third and fourth inservice inspection intervals and prior to the license renewal period. The results of those inspections will be utilized to assess continuation of the current ten-year inspection interval for continued use throughout the remaining operating period. Any proposed changes to the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program due to risk-informed inservice inspection would continue to include the limiting pressurizer surge line elbow welds in the inservice inspection scope.

The proposed aging management program to address fatigue of the St. Lucie Units 1 and 2 pressurizer surge lines during the period of extended operation is similar to the approach documented in the ASME Section XI - Rules for Inservice Inspection of Nuclear Power Plant Components, Non-mandatory Appendix L. However, FPL recognizes that, to date, the NRC has not endorsed the Appendix L approach. The primary NRC concerns with Appendix L include crack aspect ratio and acceptable fatigue crack growth rates (including environmental effects).

As noted above, several pressurizer surge line welds on Unit 1 and 2 have been ultrasonically examined. No reportable indications have been identified. In addition, FPL plans to inspect the limiting surge line welds on St. Lucie Units 1 and 2 during the third and fourth inservice inspection interval, and prior to entering the extended period of operation. The results of these inspections will be utilized to assess the appropriate approach for addressing environmentally assisted fatigue of the surge lines. The approach developed could include one or more of the following:

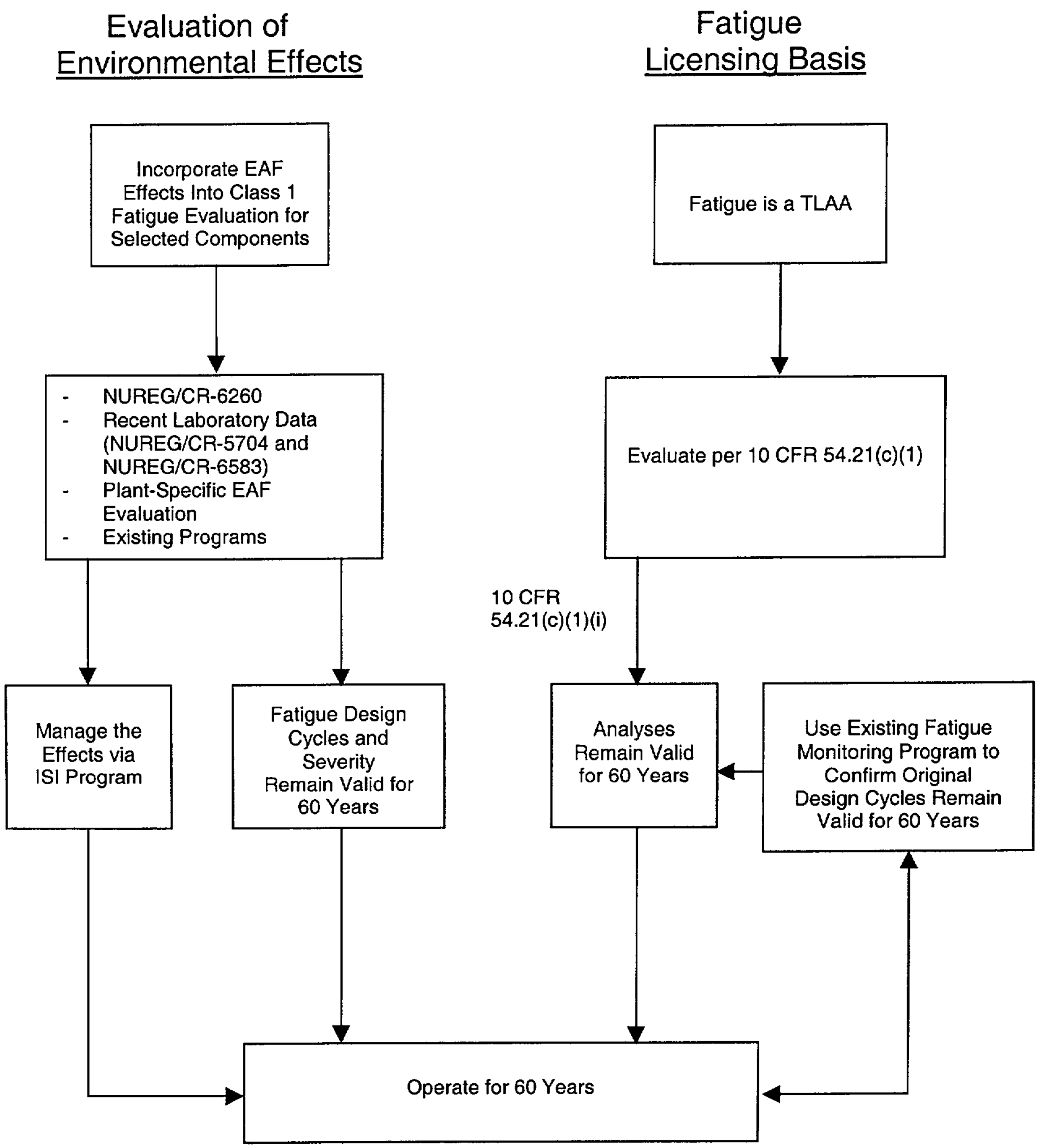
1. Further refinement of the fatigue analyses to lower the CUF(s) to below 1.0, or
2. Repair of the affected locations, or
3. Replacement of the affected locations, or
4. Management of the effects of fatigue by an inspection program that has been reviewed and approved by the NRC (e.g., periodic non-destructive examination of the affected locations at inspection intervals to be determined by a method accepted by the NRC).

Should FPL select Option 4 (i.e., inspection) to manage environmentally assisted fatigue during the period of extended operation at St. Lucie Units 1 and 2, inspection details such as scope, qualification, method, and frequency will be provided to the NRC prior to entering the period of extended operation.

The recommended FPL position to address the effects of environmentally assisted fatigue at St. Lucie Units 1 and 2 meets the requirements specified in the NRC closure of GSI-190. The position takes a proactive approach by performing volumetric and surface examinations of the most fatigue-sensitive locations, the pressurizer surge line elbow welds, during both the current period of operation and the license renewal period of extended operation. The commitment to inspect the fatigue-sensitive surge line locations in accordance with the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides reasonable assurance that potential environmental effects of fatigue will be managed such that components within the scope of license renewal will continue to perform their intended functions consistent with the St. Lucie Units 1 and 2 CLBs for the period of extended operation.

FIGURE 4.3-1

GSI-190 EVALUATION PROCESS



4.3.4 REFERENCES

4.3-1 EPRI Report No. TR-104534, "Fatigue Management Handbook", Volumes 1, 2 and 3, Research Project 3321, Revision 1, Electric Power Research Institute, December 1994.

4.3-2 Generic Safety Issue 190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life," U. S. Nuclear Regulatory Commission.

4.3-3 Thadani, A. C. (NRC) memorandum to Travers, W. D. (NRC), "Closeout of Generic Safety Issue 190, Fatigue Evaluation of Metal Components for 60 Year Plant Life," U. S. Nuclear Regulatory Commission, December 26, 1999.

4.3-4 Powers, D. A. (ACRS) letter to Travers, W. D. (NRC), "Proposed Resolution of Generic Safety Issue-190, Fatigue Evaluation of Metal Components for 60-Year Plant Life," December 10, 1999.

4.3-5 EPRI Report No. TR-107515, "Evaluation of Thermal Fatigue Effects on Systems Requiring Aging Management Review for License Renewal for the Calvert Cliffs Nuclear Power Plant," Electric Power Research Institute, January 1998.

4.3-6 EPRI Report No. TR-110043, "Evaluation of Environmental Fatigue Effects for a Westinghouse Nuclear Power Plant," Electric Power Research Institute, April 1998.

