3.4 AGING MANAGEMENT OF THE STEAM AND POWER CONVERSION SYSTEM

3.4.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.3.4, Steam and Power Conversion System, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Auxiliary Feedwater System (2.3.4.1)
- Main Condensate and Feedwater System (2.3.4.2)
- Main Condenser and Air Removal (2.3.4.3)
- Main Steam System (2.3.4.4)
- Main Turbine and Auxiliaries System (2.3.4.5)

3.4.2 RESULTS

The following tables summarize the results of the aging management review for the Steam and Power Conversion System.

Table 3.4.2-1 Summary of Aging Management Evaluation – Auxiliary Feedwater System

Table 3.4.2-2 Summary of Aging Management Evaluation – Main Condensate and Feedwater System

Table 3.4.2-3 Summary of Aging Management Evaluation – Main Condenser and Air Removal System

Table 3.4.2-4 Summary of Aging Management Evaluation – Main Steam System

Table 3.4.2-5 Summary of Aging Management Evaluation – Main Turbine and Auxiliaries System

3.4.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Managements Programs

3.4.2.1.1 Auxiliary Feedwater System

Materials

The materials of construction for the Auxiliary Feedwater System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Gray Cast Iron
- Stainless Steel

Environments

The Auxiliary Feedwater System components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Air/Gas - Wetted
- Closed Cycle Cooling Water > 140 °F
- Lubricating Oil
- Soil
- Steam
- Treated Water
- Treated Water >140 °F

Aging Effects/Mechanisms Requiring Management

The following aging effects associated with the Auxiliary Feedwater System components require management:

- Cracking/Stress Corrosion Cracking
- Cumulative Fatigue Damage/Fatigue
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, Crevice, and Microbiologically-Influenced Corrosion
- Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening

- Reduction of Heat Transfer/Fouling
- Wall Thinning/Flow Accelerated Corrosion

Aging Management Programs

The following aging management programs manage the aging effects for the Auxiliary Feedwater System components:

- Aboveground Non-Steel Tanks (B.2.2.3)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Buried Piping Inspection (B.2.1.22)
- Closed-Cycle Cooling Water System (B.2.1.12)
- External Surfaces Monitoring (B.2.1.24)
- Flow-Accelerated Corrosion (B.2.1.8)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.26)
- Lubricating Oil Analysis (B.2.1.27)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

Table 3.4.2-1, Summary of Aging Management Evaluation – Auxiliary Feedwater System summarizes the results of the aging management review for the Auxiliary Feedwater System.

3.4.2.1.2 Main Condensate and Feedwater System

Materials

The materials of construction for the Main Condensate and Feedwater System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Cast Austenitic Stainless Steel (CASS)
- Stainless Steel
- Stainless Steel Bolting

Environments

The Main Condensate and Feedwater System components are exposed to the following environments:

- Air - Indoor
- Air with Borated Water Leakage
- Treated Water
- Treated Water >140 °F

Aging Effects/Mechanisms Requiring Management

The following aging effects associated with the Main Condensate and Feedwater System components require management:

- Cracking/Stress Corrosion Cracking
- Cumulative Fatigue Damage/Fatigue
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion
- Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening
- Wall Thinning/Flow Accelerated Corrosion

Aging Management Programs

The following aging management programs manage the aging effects for the Main Condensate and Feedwater System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring (B.2.1.24)
- Flow-Accelerated Corrosion (B.2.1.8)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

Table 3.4.2-2, Summary of Aging Management Evaluation – Main Condensate and Feedwater System summarizes the results of the aging management review for the Main Condensate and Feedwater System.

3.4.2.1.3 Main Condenser and Air Removal System

Materials

The materials of construction for the Main Condenser and Air Removal System components are:

- Carbon Steel
- Copper Alloy with 15% Zinc or More
- Stainless Steel

Environments

The Main Condenser and Air Removal System components are exposed to the following environments:

- Air - Indoor
- Raw Water
- Treated Water

Aging Effects/Mechanisms Requiring Management

The following aging effects associated with the Main Condenser and Air Removal System components require management:

- Loss of Material/General, Pitting, Crevice, Microbiologically-Influenced Corrosion, and Fouling
- Loss of Material/Selective Leaching

Aging Management Programs

The following aging management programs manage the aging effects for the Main Condenser and Air Removal System components:

- External Surfaces Monitoring (B.2.1.24)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)
- Selective Leaching of Materials (B.2.1.21)

- Water Chemistry (B.2.1.2)

Table 3.4.2-3, Summary of Aging Management Evaluation – Main Condenser and Air Removal System summarizes the results of the aging management review for the Main Condenser and Air Removal System.

3.4.2.1.4 Main Steam System

Materials

The materials of construction for the Main Steam System components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Stainless Steel

Environments

The Main Steam System components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Steam
- Treated Water
- Treated Water >140 °F

Aging Effects Requiring Management

The following aging effects associated with the Main Steam System components require management:

- Cracking/Stress Corrosion Cracking
- Cumulative Fatigue Damage/Fatigue
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, and Crevice Corrosion
- Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening
- Wall Thinning/Flow Accelerated Corrosion

Aging Management Programs

The following aging management programs manage the aging effects for the Main Steam System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring (B.2.1.24)
- Flow-Accelerated Corrosion (B.2.1.8)
- One-Time Inspection (B.2.1.20)
- Periodic Inspection (B.2.2.2)
- TLAA
- Water Chemistry (B.2.1.2)

Table 3.4.2-4, Summary of Aging Management Evaluation – Main Steam System summarizes the results of the aging management review for the Main Steam System

3.4.2.1.5 Main Turbine and Auxiliaries System

Materials

The materials of construction for the Main Turbine and Auxiliaries System components are:

- Aluminum
- Carbon and Low Alloy Steel Bolting
- Stainless Steel

Environments

The Main Turbine and Auxiliaries System components are exposed to the following environments:

- Air - Indoor
- Lubricating Oil

Aging Effects Requiring Management

The following aging effects associated with the Main Turbine and Auxiliaries System components require management:

- Loss of Material/General Corrosion, Pitting, Crevice, and Microbiologically-Influenced Corrosion

- Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening

Aging Management Programs

The following aging management programs manage the aging effects for the Main Turbine and Auxiliaries System components:

- Bolting Integrity (B.2.1.9)
- Lubricating Oil Analysis (B.2.1.27)
- One-Time Inspection (B.2.1.20)

Table 3.4.2-5, Summary of Aging Management Evaluation – Main Turbine and Auxiliaries System summarizes the results of the aging management review for the Main Turbine and Auxiliaries System.