4.3-7 EPRI Report No. TR-110356, "Evaluation of Environmental Thermal Fatigue Effects on Selected Components in a Boiling Water Reactor Plant," Electric Power Research Institute, April 1998.

4.3-8 EPRI Report No. TR-107943, "Environmental Fatigue Evaluations of Representative BWR Components," Electric Power Research Institute, May 1998.

4.3-9 NUREG/CR-6260 (INEL-95/0045), "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," U. S. Nuclear Regulatory Commission, March 1995.

4.3-10 NUREG/CR-5999 (ANL-93/3), "Interim Fatigue Design Curves for Carbon, Low-Alloy, and Austenitic Stainless Steels in LWR Environments," U. S. Nuclear Regulatory Commission, August 1993.

4.3-11 NUREG/CR-6583 (ANL-97/18), "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," U. S. Nuclear Regulatory Commission, March 1998.

4.3-12 NUREG/CR-5704 (ANL-98/31), "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels," U. S. Nuclear Regulatory Commission, April 1999.

4.4 ENVIRONMENTAL QUALIFICATION OF ELECTRIC EQUIPMENT

The thermal, radiation, and wear cycle aging analyses of plant electrical/I&C components required to meet 10 CFR 50.49 have been identified as TLAAs for St. Lucie Units 1 and 2.

The NRC has established nuclear station EQ requirements in 10 CFR 50, Appendix A, and in 10 CFR 50.49. The requirements in 10 CFR 50.49 specify that an EQ program be established to demonstrate that certain electrical/I&C components located in "harsh" plant environments (i.e., those areas of the plant that could be subject to the harsh environment effects of a LOCA, high energy line break, or post LOCA radiation) are qualified to perform their safety function in those harsh environments after the effects of inservice aging. Further, 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of EQ.

All operating plants must meet the requirements of 10 CFR 50.49 for certain electrical/I&C components important to safety. The scope of components to be included is defined in 10 CFR 50.49, which also requires the preparation and maintenance of a list of in-scope components, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics, and environmental conditions. The requirements in 10 CFR 50.49(e)(5) contain provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e) also requires component replacement or refurbishment prior to the end of designated life unless additional life is established through ongoing qualification. 10 CFR 50.49(f) establishes four methods of demonstrating qualification for aging and accident conditions. The requirements in 10 CFR 50.49 (k) and (l) permit different criteria to apply based on plant and component vintage. Supplemental EQ regulatory guidance for compliance with these different qualification criteria is provided in the DOR Guidelines, "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors" [Reference 4.4-1], NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment," and Regulatory Guide 1.89, "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants," Revision 1. Compliance with 10 CFR 50.49 provides evidence that the component will perform its intended functions during accident conditions after experiencing the effects of inservice aging.

The St. Lucie Environmental Qualification Program complies with all applicable regulations and is consistent with the GALL Report [Reference 4.4-2]. However, FPL does not consider the St. Lucie Environmental Qualification Program to be an aging management program, but credits the program as part of the screening process for ensuring the qualified life of electrical/I&C components within the scope of 10 CFR 50.49 is maintained. The St. Lucie Environmental Qualification Program includes three main elements: identifying applicable components and environmental requirements, establishing the qualification, and maintaining (or preserving) that qualification.

The first element involves establishment and control of the Environmental Qualification List of components and the service conditions for the harsh environment plant areas. The second element involves establishment and control of the components' EQ documentation, including vendor test reports, vendor correspondence, calculations, evaluations of component tested conditions to plant required conditions, and determinations of configuration and maintenance requirements. The third element includes preventive maintenance processes (for replacing parts and components at specified intervals), design control processes (ensuring changes to the plant are evaluated for impact to the Environmental Qualification Program), procurement processes (ensuring new and replacement components are purchased to applicable EQ requirements), and corrective action processes in accordance with the FPL Quality Assurance Program. As part of the design control aspect of the Environmental Qualification Program, any plant modification that could affect the qualification of a component in the program is addressed and resolved in the modification package. Similarly for events, the effect on the qualification is addressed and resolved by the corrective action process. These controls assure any environmental changes occurring due to plant modifications and events are properly dispositioned for the remainder of the current license and throughout the renewal period.

There have not been any major plant modifications or events at St. Lucie Units 1 and 2 of sufficient duration to change the normal temperature and radiation values that were used in the underlying assumptions in the EQ calculations due to the conservative profile of the temperature and radiation values used. In 1994 and 2000, FPL increased the EQ design basis accident temperature profile for Unit 1 in response to Loss of Coolant and Main Steam Line Break reanalyses that increased the required temperature profile. The EQ components inside Containment were then shown to meet the new profile

For radiation values, the postulated normal operating dose rates are based on the assumption of 1% failed fuel and the postulated accident doses are based on the conservative assumptions and methodologies in NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-term Recommendations," NUREG-0737, "Clarification of TMI Action Plan Requirements," and NUREG-0588.

The guidance in10 CFR 50.49 requires EQ components to be refurbished, replaced, or have their qualification extended prior to reaching their aging limits as established in the St. Lucie Environmental Qualification Program aging evaluations. Therefore, although the preferred method is to demonstrate that there is enough conservatism in the EQ analyses to absorb environmental changes occurring due to plant modifications and events, there are other options available (e.g., replacement). The St. Lucie Environmental Qualification Program will be maintained through the period of extended operation.

The temperature and radiation values used for service conditions in the EQ analyses are the maximum operating values for St. Lucie. With regard to radiation, EQ is based on area radiation dose rate values for continuous operation with 1% failed fuel. This is conservative because St. Lucie Units 1 and 2 have never operated with more than 0.1% fuel clad leaks, and have had a number of fuel cycles with no fuel clad leaks.

Containment area radiation levels are monitored continuously by eight (four per Unit) radiation monitors located in various locations throughout each Containment (note that these monitors are in addition to the safety-related high range radiation, particulate, and gas monitors). The Unit 1 UFSAR Chapter 12.1.4, and Unit 2 UFSAR Chapter 12.3.4, describe the Area Radiation Monitoring Systems. High radiation activity in any of these monitored locations is indicated, recorded and alarmed in the appropriate control room. To ensure that monitored radiation levels are bounding for the service environment for EQ components, the high alarm setpoint of the monitors is much less than the values used for normal containment dose rates in EQ calculations.

For the balance of the plant, the Area Radiation Monitoring Systems have 26 monitors on Unit 1 and 33 monitors on Unit 2, located throughout the Auxiliary and Fuel Handling Buildings, that are indicated, recorded, and alarmed in the appropriate control room. In addition, the Health Physics radiation monitoring program surveys areas outside the Containments at least monthly, and in some cases daily or weekly. This combined with the dose calculation assumption of 1% failed fuel (St. Lucie Units 1 and 2 have never had more than 0.1% failed fuel), and the fact that accident doses are typically 10 to 100 times greater than normal operating doses, assures that any changes in the normal dose will be identified long before a component exceeds its qualified dose.

St. Lucie Units 1 and 2 are required by 3.6.1.5 of their respective Technical Specifications to assure that the average air temperature inside the Containments does not exceed 120°F. This is accomplished by recording the average of three of the four containment fan cooler inlet temperature detectors for Unit 1 and the two containment air temperature detectors for Unit 2 daily. Per the plant operating procedures, the recorded average temperature is required to be less than or equal to 115°F. It should be noted that the average of three of the four containment fan cooler inlet temperature detectors may be used for Unit 2 if one of the containment air temperature detectors is out of service. Containment air temperature detectors are also installed on Unit 1 and are used for monitoring temperature in response to a containment pressure pre-trip alarm.