3.4.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Steam and Power Conversion System, those programs are addressed in the following subsections.

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of metal fatigue as a TLAA for the Auxiliary Feedwater System, Component Cooling System, Main Condensate and Feedwater System, and Main Steam System is discussed in Section 4.3.

3.4.2.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. *Loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

   Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements, heat exchanger components, tanks, turbine casings, and steel components exposed to treated water or steam in the Auxiliary Feedwater System, Component Cooling System, Demineralized Water System, Main Condensate and Feedwater System, Main Condenser and Air Removal System, Main Steam System, Reactor Coolant System, Sampling System, and Steam Generators. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

2. *Loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

   Salem will implement a One-Time Inspection program, B.2.1.20, to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to lubricating oil in the Auxiliary Feedwater System. The Lubricating Oil Analysis and One-Time Inspection programs are described in Appendix B.

3.4.2.2.3 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion (MIC), and Fouling

Loss of material due to general, pitting, crevice, and MIC, and fouling could occur in steel piping, piping components, and piping elements exposed to raw water. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.4.1-8 is not applicable to Salem. There are no steel piping, piping components, and piping elements exposed to raw water in the Steam and Power Conversion System.

3.4.2.2.4 Reduction of Heat Transfer due to Fouling

1. *Reduction of heat transfer due to fouling could occur for stainless steel and copper alloy heat exchanger tubes exposed to treated water. The existing aging management program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of water chemistry may not always have been adequate to preclude fouling. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. A one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.*

   Salem will implement a One-Time Inspection program, B.2.1.20, to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the reduction of heat transfer due to fouling in stainless steel heat exchanger components exposed to treated water in the Auxiliary Feedwater System and Component Cooling System. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

2. *Reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing aging management program relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that fouling is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of lube oil chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's*

intended function will be maintained during the period of extended operation.

Salem will implement a One-Time Inspection program, B.2.1.20, to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the reduction of heat transfer due to fouling in stainless steel heat exchanger tubes exposed to lubricating oil in the Auxiliary Feedwater System, Component Cooling System, and Service Water System. The Lubricating Oil Analysis and One-Time Inspection programs are described in Appendix B.

3.4.2.2.5 Loss of Material due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

1. *Loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel (with or without coating or wrapping) piping, piping components, piping elements, and tanks exposed to soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting, and crevice corrosion, and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.*

   Salem will implement a Buried Piping Inspection program, B.2.1.22, to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion (MIC) in steel piping, piping components, and piping elements exposed to soil in the Auxiliary Feedwater System and the Demineralized Water System. The Buried Piping Inspection program is described in Appendix B.

2. *Loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

   Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion (MIC) in steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to lubricating oil in the Auxiliary Feedwater System and Reactor Coolant System. The Lubricating Oil Analysis and One-Time Inspection programs are described in Appendix B.

3.4.2.2.6 Cracking due to Stress Corrosion Cracking (SCC)

Cracking due to SCC could occur in the stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60°C (>140°F), and for stainless steel piping, piping components, and piping elements exposed to steam. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the period of extended operation.

Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in stainless steel piping, piping components, piping elements, heat exchanger components, steam generator components, and tanks exposed to treated water > 60 deg C (>140 °F) in the Auxiliary Feedwater System, Demineralized Water System, Main Condensate and Feedwater System, Main Steam System, Sampling System, and Steam Generators. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

3.4.2.2.7 Loss of Material due to Pitting and Crevice Corrosion

1. *Loss of material due to pitting and crevice corrosion could occur for stainless steel, aluminum, and copper alloy piping, piping components, and piping elements, and for stainless steel tanks and heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to pitting and crevice corrosion. However, control of water chemistry does not preclude corrosion at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the water chemistry program should be verified to ensure that corrosion is not occurring. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to pitting and crevice corrosion in aluminum, copper alloy, and stainless steel piping, piping components and piping elements, tanks, and heat exchanger components exposed to treated water in the Auxiliary Feedwater System, Chemical and Volume Control System, Component Cooling System, Demineralized Water System, Main Condensate and Feedwater System, Main Condenser and Air Removal System, Main Steam System, Reactor Coolant System, Sampling System, and Steam Generators. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

2. *Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific aging management to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.4.1-17 is not applicable to Salem. The stainless steel piping, piping components, and piping elements external surfaces in the Steam and Power Conversion System are not exposed to soil.

3. *Loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

   Item Number 3.4.1-18 is not applicable to Salem. There are no copper alloy piping, piping components, and piping elements exposed to lubricating oil in the Steam and Power Conversion System.

3.4.2.2.8 Loss of Material due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

Loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants *within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.*

Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion (MIC) in stainless steel heat exchangers, piping, and piping components exposed to lubricating oil in the Auxiliary Feedwater System and Main Turbine and Auxiliaries System. The Lubricating Oil Analysis and One-Time Inspection programs are described in Appendix B.

3.4.2.2.9 Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

Loss of material due to general, pitting, crevice, and galvanic corrosion can occur for steel heat exchanger components exposed to treated water. The existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

Salem will implement a One-Time Inspection program, B.2.1.20, for susceptible locations to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, crevice, and galvanic corrosion in steel heat exchanger components exposed to treated water in the Main Condensate and Feedwater System. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

3.4.2.2.10 Quality Assurance for Aging Management of Non-Safety Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.4.2.3 Time-Limited Aging Analyses

The time-limited aging analyses identified below are associated with the Steam and Power Conversion System components:

- Section 4.3, Metal Fatigue of Piping and Components

3.4.3 CONCLUSION

The Steam and Power Conversion System piping, fittings, and components that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Steam and Power Conversion System components are identified in the summaries in Section 3.4.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Steam and Power Conversion System components will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the current licensing basis during the period of extended operation.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-1	Steel piping, piping components, and piping elements exposed to steam or treated water	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Fatigue is a TLAA; further evaluation is documented in Subsection 3.4.2.2.1.
3.4.1-2	Steel piping, piping components, and piping elements exposed to steam	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, and crevice corrosion in steel turbine casings, piping, piping components, and piping elements exposed to steam. See Subsection 3.4.2.2.2.1.
3.4.1-3	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, and crevice corrosion in steel heat exchanger components exposed to treated water. See Subsection 3.4.2.2.2.1.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-4	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2 to manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to treated water. See Subsection 3.4.2.2.2.1.
3.4.1-5	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, crevice, and galvanic corrosion in steel heat exchanger components exposed to treated water. See Subsection 3.4.2.2.9.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-6	Steel and stainless steel tanks exposed to treated water	Loss of material due to general (steel only) pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to pitting and crevice corrosion in stainless steel tanks exposed to treated water. See Subsection 3.4.2.2.7.1 Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to general, pitting, and crevice corrosion in steel tanks exposed to treated water. See Subsection 3.4.2.2.2.1.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-7	Steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801 with exceptions. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to lubricating oil. Exceptions apply to the NUREG-1801 recommendations for Lubricating Oil Analysis program implementation. See Subsection 3.4.2.2.2.2.
3.4.1-8	Steel piping, piping components, and piping elements exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Plant specific	Yes, plant specific	Not Applicable. See Subsection 3.4.2.2.3.
3.4.1-9	Stainless steel and copper alloy heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the reduction of heat transfer due to fouling in stainless steel heat exchanger tubes exposed to treated water. See Subsection 3.4.2.2.4.1.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-10	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801 with exceptions. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the reduction of heat transfer due to fouling in stainless steel heat exchanger tubes exposed to lubricating oil. Exceptions apply to the NUREG-1801 recommendations for Lubricating Oil Analysis program implementation. See Subsection 3.4.2.2.4.2.
3.4.1-11	Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes, detection of aging effects and operating experience are to be further evaluated	Consistent with NUREG-1801. The Buried Piping Inspection program, B.2.1.22, will be used to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion (MIC) in steel piping, piping components, and piping elements exposed to soil. See Subsection 3.4.2.2.5.1.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-12	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801 with exceptions. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion (MIC) in steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to lubricating oil. Exceptions apply to the NUREG-1801 recommendations for Lubricating Oil Analysis program implementation. See Subsection 3.4.2.2.5.2.
3.4.1-13	BWR Only				

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-14	Stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in stainless steel piping, piping components, piping elements, heat exchanger components, steam generator components, and tanks exposed to treated water > 60 deg C (>140 °F). See Subsection 3.4.2.2.6.
3.4.1-15	Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to pitting and crevice corrosion in copper alloy heat exchanger components and aluminum tanks exposed to treated water. See Subsection 3.4.2.2.7.1.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-16	Stainless steel piping, piping components, and piping elements; tanks, and heat exchanger components exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the loss of material due to stress corrosion cracking in stainless steel piping, piping components, piping elements, heat exchanger components, steam generator components, and tanks exposed to treated water. See Subsection 3.4.2.2.7.1.
3.4.1-17	Stainless steel piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	Plant specific	Yes, plant specific	Not Applicable. See Subsection 3.4.2.2.7.2.
3.4.1-18	Copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Not Applicable. See Subsection 3.4.2.2.7.3