The detectors associated with the containment fan coolers for Unit 1 are located on the 45- and 62-foot elevations in Containment. The Unit 2 detectors are located at the 70-foot elevation. Thus the Unit 1 detectors are at the same level as the EQ components inside Containment. Since the aging calculations for Unit 1 assume a continuous temperature of 120°F, take into account self-heating, and do not credit seasonal and shutdown temperature reductions, significant margin exists to ensure that the qualified life of the EQ components inside containment is not exceeded. The Unit 2 detectors are higher than the EQ components inside Containment. This, in combination with the items mentioned for Unit 1, permits a continuous temperature of 115°F to be used for the Unit 2 in-Containment EQ component aging calculations and still assures that the qualified life of a component will not be exceeded.

Outside the Containments, the qualified life calculations are based on a continuous maximum temperature of 104°F. The only defined harsh temperature areas in the Environmental Qualification Program outside of the Containments are located in outdoor areas (i.e., Main Steam Trestles). Components on the Environmental Qualification List that are located in the Auxiliary Buildings are only required to be qualified for harsh radiation environments. Per Unit 1 UFSAR Table 2.3-10 and Unit 2 UFSAR Tables 2.3-37 and 2.3-38, the annual mean temperature for the site is between 72.5°F and 75°F. This 29°F difference in temperature indicates that the qualified life based on actual average temperature is more than double the life used by the St Lucie EQ analyses. This, combined with feedback through FPL's Corrective Action Program from operator walkdowns as part of their daily rounds, and maintenance and system engineering personnel assures that changes in the plant environment or unexpected degradation of an EQ component is identified prior to the component exceeding its qualified life. Components included in the St. Lucie Environmental Qualification Program have been evaluated to determine if existing EQ aging analyses remain valid for the period of extended operation. Qualification for the license renewal period will be treated the same as for components currently included in the Environmental Qualification Program.

The St. Lucie Environmental Qualification Program manages component thermal, radiation, and wear cycle aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components must be refurbished, replaced, or their qualification extended prior to reaching the aging limits established in the evaluation. Aging evaluations for EQ components that specify a qualification of at least 40 years are considered TLAAs for license renewal.

4.4.1 ELECTRICAL AND I&C COMPONENT ENVIRONMENTAL QUALIFICATION ANALYSES

Age-related service conditions that are applicable to EQ components (i.e., 60 years of exposure versus 40 years) were evaluated for the period of extended operation to verify that the current EQ analyses were bounding. Temperature and radiation values assumed for service conditions in the EQ analyses are the maximum required operating values for St. Lucie Units 1 and 2. The following paragraphs describe the thermal, radiation, and wear cycle aging effects that were evaluated.

THERMAL CONSIDERATIONS - The component qualification temperatures were calculated for 60 years using the Arrhenius method, as described in EPRI NP-1558, "A Review of Equipment Aging Theory and Technology" [Reference 4.4-3]. The St. Lucie Units 1 and 2 Technical Specifications temperature limit for inside each Containment is 120°F. By plant procedure, the temperature is limited to 115°F on both Units. Normally the 120°F temperature is used for the in-Containment aging calculations, however, the plant procedures limit of 115°F is used for some components in Unit 2. For areas outside Containment the aging calculations are based on a temperature of 104°F.

For conservatism, a temperature rise of 18°F was added to the maximum design operating temperature for power cables and penetrations to account for ohmic heating during normal operations. This results in maximum required operating temperatures of 138°F inside Containment and 122°F outside Containment for these power cables and penetrations. A review of EQ motor applications on both Units identified two applications that have a heat rise greater than 18°F. These two applications are the Unit 1 charging pump and Unit 1 containment fan cooler motors. In these applications the motors are normally running to support plant operation. A review of the qualification for the cables associated with the Unit 1 charging pump and Unit 1 containment fan cooler motors shows that the specific power cables are qualified for the higher temperature rise (see Subsections 4.4.1.27, 4.4.1.31, 4.4.1.32, and 4.4.1.33). If the component qualification temperature bounded its maximum required operating temperatures, then no additional evaluation was required.

In connection with plant modifications, some new EQ components that will not experience 60 years of thermal aging by the end of the license renewal period were installed at St. Lucie. In these cases, credit may be taken for less than 60 years of aging. This applies to three EQ analyses; EGS Grayboot connectors, Bisco Locaseals, and United Controls International Silicone Tape, described in Subsections 4.4.1.15, 4.4.1.25 and 4.4.1.51, respectively.

RADIATION CONSIDERATIONS - The St. Lucie Environmental Qualification Program has established bounding radiation dose qualification values for all EQ components. These bounding radiation dose values were determined by component vendors through testing. To verify that the bounding radiation values are acceptable for the period of extended operation, 60-year integrated dose values were determined and then compared to the bounding values. The total integrated dose for the 60-year period is determined by adding 60-year normal operating dose (i.e., 1.5 times the 40-year normal operating dose) to the established accident dose for the component.

The EQ component 60-year total integrated doses inside the Containments are predominately $2x10^7$ rads for Unit 1 and $1.61x10^7$ rads for Unit 2. Some components may have different total integrated doses based on the location of the component and/or the required operating time of the component during and following design basis accidents. Radiation zone maps provide the 60-year normal operating dose and the 1 day, 30 day, and 1 year design basis accident doses. The total integrated dose is determined by adding the 60-year normal dose to the appropriate accident dose (based on required post accident operating time) for the specific location of the component.

WEAR CYCLE CONSIDERATIONS - Wear cycle aging mechanically ages the electro-mechanical components to the end of their qualified lives prior to performing design basis accident testing. The EQ components at St. Lucie Units 1 and 2 where wear is a consideration are motors and solenoid valves.

EQ motors are either normally energized or in a standby mode during normal operation. Standby components are tested once a month with preventive maintenance every 18 months. This results in less than 2000 cycles for valve operators and less than 1000 cycles for other motors over a 60-year life. This is less than the 2000 cycles that Limitorque performed in their valve operator EQ testing and significantly less than the 35,000 to 50,000 cycles that a continuous duty motor is capable of withstanding. Normally energized motors would be tested even less frequently than the standby motors and most likely will be limited by their thermal qualified life before they exceed their cycle life.

Depending on the application, solenoid valves can be cycled significantly more often than motors. This is why the solenoid valve vendors, ASCO, Target Rock, and Valcor, cycled their valves from 18,000 to 50,000 times during their EQ testing. Of these three solenoid valves used in EQ applications at St. Lucie, only ASCO solenoid valves are used in high cycle applications. ASCO solenoid valves that experience a high cycle rate are classified as normally energized. As identified in the EQ evaluations, normally energized solenoid valves reach the end of their thermal qualified lives prior to 40 years. Therefore, they will be replaced periodically when they reach the end of their qualified lives. Thus, their qualification for life cycles is not considered to be a TLAA. Normally de-energized solenoid valves are operated the same as any other standby component, thereby establishing acceptability for the period of extended operation.

The values for margin identified in Section 6.3.1.5 of Institute of Electrical and Electronic Engineers (IEEE) 323-1974 were used as criteria in the St. Lucie Environmental Qualification Program. The only regular exception to the IEEE 323-1974 margins was for radiation. As identified in Item 1.4 of NUREG-0588, additional margin need not be added to the radiation parameters if the methods identified in Appendix D of NUREG-0588 are utilized. The methods used to determine the St. Lucie radiation parameters are consistent with the Appendix D methodology. Hence, the radiation margins required by Section 6.3.1.5 of IEEE 323-1974 are not necessary. Accordingly, margin is adequately addressed in the St. Lucie Environmental Qualification Program.

The following Subsections (4.4.1.1 through 4.4.1.51) provide a description for each of the EQ analyses for the period of extended operation.

4.4.1.1 ALPHA WIRE AND CABLE

Alpha wire and cable is used as Type "J" thermocouple extension wire in outside Containment applications at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Alpha wire and cable used as Type "J" thermocouple extension wire shows the cables are qualified for greater than 60 years of service at a temperature of 104°F. These cables have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Alpha wire and cable used as Type "J" thermocouple extension wire shows the cables are qualified for 6.4×10^6 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is 2.61×10^5 rads.