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-19	Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801 with exceptions. The One-Time Inspection program, B.2.1.20, will be used to verify the effectiveness of the Lubricating Oil Analysis program, B.2.1.27, to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion (MIC) in stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. Exceptions apply to the NUREG-1801 recommendations for Lubricating Oil Analysis program implementation. See Subsection 3.4.2.2.8
3.4.1-20	Steel tanks exposed to air – outdoor (external)	Loss of material/ general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	Not Applicable. There are no steel tanks exposed to air – outdoor (external) in the Steam and Power Conversion System.
3.4.1-21	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	Not Applicable. There are no high-strength steel closure bolting exposed to air with steam or water leakage in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-22	Steel bolting and closure bolting exposed to air with steam or water leakage, air – outdoor (external), or air – indoor uncontrolled (external);	Loss of material due to general, pitting, and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Consistent with NUREG-1801 with exceptions. The Bolting Integrity program, B.2.1.9, will be used to manage the loss of material due to general, pitting, and crevice corrosion, and the loss of preload due to thermal effects, gasket creep, and self-loosening in steel bolting exposed to indoor and outdoor air in the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, and Main Turbine and Auxiliaries System. Exceptions apply to the NUREG-1801 recommendations for Bolting Integrity program implementation.
3.4.1-23	Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	Consistent with NUREG-1801 with exceptions. The Closed-Cycle Cooling Water System program, B.2.1.12, will be used to manage the cracking due to stress corrosion cracking in stainless steel heat exchanger components exposed to closed-cycle cooling water >60°C (>140°F) in the Auxiliary Feedwater System and Chemical and Volume Control System. Exceptions apply to the NUREG-1801 recommendations for Closed-Cycle Cooling Water System program implementation.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-24	Steel heat exchanger components exposed to closed cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not Applicable. There are no steel heat exchanger components exposed to closed cycle cooling water in the Steam and Power Conversion System.
3.4.1-25	Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Consistent with NUREG-1801 with exceptions. The Closed-Cycle Cooling Water System program, B.2.1.12, will be used to manage loss of material due to pitting and crevice corrosion in stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water in the Auxiliary Feedwater System. Exceptions apply to the NUREG-1801 recommendations for Closed-Cycle Cooling Water System program implementation.
3.4.1-26	Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not Applicable. There are no copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-27	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Not Applicable. There are no stainless steel, steel or copper alloy heat exchanger tubes exposed to closed cycle cooling water in the Steam and Power Conversion System.
3.4.1-28	Steel external surfaces exposed to air – indoor uncontrolled (external), condensation (external), or air outdoor (external)	Loss of material due to general corrosion	External Surfaces Monitoring	No	Consistent with NUREG-1801. The External Surfaces Monitoring program, B.2.1.24, will be used to manage the loss of material due to general corrosion on the external surfaces of steel piping, piping components, piping elements, heat exchanger components, tanks, and steam generator and turbine casings exposed to indoor air in the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Condenser and Air Removal System, Main Steam System, and Steam Generators.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-29	Steel piping, piping components, and piping elements exposed to steam or treated water	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Consistent with NUREG-1801 with exceptions. The Flow-Accelerated Corrosion program, B.2.1.8, will be used to manage wall thinning due to flow-accelerated corrosion in steel piping, piping components, piping elements, and heat exchanger exposed to steam or treated water in the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, and Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Flow-Accelerated Corrosion program implementation.
3.4.1-30	Steel piping, piping components, and piping elements exposed to air outdoor (internal) or condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program, B.2.1.26, will be used to manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements, and turbine components exposed to air/gas - wetted in the Auxiliary Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-31	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Not Applicable. There are no steel heat exchanger components exposed to raw water in the Steam and Power Conversion System.
3.4.1-32	Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	Not applicable. There are no stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-33	Stainless steel heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System program, B.2.1.11, will be used to manage the loss of material due to pitting, crevice, microbiologically-influenced corrosion, and fouling in stainless steel heat exchanger components, piping, piping components, and piping elements exposed to raw water in the Main Condensers and Air Removal System and Service Water System. Components in the Fire Protection System have been aligned to this item number based on material, environment, and aging effect. The Fire Water System program, B.2.1.16, will be substituted to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion (MIC), and fouling of the stainless steel heat exchanger components exposed to raw water for the Fire Protection System. Components in the Radioactive Drain System and Containment Structure have been aligned to this item number based on material, environment, and aging effect. The Periodic Inspection program B.2.2.2 will be substituted to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion (MIC), and fouling of the stainless steel piping, piping components, sump screens, and piping elements exposed to raw water for the Radioactive Drain System and Containment Structure.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-34	Steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Not applicable. There are no steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water with a reduction of heat transfer due to fouling aging effect/mechanism in the Steam and Power Conversion System.
3.4.1-35	Copper alloy >15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water, raw water, or treated water	Loss of material due to selective leaching	Selective Leaching of Materials	No	Consistent with NUREG-1801. The Selective Leaching of Materials program, B.2.1.21, will be used to manage the loss of material due to selective leaching in copper alloy with greater than 15% Zn heat exchanger components exposed to raw or treated water in the Main Condenser and Air Removal System.
3.4.1-36	Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable. There are no gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-37	Steel, stainless steel, and nickel-based alloy piping, piping components, and piping elements exposed to steam	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Consistent with NUREG-1801. The Water Chemistry program, B.2.1.2, will be used to manage the loss of material due to pitting and crevice corrosion in stainless steel, piping, piping components, and piping elements exposed to steam in the Auxiliary Feedwater System and Main Steam System.
3.4.1-38	Steel bolting and external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Consistent with NUREG-1801. The Boric Acid Corrosion program, B.2.1.4, will be used to manage the loss of material due to boric acid corrosion on the external surfaces of steel bolting, heat exchanger components, piping, piping components, piping elements, steam generator components, tanks, and turbine casings exposed to air with borated water leakage in the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, and Steam Generators.
3.4.1-39	Stainless steel piping, piping components, and piping elements exposed to steam	Cracking due to stress corrosion cracking	Water Chemistry	No	Consistent with NUREG-1801. The Water Chemistry program, B.2.1.2, will be used to manage cracking due to stress corrosion cracking in stainless steel piping, piping components, and piping elements exposed to steam in the Auxiliary Feedwater System and Main Steam System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-40	Glass piping elements exposed to air, lubricating oil, raw water, and treated water	None	None	NA - No AEM or AMP	Not applicable. There are no glass piping elements exposed to air, lubricating oil, raw water, and treated water in the Steam and Power Conversion System.
3.4.1-41	Stainless steel, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled (external)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.4.1-42	Steel piping, piping components, and piping elements exposed to air – indoor controlled (external)	None	None	NA - No AEM or AMP	Not applicable. All indoor air environments at Salem are assumed to be uncontrolled for license renewal.
3.4.1-43	Steel and stainless steel piping, piping components, and piping elements in concrete	None	None	NA - No AEM or AMP	Not applicable. There are no steel and stainless steel piping, piping components, and piping elements in concrete in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-44	Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	NA - No AEM or AMP	Not applicable. There are no steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas in the Steam and Power Conversion System.

Table 3.4.2-1
Auxiliary Feedwater System
Summary of Aging Management Evaluation

Table 3.4.2-1 Auxiliary Feedwater System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bird Screen	Filter	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Aboveground Non-Steel Tanks	III.B2-7	3.5.1-50	E, 1
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-4	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	VIII.H-5	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-1	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-2	3.4.1-38	A
Flow Element	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Flow Element	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Flow Element	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Flow Element	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Leakage Boundary	Stainless Steel (Tubeside Components)	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	C

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Leakage Boundary	Stainless Steel (Tubeside Components)	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	C
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Leakage Boundary	Stainless Steel (Tubeside Components)	Closed Cycle Cooling Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Closed-Cycle Cooling Water System	VIII.G-28	3.4.1-23	D
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Leakage Boundary	Stainless Steel (Tubeside Components)	Closed Cycle Cooling Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Closed-Cycle Cooling Water System	VIII.G-2	3.4.1-25	B
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Shellside Components)	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	C
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Shellside Components)	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	C
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Shellside Components)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.F-27	3.4.1-16	A
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Shellside Components)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.F-27	3.4.1-16	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubes)	Closed Cycle Cooling Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Closed-Cycle Cooling Water System	VIII.G-28	3.4.1-23	D
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubes)	Closed Cycle Cooling Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Closed-Cycle Cooling Water System	VIII.G-2	3.4.1-25	B
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	C
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	C
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubesheet)	Closed Cycle Cooling Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Closed-Cycle Cooling Water System	VIII.G-28	3.4.1-23	D
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubesheet)	Closed Cycle Cooling Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Closed-Cycle Cooling Water System	VIII.G-2	3.4.1-25	B
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubesheet)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.F-27	3.4.1-16	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel (Tubesheet)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.F-27	3.4.1-16	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Heat Transfer	Stainless Steel (Tubes)	Lubricating Oil (External)	Reduction of Heat Transfer/Fouling	Lubricating Oil Analysis	VIII.G-12	3.4.1-10	B
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Heat Transfer	Stainless Steel (Tubes)	Lubricating Oil (External)	Reduction of Heat Transfer/Fouling	One-Time Inspection	VIII.G-12	3.4.1-10	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Heat Transfer	Stainless Steel (Tubes)	Treated Water (Internal)	Reduction of Heat Transfer/Fouling	One-Time Inspection	VIII.F-10	3.4.1-9	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Heat Transfer	Stainless Steel (Tubes)	Treated Water (Internal)	Reduction of Heat Transfer/Fouling	Water Chemistry	VIII.F-10	3.4.1-9	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Carbon Steel (Shellside Components)	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Carbon Steel (Shellside Components)	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Carbon Steel (Shellside Components)	Lubricating Oil (Internal)	Loss of Material/General, Pitting, Crevice, and Microbiologically-Influenced Corrosion	Lubricating Oil Analysis	VIII.G-6	3.4.1-12	B
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Carbon Steel (Shellside Components)	Lubricating Oil (Internal)	Loss of Material/General, Pitting, Crevice, and Microbiologically-Influenced Corrosion	One-Time Inspection	VIII.G-6	3.4.1-12	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Stainless Steel (Tubes)	Lubricating Oil (External)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	Lubricating Oil Analysis	VIII.G-3	3.4.1-19	B
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Stainless Steel (Tubes)	Lubricating Oil (External)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	One-Time Inspection	VIII.G-3	3.4.1-19	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.F-27	3.4.1-16	A
Heat Exchanger Components (Turbine-Driven Pump Governor, Turbine Bearing)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.F-27	3.4.1-16	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Piping and Fittings	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	External Surfaces Monitoring	VII.H1-8	3.3.1-60	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air/Gas - Wetted (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.G-34	3.4.1-30	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Lubricating Oil Analysis	VIII.G-35	3.4.1-7	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-35	3.4.1-7	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Soil (External)	Loss of Material/General, Pitting, Crevice, and Microbiologically-Influenced Corrosion	Buried Piping Inspection	VIII.G-1	3.4.1-11	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VIII.B1-10	3.4.1-1	A, 2