CONCLUSION

Alpha wire and cable used as Type "J" thermocouple extension wire is qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.2 AMERACE TERMINAL BLOCKS

The Amerace terminal blocks are located outside Containment at St. Lucie Units 1 and 2 for providing terminations between the field cables and electrical devices in the Steam Trestle Areas.

THERMAL ANALYSIS

The qualified life analysis for Amerace terminal blocks shows that the terminal blocks are qualified for greater than 60 years at a temperature of 104°F. The terminal blocks have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Amerace terminal blocks shows the terminals blocks are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these terminal blocks are $1.14x10^7$ rads for St. Lucie Unit 1, and $4.2x10^2$ rads for St. Lucie Unit 2.

CONCLUSION

Amerace terminal blocks are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.3 ANCHOR DARLING VALVE ACTUATORS

The Anchor Darling valve actuators are located in the Steam Trestle Areas outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for the Anchor Darling valve actuators shows that the actuators are qualified for greater than 60 years at a temperature of 104°F. These valve actuators have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for components of the Anchor Darling valve actuators shows the actuators are qualified for 1×10^4 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these valve actuators is 7.7×10^2 rads.

CONCLUSION

Anchor Darling valve actuators are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.4 ASCO NORMALLY DE-ENERGIZED SOLENIOD VALVES; MODELS 206-381 AND NP-8320

Normally de-energized ASCO 206-381 solenoid valves are located inside and outside Containment on Unit 2 and inside Containment only on Unit 1. No normally de-energized ASCO NP-8320 solenoid valves are currently installed; however, the ASCO NP-8320 solenoid valve has been environmentally qualified for installation both inside and outside Containment on St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for normally de-energized ASCO 206-381 and NP-8320 solenoid valves shows the solenoid valves are qualified for greater than 60 years of service at temperatures of 120°F for solenoid valves inside Containment and 104°F for solenoid valves outside Containment. These solenoid valves have maximum required operating temperatures of 120°F inside Containment and 104°F outside Containment.

RADIATION ANALYSIS

The qualified life analysis for normally de-energized ASCO 206-381 and NP-8320 solenoid valves shows the solenoid valves are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these solenoid valves are $1.12x10^6$ rads for St. Lucie Unit 1, and $2.29x10^6$ rads for St. Lucie Unit 2.

WEAR/CYCLES

The qualified life analysis for normally de-energized ASCO 206-381 and NP-8320 solenoid valves shows the solenoid valves are qualified for 40,000 cycles. The maximum projected usage for these solenoid valves is less than 1000 cycles.

CONCLUSION

ASCO 206-381 and NP-8320 solenoid valves are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.5 ASCO NORMALLY DE-ENERGIZED SOLENOID VALVES; MODELS NP-8316, NP-8321, AND NP-8344

Normally de-energized ASCO NP-8316, NP-8321, and NP-8344 solenoid valves are located in locations both inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for normally de-energized ASCO NP-8316, NP-8321, and NP-8344 solenoid valves shows the solenoid valves are qualified for greater than 60 years of service at temperatures of 120°F for solenoid valves inside Containment and 104°F for solenoid valves outside Containment. These solenoid valves have maximum required operating temperatures of 120°F inside Containment and 104°F outside Containment.

RADIATION ANALYSIS

The qualified life analysis for normally de-energized ASCO NP-8316, NP-8321, and NP-8344 solenoid valves shows the solenoid valves are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these solenoid valves are $2.22x10^6$ rads for St. Lucie Unit 1, and $1.78x10^6$ rads for St. Lucie Unit 2.

WEAR/CYCLES

The qualified life analysis for normally de-energized ASCO NP-8316, NP-8321, and NP-8344 solenoid valves shows the solenoid valves are qualified for 40,000 cycles. The maximum projected usage for these solenoid valves is less than 1000 cycles.

CONCLUSION

Normally de-energized ASCO NP-8316, NP-8321, and NP-8344 solenoid valves are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.6 BOSTON INSULATED WIRE CABLES

The Boston Insulated Wire cables are used for instrumentation circuits inside and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Boston Insulated Wire cables shows the cables are qualified for greater than 60 years of service at a temperature of 120°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Boston Insulated Wire cables used inside Containment shows the cables are qualified for $1.8x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is $4.22x10^6$ rads.

The qualified life analysis for Boston Insulated Wire cables used outside Containment shows the cables are qualified for $5x10^5$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is $1.1x10^5$ rads.

CONCLUSION

Boston Insulated Wire cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.7 CERRO (ROCKBESTOS) CABLES

The Rockbestos cables with XLPE insulation are installed in instrumentation, control, and power applications both inside and outside Containment at St. Lucie Units 1 and 2.

INSTRUMENTATION AND CONTROL CABLES

THERMAL ANALYSIS

The qualified life analysis for Rockbestos I&C cables shows the cables are qualified for greater than 60 years of service at temperatures of 147°F for St. Lucie Unit 1 and 190°F for St. Lucie Unit 2. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Rockbestos I&C cables shows the cables are qualified for $5x10^7$ rads to $2x10^8$ rads for St. Lucie Unit 1, and $2x10^8$ rads for St. Lucie Unit 2. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are $2x10^7$ rads for St. Lucie Unit 1, and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Rockbestos I&C cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10C FR 54.21(c)(1)(ii).

POWER CABLES

THERMAL ANALYSIS

The qualified life analysis for Rockbestos power cables shows the cables are qualified for greater than 60 years of service at a temperature of 190°F. These cables have a maximum required operating temperature of 138°F.

RADIATION ANALYSIS

The qualified life analysis for Rockbestos power cables shows the cables are qualified for $5x10^7$ rads to $2x10^8$ rads for St. Lucie Unit 1, and $2x10^8$ rads for St. Lucie Unit 2. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are $2x10^7$ rads for St. Lucie Unit 1 and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Rockbestos power cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.8 CERRO (ROCKBESTOS) COAXIAL/TRIAXIAL CABLES

The Rockbestos coaxial and triaxial cables are located inside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Rockbestos coaxial and triaxial cables shows the cables are qualified for greater than 60 years of service at a temperature of 149°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Rockbestos coaxial and triaxial cables shows the cables are qualified for 2×10^{8} rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is 1.61×10^{7} rads.

CONCLUSION

Rockbestos coaxial and triaxial cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.9 COMBUSTION ENGINEERING MINERAL INSULATED CABLES AND CONNECTORS

The Combustion Engineering Mineral Insulated cables with Litton, Whittaker, and ERD connectors are located inside Containment at St. Lucie Units 1 and 2.

COMBUSTION ENGINEERING MINERAL INSULATED CABLE WITH LITTON (HJTC) CONNECTORS

THERMAL ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Litton (HJTC) connectors shows the cables and connectors are qualified for greater than 60 years of service at a temperature of 150°F. These cables and connectors have a maximum required operating temperature of 150°F per Combustion Engineering.

RADIATION ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Litton (HJTC) connectors shows the cables and connectors are qualified for 5.5×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables and connectors are 1.5×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Combustion Engineering Mineral Insulated cables with Litton (HJTC) connectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

COMBUSTION ENGINEERING MINERAL INSULATED CABLE WITH LITTON (CET) CONNECTORS

THERMAL ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Litton (CET) connectors shows the cables and connectors are qualified for greater than 60 years of service at a temperature of 150°F. These cables and connectors have a maximum required operating temperature of 150°F per Combustion Engineering.