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B1-9	3.4.1-29	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.A-10	3.4.1-39	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.A-12	3.4.1-37	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A
Pump Casing (AFST Circulator)	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Pump Casing (AFST Circulator)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Pump Casing (AFST Circulator)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Pump Casing (AFST Circulator)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Pump Casing (Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Pump Casing (Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Pump Casing (Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Pump Casing (Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.G-33	3.4.1-14	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.G-33	3.4.1-14	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A
Restricting Orifices	Throttle	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Restricting Orifices	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Restricting Orifices	Throttle	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Restricting Orifices	Throttle	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A
Strainer Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Strainer Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Tanks (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Aboveground Non-Steel Tanks	III.B2-7	3.5.1-50	E, 1
Tanks (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel	Soil (External)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	Aboveground Non-Steel Tanks			G, 3
Tanks (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-41	3.4.1-6	A
Tanks (Auxiliary Feedwater Storage Tank)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-41	3.4.1-6	A
Thermowell	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Thermowell	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Thermowell	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Thermowell	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Turbine Casing (Turbine-driven Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Turbine Casing (Turbine-driven Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Turbine Casing (Turbine-driven Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Air/Gas - Wetted (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.G-34	3.4.1-30	A
Turbine Casing (Turbine-driven Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Turbine Casing (Turbine-driven Auxiliary Feedwater)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Valve Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	External Surfaces Monitoring	VII.H1-8	3.3.1-60	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B1-9	3.4.1-29	B
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.G-38	3.4.1-4	A
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.G-38	3.4.1-4	A
Valve Body	Pressure Boundary	Gray Cast Iron	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Pressure Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Valve Body	Pressure Boundary	Gray Cast Iron	Air/Gas - Wetted (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.G-34	3.4.1-30	A
Valve Body	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Valve Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.G-32	3.4.1-16	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.G-32	3.4.1-16	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material, and environment combination.
I	Aging effect in NUREG-1801 for this component, material, and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Aboveground Non-Steel Tanks program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.3.

3. The Aboveground Non-Steel Tanks program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.4.2-2
Main Condensate and Feedwater System
Summary of Aging Management Evaluation

Table 3.4.2-2 Main Condensate and Feedwater System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-4	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	VIII.H-5	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-2	3.4.1-38	A
Bolting	Mechanical Closure	Stainless Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	IV.C2-8	3.1.1-52	B
Bolting	Mechanical Closure	Stainless Steel Bolting	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	C
Flow Device	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Flow Device	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A
Flow Device	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A
Flow Element	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Flow Element	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A
Flow Element	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Shellside Components)	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Shellside Components)	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.E-37	3.4.1-3	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Shellside Components)	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.E-37	3.4.1-3	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (External)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (External)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (External)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D1-9	3.4.1-29	D
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (Internal)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (Internal)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tube Sheet)	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D1-9	3.4.1-29	D
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tubeside Components)	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tubeside Components)	Treated Water (Internal)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tubeside Components)	Treated Water (Internal)	Loss of Material/General, Pitting, Crevice, and Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Carbon Steel (Tubeside Components)	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D1-9	3.4.1-29	D
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.F-3	3.4.1-14	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.F-3	3.4.1-14	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-4	3.4.1-16	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-4	3.4.1-16	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.F-3	3.4.1-14	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.F-3	3.4.1-14	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-4	3.4.1-16	A
Heat Exchanger Components (Feedwater Heaters)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-4	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VIII.D1-7	3.4.1-1	A, 1
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D1-9	3.4.1-29	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.D1-5	3.4.1-14	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.D1-5	3.4.1-14	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C2-10	3.1.1-7	A, 1
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Pump Casing (Condensate)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Pump Casing (Condensate)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A
Pump Casing (Condensate)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Pump Casing (SG Feedwater)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Pump Casing (SG Feedwater)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.D1-5	3.4.1-14	A
Pump Casing (SG Feedwater)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.D1-5	3.4.1-14	A
Pump Casing (SG Feedwater)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A
Pump Casing (SG Feedwater)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A
Spectacle Blinds	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Spectacle Blinds	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Spectacle Blinds	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Strainer Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Thermowell	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Thermowell	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A
Thermowell	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Valve Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.D1-8	3.4.1-4	A
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.D1-8	3.4.1-4	A
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D1-9	3.4.1-29	B
Valve Body	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D1-4	3.4.1-16	A

Table 3.4.2-2 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D1-4	3.4.1-16	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material, and environment combination.
I	Aging effect in NUREG-1801 for this component, material, and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.3.

Table 3.4.2-3
Main Condenser and Air Removal System
Summary of Aging Management Evaluation

Table 3.4.2-3 Main Condenser and Air Removal System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Carbon Steel (Shellside components)	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Carbon Steel (Shellside components)	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.E-37	3.4.1-3	A
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Carbon Steel (Shellside components)	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.E-37	3.4.1-3	A
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Copper Alloy with 15% Zinc or More (Tubesheet)	Raw Water (External)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion, and Fouling	Open-Cycle Cooling Water System	VII.C1-9	3.3.1-81	C
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Copper Alloy with 15% Zinc or More (Tubesheet)	Raw Water (External)	Loss of Material/Selective Leaching	Selective Leaching of Materials	VIII.E-20	3.4.1-35	C
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Copper Alloy with 15% Zinc or More (Tubesheet)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-5	3.4.1-15	C
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Copper Alloy with 15% Zinc or More (Tubesheet)	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.A-5	3.4.1-15	C

Table 3.4.2-3 Main Condenser and Air Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Copper Alloy with 15% Zinc or More (Tubesheet)	Treated Water (Internal)	Loss of Material/Selective Leaching	Selective Leaching of Materials	VIII.E-21	3.4.1-35	C
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Stainless Steel (Tubes)	Raw Water (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion, and Fouling	Open-Cycle Cooling Water System	VIII.E-3	3.4.1-33	A
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-36	3.4.1-16	A
Heat Exchanger Components (Main Condenser and Hotwell)	Pressure Boundary	Stainless Steel (Tubes)	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-36	3.4.1-16	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material, and environment combination.
I	Aging effect in NUREG-1801 for this component, material, and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None

Table 3.4.2-4
Main Steam System
Summary of Aging Management Evaluation

Table 3.4.2-4 Main Steam System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-4	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	VIII.H-5	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-1	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-2	3.4.1-38	A
Condensing Chamber	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	C
Condensing Chamber	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	C
Condensing Chamber	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.E-38	3.4.1-14	A
Condensing Chamber	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.E-38	3.4.1-14	A
Condensing Chamber	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	C
Condensing Chamber	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	C
Flow Element	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Flow Element	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-2	3.4.1-39	A, 1

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Flow Element	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-3	3.4.1-37	A, 1
Flow Element	Throttle	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-2	3.4.1-39	A, 1
Flow Element	Throttle	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-3	3.4.1-37	A, 1
Piping and Fittings	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.B1-11	3.4.1-4	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.B1-11	3.4.1-4	A
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B1-9	3.4.1-29	B
Piping and Fittings	Leakage Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B1-5	3.4.1-14	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-5	3.4.1-14	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	External Surfaces Monitoring	VII.H1-8	3.3.1-60	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VIII.B1-10	3.4.1-1	A, 2
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B1-9	3.4.1-29	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Piping and Fittings	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-2	3.4.1-39	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-3	3.4.1-37	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B1-5	3.4.1-14	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-5	3.4.1-14	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Restricting Orifices	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Restricting Orifices	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Restricting Orifices	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.B1-11	3.4.1-4	A
Restricting Orifices	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.B1-11	3.4.1-4	A
Restricting Orifices	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Restricting Orifices	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Restricting Orifices	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Restricting Orifices	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Strainer Body	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Strainer Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.B1-11	3.4.1-4	A
Strainer Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.B1-11	3.4.1-4	A
Strainer Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Strainer Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.B1-11	3.4.1-4	A
Strainer Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.B1-11	3.4.1-4	A
Thermowell	Leakage Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Thermowell	Leakage Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Thermowell	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Thermowell	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B1-5	3.4.1-14	A
Thermowell	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-5	3.4.1-14	A
Thermowell	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	A
Thermowell	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	A
Thermowell	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Thermowell	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Thermowell	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Thermowell	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-2	3.4.1-39	A
Thermowell	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-3	3.4.1-37	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.B1-11	3.4.1-4	A
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.B1-11	3.4.1-4	A
Valve Body	Leakage Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Valve Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Valve Body	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B1-5	3.4.1-14	A
Valve Body	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-5	3.4.1-14	A
Valve Body	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	A
Valve Body	Leakage Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	A
Valve Body	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	External Surfaces Monitoring	VII.H1-8	3.3.1-60	A
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	VIII.H-9	3.4.1-38	A
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	One-Time Inspection	VIII.A-16	3.4.1-2	A
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting, and Crevice Corrosion	Water Chemistry	VIII.A-16	3.4.1-2	A
Valve Body	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Valve Body	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J-16	3.3.1-99	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B1-5	3.4.1-14	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B1-5	3.4.1-14	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-4	3.4.1-16	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B1-4	3.4.1-16	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material, and environment combination.
I	Aging effect in NUREG-1801 for this component, material, and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Stainless steel flow elements are inserted into a carbon steel pipe. Therefore, the flow element does not have an external environment.
2. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.3.
3. The Periodic Inspection program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.4.2-5
Main Turbine and Auxiliaries System
Summary of Aging Management Evaluation

Table 3.4.2-5 Main Turbine and Auxiliaries System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting, and Crevice Corrosion	Bolting Integrity	VIII.H-4	3.4.1-22	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	VIII.H-5	3.4.1-22	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	Lubricating Oil Analysis	VIII.A-9	3.4.1-19	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	One-Time Inspection	VIII.A-9	3.4.1-19	A
Valve Body	Pressure Boundary	Aluminum	Air - Indoor (External)	None	None	V.F-2	3.2.1-50	A
Valve Body	Pressure Boundary	Aluminum	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	Lubricating Oil Analysis			G
Valve Body	Pressure Boundary	Aluminum	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	One-Time Inspection			G
Valve Body	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	VIII.I-10	3.4.1-41	A
Valve Body	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	Lubricating Oil Analysis	VIII.A-9	3.4.1-19	B

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material/Pitting, Crevice, and Microbiologically-Influenced Corrosion	One-Time Inspection	VIII.A-9	3.4.1-19	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material, and environment combination.
I	Aging effect in NUREG-1801 for this component, material, and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None

3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

3.5.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.4, Scoping and Screening Results: Structures and Component Supports, as being subject to aging management review. The structures and component supports or portions of structures, component supports and commodities, which are addressed in this section, are described in the indicated sections.