RADIATION ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Litton (CET) connectors shows the cables and connectors are qualified for 2.07×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables and connectors are 1.5×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Combustion Engineering Mineral Insulated cables with Litton (CET) connectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

COMBUSTION ENGINEERING MINERAL INSULATED CABLE WITH WHITTAKER CONNECTORS

THERMAL ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Whittaker connectors shows the cables and connectors are qualified for greater than 60 years of service at a temperature of 150°F. These cables and connectors have a maximum required operating temperature of 150°F per Combustion Engineering.

RADIATION ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with Whittaker connectors shows the cables and connectors are qualified for 2.2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables and connectors are 1.5×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Combustion Engineering Mineral Insulated cables with Whittaker connectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

COMBUSTION ENGINEERING MINERAL INSULATED CABLE WITH ERD/LITTON CONNECTORS

THERMAL ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with ERD/Litton connectors shows the cables and connectors are qualified for greater than 60 years of service at a temperature of 140°F. These cables and connectors have a maximum required operating temperature of 140°F per Combustion Engineering.

RADIATION ANALYSIS

The qualified life analysis for Combustion Engineering Mineral Insulated cables with ERD/Litton connectors shows the cables and connectors are qualified for 2.1×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables and connectors is 1.5×10^7 rads.

CONCLUSION

Combustion Engineering Mineral Insulated cables with ERD/Litton connectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.10 CONAX CONDUIT SEALS

The Conax electric conductor seal assemblies are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Conax electric conductor seal assemblies shows the assemblies are qualified for greater than 60 years of service at a temperature of 194°F. These assemblies have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Conax electric conductor seal assemblies shows the assemblies are qualified for $1.4x10^9$ rads (beta and gamma). The maximum projected post accident plus 60-year normal operation radiation doses for these assemblies are $2x10^7$ for St. Lucie Unit 1, and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Conax electric conductor seal assemblies are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.11 CONAX PENETRATIONS

The Conax electrical penetrations are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Conax electrical penetrations shows the penetrations are qualified for greater than 60 years of service at a temperature of 194°F. These penetrations have maximum required operating temperatures of 138°F for power applications and 120°F for I&C applications.

RADIATION ANALYSIS

The qualified life analysis for Conax electrical penetrations shows the penetrations are qualified for 1.1×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these penetrations are 2×10^7 for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Conax electrical penetrations are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.12 CONAX THERMOCOUPLES

The Conax thermocouples are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Conax thermocouples shows the thermocouples are qualified for greater than 60 years of service at a temperature of 120°F. These thermocouples have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Conax thermocouples shows the thermocouples are qualified for 2.27×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these thermocouples are 2×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Conax thermocouples are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.13 CONTINENTAL CABLES

The Continental cables are used as thermocouple extension wires both inside and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Continental cables shows the cables are qualified for greater than 60 years of service at a temperature of 125°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Continental cables shows the cables are qualified for $1x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is $2x10^7$ rads.

CONCLUSION

Continental cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.14 CVI HEATERS

The CVI heaters are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for CVI heaters shows the heaters are qualified for greater than 60 years of service at a temperature of 107°F. These heaters have a maximum required operating temperature of 107°F.

RADIATION ANALYSIS

The qualified life analysis for CVI heaters shows the heaters are qualified for $6.4x10^6$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these heaters is $2.6x10^5$ rads.

CONCLUSION

CVI heaters are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.15 EGS GRAYBOOT CONNECTORS

The EGS Grayboot connectors are installed both inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The EGS Grayboot connectors were first installed at St. Lucie Units 1 and 2 in 1995. The qualified life analysis for EGS Grayboot connectors shows the connectors are qualified for greater than 47.4 years at a temperature of 130°F. These connectors have a maximum required operating temperature of 130°F.

RADIATION ANALYSIS

The qualified life analysis for EGS Grayboot connectors shows the connectors are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these connectors is $5.25x10^7$ rads.

CONCLUSION

Since EGS Grayboot connectors were not used at St. Lucie Units 1 and 2 until 1995, a qualified life of 47.4 years provides qualification through the end of the period of extended operation. EGS Grayboot connectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.16 FLUID CONTROL INCORPORATED LEVEL SENSORS

Fluid Control Incorporated level sensors are located inside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Fluid Control Incorporated level sensors shows the sensors are qualified for greater than 60 years of service at a temperature of 120°F. These sensors have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Fluid Control Incorporated level sensors shows the sensors are qualified for 1×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these sensors is 8.65×10^6 rads.

CONCLUSION

Fluid Control Incorporated level sensors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.17 GENERAL ATOMIC RADIATION MONITORS

The General Atomic radiation monitor detectors are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for General Atomic radiation monitor detectors shows the detectors are composed of inorganic materials and are not susceptible to thermal degradation. At St. Lucie Unit 2, two associated components are susceptible to thermal degradation, a Teflon connector and a silicon rubber seal. The qualified life analysis for these components shows the Unit 2 detectors and associated components are qualified for greater than 92 years of service at a temperature of 120°F. The Unit 2 detectors and associated components have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for General Atomic radiation monitor detectors shows the detectors are composed of inorganic materials and are not susceptible to radiation degradation. At St. Lucie Unit 2, two associated components are susceptible to radiation aging, a Teflon connector and a silicon rubber seal. The qualified life analysis for these components shows the Unit 2 detectors and associated components are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for the Unit 2 detectors and associated components is $1.61x10^7$ rads.

CONCLUSION

General Atomic radiation monitor detectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.18 GENERAL CABLE CABLES

General Cable instrumentation cables are located inside and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for General Cable instrumentation cables shows the cables are qualified for greater than 60 years of service at a temperature of 121°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for General Cable instrumentation cables shows the cables are qualified for $5x10^7$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is $5.15x10^6$ rads.

CONCLUSION

General Cable instrumentation cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.19 GENERAL ELECTRIC CABLES

The General Electric Vulkene cables are installed as jumper wire for the main steam isolation valve limit switches in the Steam Trestle Area outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for General Electric Vulkene cables shows the cables are qualified for greater than 60 years of service at a temperature of 150°F. These cables have a maximum required operating temperature of 150°F.

RADIATION ANALYSIS

The qualified life analysis for General Electric Vulkene cables shows the cables are qualified for 2.2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is less than 1×10^3 rads.

CONCLUSION

General Electric Vulkene cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.20 GENERAL ELECTRIC HIGH PRESSURE SAFETY INJECTION (UNIT 1) AND AUXILIARY FEEDWATER PUMP MOTORS

The General Electric High Pressure Safety Injection (Unit 1) and Auxiliary Feedwater (Units 1 and 2) pump motors are located outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for General Electric High Pressure Safety Injection (Unit 1) and Auxiliary Feedwater (Units 1 and 2) pump motors shows the motors are qualified for greater than 60 years of service at an ambient temperature of 104°F. This qualified life is the life remaining after subtracting the motor run time for maintenance and periodic testing during the 60-year plant lifetime at a motor operating temperature of 266°F. The effect of the motor space heater during motor inactive periods has also been subtracted from the motor qualified life. These motors are located in an area where the ambient temperature is 104°F.

RADIATION ANALYSIS

The qualified life analysis for General Electric High Pressure Safety Injection (Unit 1) and Auxiliary Feedwater (Units 1 and 2) pump motors shows the motors are qualified for $1x10^7$ rads for St. Lucie Unit 1, and $1x10^6$ rads for St. Lucie Unit 2. The maximum projected post accident plus 60-year normal operation radiation doses for these motors are less than $1x10^3$ rads for the auxiliary feedwater pump motors, and $3.25x10^5$ rads for the high pressure safety injection pump motors.

CONCLUSION

General Electric High Pressure Safety Injection (Unit 1) and Auxiliary Feedwater (Units 1 and 2) pump motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.21 GENERAL ELECTRIC HIGH PRESSURE SAFETY INJECTION (UNIT 2) PUMP MOTORS

The General Electric High Pressure Safety Injection (Unit 2) pump motors are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for General Electric High Pressure Safety Injection (Unit 2) pump motors shows the motors are qualified for greater than 60 years at an ambient temperature of 104°F. This qualified life is the life remaining after subtracting the motor run time for maintenance and periodic testing during the 60-year plant lifetime at a motor operating temperature of 230°F. The effect of the motor space heater during motor inactive periods has also been subtracted from the motor qualified life. These motors are located in an area where the ambient temperature is 104°F.

RADIATION ANALYSIS

The qualified life analysis for General Electric High Pressure Safety Injection (Unit 2) pump motors shows the motors are qualified for 1×10^6 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is 8.15×10^5 rads.

CONCLUSION

General Electric High Pressure Safety Injection (Unit 2) pump motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.22 GENERAL ELECTRIC TERMINAL BLOCKS

General Electric terminal blocks are located outside Containment at St. Lucie Units 1 and 2. St. Lucie Unit 1 has General Electric type EB-5, CR-2940 and CR-151 terminal blocks installed. St. Lucie Unit 2 has General Electric type EB-5 and EB-25 terminal blocks installed.

THERMAL ANALYSIS

The qualified life analysis for General Electric terminal blocks shows the terminal blocks are qualified for greater than 60 years of service at a temperature of 104°F. These terminal blocks have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for General Electric St. Lucie Unit 1 terminal blocks shows the terminal blocks are qualified for 1.2×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these terminal blocks is 1×10^7 rads.

The qualified life analysis for General Electric St. Lucie Unit 2 terminal blocks shows the terminal blocks are qualified for 2.1×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these terminal blocks is 5.25×10^7 rads.

CONCLUSION

General Electric terminal blocks are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.23 GORDON THERMOCOUPLES

The Gordon thermocouples are located outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Gordon thermocouples shows that the thermocouples are qualified for greater than 60 years at a temperature of 104°F. These thermocouples have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Gordon thermocouples shows the thermocouples are qualified for 1.06×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these thermocouples is 3.7×10^5 rads.

CONCLUSION

Gordon thermocouples are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.24 GULF GENERAL ATOMIC ELECTRICAL PENETRATIONS

The Gulf General Atomic electrical penetrations are in use at St. Lucie Unit 1 for low voltage power, control, and instrumentation circuits.

THERMAL ANALYSIS

The qualified life analysis for Gulf General Atomic electrical penetrations shows that the penetrations are qualified for greater than 60 years at a temperature of 140°F. These penetrations have a maximum required operating temperature of 138°F.

RADIATION ANALYSIS

The qualified life analysis for Gulf General Atomic electrical penetrations shows the penetrations are qualified for $5.5x10^7$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these penetrations is $2x10^7$ rads.

CONCLUSION

Gulf General Atomic electrical penetrations are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.25 IMO INDUSTRIES LEVEL SENSORS

The IMO Industries level sensors are located inside Containment at St. Lucie Unit 1. The level sensors utilize Bisco Locaseals to provide a watertight connection for the system conduits that are below flood level.

THERMAL ANALYSIS

The qualified life analysis for IMO Industries level sensors shows that the sensors are qualified for greater than 60 years at a temperature of 120°F. The Bisco Locaseal material has been demonstrated to have a qualified life of 56 years at 120°F. These sensors and seals have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for IMO Industries level sensors shows the sensors are qualified for 1.16×10^8 rads. The Bisco Locaseal material is qualified for 2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these sensors and seals is 9.25×10^6 rads.

CONCLUSION

Since the Bisco Locaseal material was not used at St. Lucie Unit 1 until 1991, the IMO Industries level sensors and Bisco Locaseals are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.26 INDEECO HEATERS

The Indeeco heaters are located outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Indeeco heaters shows that the heaters are qualified for greater than 60 years at a temperature of 104°F. These heaters are not used except following a design basis event. These heaters have a normal operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Indeeco heaters shows the heaters are qualified for 1×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these heaters is 3.7×10^5 rads.

CONCLUSION

Indeeco heaters are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.27 KERITE CABLES (FR, FR2, AND HTK INSULATION)

The Kerite cables with FR, FR2, and HTK insulation are located inside and outside Containment at St. Lucie Units 1 and 2 in low and medium voltage power, control, and instrumentation circuits.

THERMAL ANALYSIS

The qualified life analysis for Kerite cables with FR, FR2, and HTK insulation shows that the cables are qualified for greater than 60 years at a temperature of 194°F. These cables have a maximum required operating temperature of 145°F (Unit 1 containment fan cooler motors).

RADIATION ANALYSIS

The qualified life analysis for Kerite cables with FR, FR2, and HTK insulation shows the cables are qualified for 5×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are 2×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Kerite cables with FR, FR2, and HTK insulation are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.28 LIMITORQUE VALVE OPERATORS

The Limitorque operators with Class B insulation are located outside Containment, and Limitorque operators with Class RH insulation are located inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Limitorque actuators with Class B and Class RH insulation shows that the actuators are qualified for greater than 60 years at temperatures of 120°F for St. Lucie Unit 1 and 115°F for St. Lucie Unit 2. These actuators have maximum required operating temperatures of 120°F for St. Lucie Unit 1 and 115°F for St. Lucie Unit 2.

RADIATION ANALYSIS

The qualified life analysis for Limitorque actuators with Class B insulation shows the actuators are qualified for $2x10^7$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these actuators are $7.9x10^5$ rads for St. Lucie Unit 1, and $1.8x10^6$ rads for St. Lucie Unit 2.

The qualified life analysis for Limitorque actuators with Class RH insulation shows the actuators are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these actuators are $9.25x10^6$ rads for St. Lucie Unit 1, and $6.85x10^6$ rads for St. Lucie Unit 2.

CONCLUSION

Limitorque actuators with Class B and Class RH insulation are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.29 MAGNETROL LEVEL SWITCH

The Magnetrol level switches are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Magnetrol level switches shows that the switches are qualified for greater than 60 years at a temperature of 104°F. These switches have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Magnetrol level switches shows the switches are qualified for 2.5×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these switches is 8.15×10^5 rads.

CONCLUSION

Magnetrol level switches are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.30 MICRO SWITCH LIMIT SWITCH

The Micro Switch limit switches are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Micro Switch limit switches shows that the switches are qualified for greater than 60 years at a temperature of 104°F. These switches have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for Micro Switch limit switches shows the switches are qualified for $1x10^7$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these switches is $8.15x10^5$ rads.

CONCLUSION

Micro Switch limit switches are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.31 OKONITE CABLES (EPR INSULATION)

Okonite control cables with EPR insulation are located inside and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Okonite control cable with EPR insulation shows that the cables are qualified for greater than 60 years at a temperature of 145°F inside Containment and 122°F outside Containment. These cables have maximum required operating temperatures of 145°F (Unit 1 containment fan cooler motors) inside Containment and 122°F outside Containment.

RADIATION ANALYSIS

The qualified life analysis for Okonite control cable with EPR insulation shows the cables are qualified for 2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are 2×10^7 rads inside Containment, and 5.25×10^7 rads outside Containment.

CONCLUSION

Okonite control cables with EPR insulation are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.32 OKONITE CABLES (X-OLENE FMR INSULATION)

Okonite power, control, and low signal level cables with X-Olene FMR insulation are located inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Okonite power, control, and low signal level cables with X-Olene FMR insulation shows that the cables are qualified for greater than 60 years at a temperature of 138°F inside Containment and 134.3°F outside Containment. These cables have maximum required operating temperatures of 138°F inside Containment and 134.3 °F (Unit 1 containment fan cooler motors) outside Containment.