- Auxiliary Building (2.4.1)
- Component Supports Commodity Group (2.4.2)
- Containment Structure (2.4.3)
- Fire Pump House (2.4.4)
- Fuel Handling Building (2.4.5)
- Office Buildings (2.4.6)
- Penetration Areas (2.4.7)
- Pipe Tunnel (2.4.8)
- Piping and Component Insulation Commodity Group (2.4.9)
- SBO Compressor Building (2.4.10)
- Service Building (2.4.11)
- Service Water Accumulator Enclosures (2.4.12)
- Service Water Intake (2.4.13)
- Shoreline Protection and Dike (2.4.14)
- Switchyard (2.4.15)
- Turbine Building (2.4.16)
- Yard Structures (2.4.17)

3.5.2 RESULTS

The following tables summarize the results of the aging management review for Structures and Component Supports:

Table 3.5.2-1 Summary of Aging Management Evaluation - Auxiliary Building

Table 3.5.2-2 Summary of Aging Management Evaluation - Component Supports Commodity Group

Table 3.5.2-3 Summary of Aging Management Evaluation - Containment Structure

Table 3.5.2-4 Summary of Aging Management Evaluation - Fire Pump House

3.5.2.1 Materials, Environments, Aging Effects Requiring Management and Aging Management Programs

3.5.2.1.1 Auxiliary Building

Materials

The materials of construction for the Auxiliary Building components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Concrete block
- Copper
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Grout
- Reinforced concrete

- Stainless Steel
- Stainless Steel Bolting

Environments

The Auxiliary Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Concrete
- Encased in Steel
- Groundwater/Soil
- Raw Water
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Auxiliary Building components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Cracking/Shrinkage
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Auxiliary Building components:

- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-1, Summary of Aging Management Evaluation – Auxiliary Building summarizes the results of the aging management review for the Auxiliary Building.

3.5.2.1.2 Component Supports Commodity Group

Materials

The materials of construction for the Component Supports Commodity Group components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Graph-Air Tool Steel
- High Strength Low Alloy Steel Bolting with Yield Strength Greater than 150 ksi
- High Strength Stainless Steel Bolting with Yield Strength Greater than 150 ksi
- Lubrite
- Reinforced concrete; Grout
- Stainless Steel
- Stainless Steel Bolting

Environments

The Component Supports Commodity Group components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Air with Steam or Water Leakage
- Treated Borated Water

Aging Effects Requiring Management

The following aging effects associated with the Component Supports Commodity Group components require management:

- Lock-up due to wear
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting and Crevice Corrosion
- Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads
- Loss of Preload/Self-Loosening
- Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms
- Reduction or Loss of Isolation Function/Radiation Hardening, Temperature, Humidity, Sustained Vibratory Loading

Aging Management Programs

The following aging management programs manage the aging effects for the Component Supports Commodity Group components:

- ASME Section XI, Subsection IWF (B.2.1.30)
- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring Program (B.2.1.33)
- Water Chemistry (B.2.1.2)

Table 3.5.2-2, Summary of Aging Management Evaluation – Component Supports Commodity Group summarizes the results of the aging management review for the Component Supports Commodity Group.

3.5.2.1.3 <u>Containment Structure</u>

Materials

The materials of construction for the Containment Structure components are:

- Asbestos
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting

- Paint
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Containment Structure components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Air with Steam or Water Leakage
- Concrete
- Encased in Steel
- Groundwater/Soil
- Raw Water
- Treated Borated Water
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Containment Structure components require management:

- Cracking, Blistering, Flaking, Peeling, and Delamination
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Cumulative Fatigue Damage/Fatigue
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Leaktightness/Mechanical Wear of Locks, Hinges and Closure Mechanisms
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/Boric Acid Corrosion

- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion, and Fouling
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Containment Structure components:

- 10 CFR Part 50, Appendix J (B.2.1.31)
- ASME Section XI, Subsection IWE (B.2.1.28)
- ASME Section XI, Subsection IWL (B.2.1.29)
- Boric Acid Corrosion (B.2.1.4)
- Buried Non-Steel Piping Inspection (B.2.2.4)
- Protective Coating Monitoring and Maintenance Program (B.2.1.35)
- Structures Monitoring Program (B.2.1.33)
- TLAA (4.5)
- Water Chemistry (B.2.1.2)
- Periodic Inspection (B.2.2.2)

Table 3.5.2-3, Summary of Aging Management Evaluation – Containment Structure summarizes the results of the aging management review for the Containment Structure.

3.5.2.1.4 Fire Pump House

Materials

The materials of construction for the Fire Pump House components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Concrete block
- Elastomers
- Galvanized Steel

- Galvanized Steel Bolting
- Grout
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Fire Pump House components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil

Aging Effects Requiring Management

The following aging effects associated with the Fire Pump House components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Cracking/Shrinkage
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management program manages the aging effects for the Fire Pump House components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-4, Summary of Aging Management Evaluation – Fire Pump House summarizes the results of the aging management review for the Fire Pump House.

3.5.2.1.5 Fuel Handling Building

Materials

The materials of construction for the Fuel Handling Building components are:

- Aluminum
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Grout
- Reinforced Concrete
- Stainless Steel

Environments

The Fuel Handling Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Concrete
- Groundwater/Soil
- Treated Borated Water
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Fuel Handling Building components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Shrinkage
- Cracking/Stress Corrosion Cracking
- Cracks and Distortion/Increased Stress Levels from Settlement
- Cumulative Fatigue Damage/Fatigue

- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/ Abrasion; Cavitation
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Fuel Handling Building components:

- Boric Acid Corrosion (B.2.1.4)
- Buried Non-Steel Piping Inspection (B.2.2.4)
- One-Time Inspection (B.2.1.20)
- Periodic Inspection (B.2.2.2)
- Structures Monitoring Program (B.2.1.33)
- TLAA (4.5)
- Water Chemistry (B.2.1.2)

Table 3.5.2-5, Summary of Aging Management Evaluation – Fuel Handling Building summarizes the results of the aging management review for the Fuel Handling Building.

3.5.2.1.6 Office Buildings

Materials

The materials of construction for the Office Buildings components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Concrete block
- Elastomers

- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete

Environments

The Office Buildings components are exposed to the following environments:

- Air – Indoor
- Air – Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil

Aging Effects Requiring Management

The following aging effects associated with the Office Buildings components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management program manages the aging effects for the Office Buildings components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-6, Summary of Aging Management Evaluation – Office Buildings summarizes the results of the aging management review for the Office Buildings.

3.5.2.1.7 Penetration Areas

Materials

The materials of construction for the Penetration Areas components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Copper
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced Concrete

Environments

The Penetration Areas components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Penetration Areas components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting and Crevice Corrosion

- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Penetration Areas components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-7, Summary of Aging Management Evaluation – Penetration Areas summarizes the results of the aging management review for the Penetration Areas.