RADIATION ANALYSIS

The qualified life analysis for Okonite power, control, and low signal level cables with X-Olene FMR insulation shows the cables are qualified for 2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are 2×10^7 rads inside the St. Lucie Unit 1 Containment, 1.61×10^7 rads inside the St. Lucie Unit 2 Containment, and 5.25×10^7 rads outside Containment.

CONCLUSION

Okonite power, control, and low signal level cables with X-Olene FMR insulation are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.33 RAYCHEM CABLES

The Raychem cables with XLPE (FLAMTROL) insulation is located inside and outside Containment at St. Lucie Units 1 and 2. The St. Lucie Unit 1 cables are used in various power, control, and instrumentation circuits. The St. Lucie Unit 2 cables are used as control wiring in Limitorque motor operators.

THERMAL ANALYSIS

The qualified life analysis for Raychem cables with XLPE (FLAMTROL) insulation utilized for jumper wire applications in Units 1 and 2 shows that the cables are qualified for greater than 60 years at a temperature of 125°F for jumper wire applications inside Containment. These cables have a maximum required operating temperature of 125°F inside Containment.

The qualified life analysis for Raychem cables with XLPE (FLAMTROL) insulation shows the cables are qualified for greater than 60 years with a conductor temperature of 167.9°F. These cables have a maximum required operating temperature of 156°F (Unit 1 charging pump motors).

RADIATION ANALYSIS

The qualified life analysis for Raychem cables with XLPE (FLAMTROL) insulation shows the cables are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are $5.25x10^7$ rads for St. Lucie Unit 1, and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Raychem cables with XLPE (FLAMTROL) insulation are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.34 RAYCHEM SPLICES

The Raychem heat shrink sleeving is located both inside and outside Containment at St. Lucie Units 1 and 2. Raychem heat shrink sleeving includes the following types: WCSF-N, WCSF-050-N, WCSF-050-U, NPKV, NHVT, NMCK, cable breakouts, and end caps.

THERMAL ANALYSIS

The qualified life analysis for Raychem heat shrink sleeving shows that the sleeving materials are qualified for greater than 60 years at a temperature of 185°F (120°F plus 65°F self-heating). The maximum design operating temperature of the sleeving materials would be much less than 185°F due to conservative plant designs, equipment out-of-service time, equipment redundancy, and because the sleeving insulation material is not in direct contact with the cable conductor.

RADIATION ANALYSIS

The qualified life analysis for Raychem heat shrink sleeving shows the sleeving materials are qualified for $2x10^8$ rads to $2.2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these sleeving materials are $2x10^7$ rads inside the St. Lucie Unit 1 Containment, $1.61x10^7$ rads inside the St. Lucie Unit 2 Containment, and $5.25x10^7$ rads outside Containment.

CONCLUSION

Raychem heat shrink sleeving is qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.35 RdF RESISTANCE TEMPERATURE DETECTORS

The RdF resistance temperature detectors are located at St. Lucie Unit 2 outside Containment.

THERMAL ANALYSIS

The qualified life analysis for RdF resistance temperature detectors located outside Containment shows that the detectors are qualified for greater than 89 years at a temperature of 104°F. These detectors have a maximum required operating temperature of 104°F.

RADIATION ANALYSIS

The qualified life analysis for RdF resistance temperature detectors located outside Containment shows the detectors are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these detectors is $1.78x10^6$ rads outside Containment.

CONCLUSION

RdF resistance temperature detectors outside Containment are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.36 RELIANCE ELECTRIC CONTAINMENT FAN COOLER MOTORS

The Reliance Electric containment fan cooler motors are located inside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Reliance Electric containment fan cooler motors shows the motors are qualified for greater than 60 years at a maximum design temperature of 215.4°F. These motors have a maximum required operating temperature of 215.4°F.

RADIATION ANALYSIS

The qualified life analysis for Reliance Electric containment fan cooler motors shows the motors are qualified for 8×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is 1.61×10^7 rads.

CONCLUSION

Reliance Electric containment fan cooler motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.37 ROME CABLES

The Rome cables are located inside and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Rome cables shows the cables are qualified for greater than 60 years of service at a temperature of 123°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Rome cables shows the cables are qualified for 2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these cables is 5.25×10^7 rads.

CONCLUSION

Rome cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.38 SIEMENS ALLIS CONTAINMENT SPRAY PUMP MOTORS

The Siemens Allis containment spray pump motors are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for the Siemens Allis containment spray pump motors shows that the motors are qualified for greater than 60 years at an ambient temperature of 104°F based on an assumption of 15 years of motor operating time at a temperature of 250.3°F during the plant lifetime.

RADIATION ANALYSIS

The qualified life analysis for Siemens Allis containment spray pump motors shows the motors are qualified for 2×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is 8.15×10^7 rads.

CONCLUSION

Siemens Allis containment spray pump motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.39 TARGET ROCK NORMALLY DE-ENERGIZED SOLENOID VALVES; SERIES 80B

Normally de-energized Target Rock Model 80B solenoid valves are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for normally de-energized Target Rock Model 80B solenoid valves shows the solenoid valves are qualified for greater than 60 years of service at a temperature of 120°F. These solenoid valves have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for normally de-energized Target Rock Model 80B solenoid valves shows the solenoid valves are qualified for 1.35×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these solenoid valves are 2×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Normally de-energized Target Rock Model 80B solenoid valves are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.40 TARGET ROCK NORMALLY DE-ENERGIZED SOLENOID VALVES; SERIES 74Q, 76R, 78E, 84V, 89Q, AND 98K

Normally de-energized Target Rock Model 74Q and 89Q solenoid valves are located inside and outside Containment at St. Lucie Unit 1. Normally de-energized Target Rock Models 74Q, 76R, 78E, 84V, and 98K solenoid valves are located inside and outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for normally de-energized Target Rock Models 74Q, 76R, 78E, 84V, 89Q, and 98K solenoid valves shows the solenoid valves are qualified for greater than 60 years of service at a temperature of 120°F. These solenoid valves have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for normally de-energized Models 74Q, 76R, 78E, 84V, 89Q, and 98K solenoid valves shows the solenoid valves are qualified for 1.35×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these solenoid valves are 2×10^7 rads for St. Lucie Unit 1, and 1.61×10^7 rads for St. Lucie Unit 2.

CONCLUSION

Normally de-energized Models 74Q, 76R, 78E, 84V, 89Q, and 98K solenoid valves are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.41 TEC ACOUSTIC MONITORS - ACCELEROMETER AND CABLE ASSEMBLY

The TEC Acoustic Flow Monitoring Systems are located on the pressurizer safety valves inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for TEC Acoustic Flow Monitoring Systems shows the systems are qualified for greater than 60 years of service at a temperature of 122°F. These systems have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for TEC Acoustic Flow Monitoring Systems shows the systems are qualified for 1.9×10^8 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these systems are 1.05×10^6 rads for St. Lucie Unit 1, and 6.85×10^6 rads for St. Lucie Unit 2.

CONCLUSION

TEC Acoustic Flow Monitoring Systems are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.42 TELEDYNE THERMATICS CABLE

The Teledyne Thermatics cables are located both inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for Teledyne Thermatics cables shows the cables are qualified for greater than 60 years of service at a temperature of 125°F. These cables have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Teledyne Thermatics cables shows the cables are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these cables are $2x10^7$ rads for St. Lucie Unit 1, and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Teledyne Thermatics cables are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.43 3M TAPE SPLICES

The 3M tape splices are located outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for 3M tape splices shows the splices are qualified for greater than 60 years of service at a temperature of 122°F. These splices have a maximum required operating temperature of 122°F.

RADIATION ANALYSIS

The qualified life analysis for 3M tape splices shows the splices are qualified for 2×10^8 rads for 600V applications, and 1×10^8 rads for 4kV applications. The maximum projected post accident plus 60-year normal operation radiation dose for these splices is 5.25×10^7 rads for both 600V and 4kV applications.

CONCLUSION

The 3M tape splices are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.44 VALCOR NORMALLY DE-ENERGIZED SOLENOID VALVES

Normally de-energized Valcor solenoid valves are located inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for normally de-energized Valcor solenoid valves shows the solenoid valves are qualified for greater than 60 years of service at a temperature of 120°F. These solenoid valves have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for normally de-energized Valcor solenoid valves shows the solenoid valves are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these solenoid valves are $5.42x10^6$ rads for St. Lucie Unit 1, and $3.85x10^6$ rads for St. Lucie Unit 2.

CONCLUSION

Normally de-energized Valcor solenoid valves are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.45 WEED RESISTANCE TEMPERATURE DETECTORS

The Weed resistance temperature detectors are located inside Containment at St. Lucie Units 1 and 2 and outside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Weed resistance temperature detectors shows that the detectors are qualified for greater than 60 years at a temperature of 127°F. These detectors have a maximum required operating temperature of 127°F.

RADIATION ANALYSIS

The qualified life analysis for Weed resistance temperature detectors shows the detectors are qualified for $3.03x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these detectors are $2.45x10^7$ rads inside Containment, and $2.88x10^6$ rads outside Containment.

CONCLUSION

Weed resistance temperature detectors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.46 WESTINGHOUSE CHARGING PUMP MOTORS

The Westinghouse charging pump motors are located outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for the Westinghouse charging pump motors shows that the motors are qualified for greater than 60 years at an ambient temperature of 104°F based on an assumption of 42 percent operating duty at a temperature of 230°F for St. Lucie Unit 1, and 33.3 percent operating duty at a temperature of 237.5°F for St. Lucie Unit 2.

RADIATION ANALYSIS

The qualified life analysis for Westinghouse charging pump motors shows the motors are qualified for $1x10^6$ rads for St. Lucie Unit 1 and $5x10^6$ rads for St. Lucie Unit 2. The maximum projected post accident plus 60-year normal operation radiation doses for these motors are $4.45x10^5$ rads for St. Lucie Unit 1, and $2.75x10^5$ rads for St. Lucie Unit 2.

CONCLUSION

Westinghouse charging pump motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.47 WESTINGHOUSE CONTAINMENT FAN COOLER MOTORS

The Westinghouse containment fan cooler motors are located inside Containment at St. Lucie Unit 1.

THERMAL ANALYSIS

The qualified life analysis for Westinghouse containment fan cooler motors shows that the motors are qualified for greater than 67.8 years at a temperature of 180°F. These motors have a maximum required operating temperature of 180°F.

RADIATION ANALYSIS

The qualified life analysis for Westinghouse containment fan cooler motors shows the motors are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is $2x10^7$ rads.

CONCLUSION

Westinghouse containment fan cooler motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.48 WESTINGHOUSE HYDROGEN RECOMBINERS

The Westinghouse hydrogen recombiners are located inside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for the Westinghouse hydrogen recombiners shows that the recombiners are qualified for greater than 60 years at a temperature of 120°F. These recombiners have a maximum required operating temperature of 120°F.

RADIATION ANALYSIS

The qualified life analysis for Westinghouse hydrogen recombiners shows the recombiners are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation doses for these recombiners are $1.2x10^7$ rads for St. Lucie Unit 1, and $1.61x10^7$ rads for St. Lucie Unit 2.

CONCLUSION

Westinghouse hydrogen recombiners are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.49 WESTINGHOUSE LOW PRESSURE SAFETY INJECTION PUMP MOTORS

The Westinghouse low pressure safety injection pump motors are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for the Westinghouse low pressure safety injection pump motors shows that the motors are qualified for greater than 89.09 years at an ambient temperature of 104°F based on an assumption of 25 percent operating duty at a temperature of 230°F.

RADIATION ANALYSIS

The qualified life analysis for Westinghouse low pressure safety injection pump motors shows the motors are qualified for 2×10^8 rads for model 5010P39VSWT, and 5×10^7 rads for model 5010P39WPI. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is 8.15×10^5 rads.

CONCLUSION

Westinghouse low pressure safety injection pump motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.50 WESTINGHOUSE VENTILATION FAN MOTORS

The Westinghouse ventilation fan motors are located outside Containment at St. Lucie Unit 2.

THERMAL ANALYSIS

The qualified life analysis for Westinghouse ventilation fan motors shows that the motors are qualified for greater than 60 years at a temperature of 266°F. These motors have a maximum required operating temperature of 266°F.

RADIATION ANALYSIS

The qualified life analysis for Westinghouse ventilation fan motors shows the motors are qualified for $2x10^8$ rads. The maximum projected post accident plus 60-year normal operation radiation dose for these motors is $2.61x10^5$ rads.

CONCLUSION

Westinghouse ventilation fan motors are qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.1.51 UNITED CONTROLS INTERNATIONAL SILICONE TAPE

The United Controls International silicone tape is installed both inside and outside Containment at St. Lucie Units 1 and 2.

THERMAL ANALYSIS

The qualified life analysis for United Controls International silicone tape in control and intermittently energized power circuits applications shows that these splices are qualified for greater than 48.3 years at a temperature of 170°F. These splices have a maximum required operating temperature of 170°F.

RADIATION ANALYSIS

The qualified life analysis for United Controls International silicone tape in control and intermittently energized power circuits applications shows the splices are qualified for 5.77×10^7 rads. The maximum projected post accident plus 60-year normal operation radiation doses for these splices are 2×10^7 rads for St. Lucie Unit 1, and 5.25×10^7 rads for St. Lucie Unit 2.

CONCLUSION

United Controls International silicone tape was first used at St. Lucie Unit 1 in 1997, and at St. Lucie Unit 2 in 1999. Based on this, United Controls International silicone tape in control and intermittently energized power circuits applications is qualified for the period of extended operation based on the projection of the EQ analysis to the end of the period of extended operation per the provisions of 10 CFR 54.21(c)(1)(ii).

4.4.2 GSI-168, ENVIRONMENTAL QUALIFICATION OF ELECTRICAL COMPONENTS

NRC guidance for addressing GSI-168 for license renewal is contained in the June 2, 1998, NRC letter to NEI [Reference 4.4-4]. In this letter, the NRC states, "With respect to addressing GSI-168 for license renewal, until completion of an ongoing research program and staff evaluations, the potential issues associated with GSI-168 and their scope have not been defined to the point that a license renewal applicant can reasonably be expected to address them at this time. Therefore, an acceptable approach described in the Statements of Consideration is to provide a technical rationale demonstrating that the current licensing basis for EQ pursuant to 10 CFR 50.49 will be maintained in the period of extended operation. Although the Statements of Consideration also indicate that an applicant should provide a brief description of one or more reasonable options that would be available to adequately manage the effects of aging, the staff does not expect an applicant to provide the options at this time."

EQ evaluations of electrical components are identified as TLAAs for St. Lucie Units 1 and 2. The evaluations of these TLAAs are considered the technical rationale that the St. Lucie Units 1 and 2 CLBs will be maintained during the period of extended operation. These evaluations are provided in Section 4.4 of the St. Lucie Units 1 and 2 License Renewal Application. Consistent with the above NRC guidance, no additional information is required to address GSI-168 in a renewal application at this time.

4.4.3 REFERENCES

4.4-1 DOR Guidelines, "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors," U. S. Nuclear Regulatory Commission, June 1979.

4.4-2 NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," U. S. Nuclear Regulatory Commission, April 2001.

4.4-3 EPRI NP-1558, "A Review of Equipment Aging Theory and Technology," Electric Power Research Institute, September 1980.

4.4-4 Grimes, C. I. (NRC) letter to Walters, D. (NEI), "Guidance on Addressing GSI 168 for License Renewal," Project 690, June 2, 1998.