3.5.2.1.8 Pipe Tunnel

Materials

The materials of construction for the Pipe Tunnel components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Grout
- Reinforced Concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Pipe Tunnel components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Concrete
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Pipe Tunnel components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Shrinkage
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/Boric Acid Corrosion
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Pipe Tunnel components:

- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-8, Summary of Aging Management Evaluation – Pipe Tunnel summarizes the results of the aging management review for the Pipe Tunnel.

3.5.2.1.9 Piping and Component Insulation Commodity Group

Materials

The materials of construction for the Piping and Component Insulation Commodity Group components are:

- Aluminum
- Calcium Silicate
- Ceramic Fiber
- Fiberglass

- Fiberglass Blanket
- Min "K"
- NUKON
- Stainless Steel

Environments

The Piping and Component Insulation Commodity Group components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air with Borated Water Leakage
- Air with Steam or Water Leakage

Aging Effects Requiring Management

The following aging effects associated with the Piping and Component Insulation Commodity Group components require management:

- Loss of Material/Boric Acid Corrosion
- Loss of Material/Pitting and Crevice Corrosion

Aging Management Programs

The following aging management programs manage the aging effects for the Piping and Component Insulation Commodity Group components:

- Boric Acid Corrosion (B.2.1.4)
- Periodic Inspection (B.2.2.2)

Table 3.5.2-9, Summary of Aging Management Evaluation – Piping and Component Insulation Commodity Group summarizes the results of the aging management review for the Piping and Component Insulation Commodity Group.

3.5.2.1.10 <u>SBO Compressor Building</u>

Materials

The materials of construction for the SBO Compressor Building components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete block

- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete

Environments

The SBO Compressor Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Groundwater/Soil

Aging Effects Requiring Management

The following aging effects associated with the SBO Compressor Building components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting and Crevice Corrosion
- Loss of Preload/Self-Loosening

Aging Management Programs

The following aging management programs manage the aging effects for the SBO Compressor Building components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-10, Summary of Aging Management Evaluation – SBO Compressor Building summarizes the results of the aging management review for the SBO Compressor Building.

3.5.2.1.11 <u>Service Building</u>

Materials

The materials of construction for the Service Building components are:

- Aluminum
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Concrete block
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced Concrete

Environments

The Service Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Service Building components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide

- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Service Building components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-11, Summary of Aging Management Evaluation – Service Building summarizes the results of the aging management review for the Service Building.

3.5.2.1.12 Service Water Accumulator Enclosures

Materials

The materials of construction for the Service Water Accumulator Enclosures components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete

Environments

The Service Water Accumulator Enclosures components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Groundwater/soil

Aging Effects Requiring Management

The following aging effects associated with the Service Water Accumulator Enclosures components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting and Crevice Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Service Water Accumulator Enclosures components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-12, Summary of Aging Management Evaluation – Service Water Accumulator Enclosures summarizes the results of the aging management review for the Service Water Accumulator Enclosures.

3.5.2.1.13 <u>Service Water Intake</u>

Materials

The materials of construction for the Service Water Intake components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Elastomers
- Galvanized Steel
- Grout
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

- Treated Wood

Environments

The Service Water Intake components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Groundwater/soil
- Raw Water
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Service Water Intake components require management:

- Change in Material Properties, Loss of Material/ Insect Damage, and Moisture Damage
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Shrinkage
- Cracks and Distortion/Increased Stress Levels from Settlement
- Hardening and Loss of Strength/Elastomer Degradation
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/ Abrasion; Cavitation
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Service Water Intake components:

- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.34)
- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-13, Summary of Aging Management Evaluation – Service Water Intake summarizes the results of the aging management review for the Service Water Intake.

3.5.2.1.14 Shoreline Protection and Dike

Materials

The materials of construction for the Shoreline Protection and Dike components are:

- Carbon Steel
- Reinforced Concrete
- Soil, Rip-Rap, Sand, Gravel

Environments

The Shoreline Protection and Dike components are exposed to the following environments:

- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Shoreline Protection and Dike components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material, Loss of Form/Erosion, Settlement, Sedimentation, Frost Action, Waves, Currents, Surface Runoff, Seepage
- Loss of Material/ Abrasion; Cavitation
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion

Aging Management Programs

The following aging management programs manage the aging effects for the Shoreline Protection and Dike components:

- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.34)
- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-14, Summary of Aging Management Evaluation – Shoreline Protection and Dike summarizes the results of the aging management review for the Shoreline Protection and Dike.

3.5.2.1.15 Switchyard

Materials

The materials of construction for the Switchyard components are:

- Aluminum
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Galvanized Steel
- Galvanized Steel Bolting
- PVC
- Reinforced Concrete
- Stainless Steel Bolting

Environments

The Switchyard components are exposed to the following environments:

- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/soil
- Water - Standing
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Switchyard components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening

Aging Management Programs

The following aging management programs manage the aging effects for the Switchyard components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-15, Summary of Aging Management Evaluation – Switchyard summarizes the results of the aging management review for the Switchyard.

3.5.2.1.16 Turbine Building

Materials

The materials of construction for the Turbine Building components are:

- Aluminum
- Aluminum Bolting
- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Concrete
- Concrete Block
- Copper
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting

- Grout
- Reinforced Concrete
- Stainless Steel

Environments

The Turbine Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Turbine Building components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment
- Cracking/Shrinkage
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Turbine Building components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-16, Summary of Aging Management Evaluation – Turbine Building summarizes the results of the aging management review for the Turbine Building.

3.5.2.1.17 Yard Structures

Materials

The materials of construction for the Yard Structures components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel
- Cast Iron
- Concrete
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- PVC
- Reinforced concrete

Environments

The Yard Structures components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- Encased in Steel
- Groundwater/Soil
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Yard Structures components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cracks and Distortion/Increased Stress Levels from Settlement
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw

- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Preload/Self-Loosening
- Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)

Aging Management Programs

The following aging management programs manage the aging effects for the Yard Structures components:

- Structures Monitoring Program (B.2.1.33)

Table 3.5.2-17, Summary of Aging Management Evaluation – Yard Structures summarizes the results of the aging management review for the Yard Structures.

3.5.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the LRA. For the Containments, Structures, and Component Supports, those programs are addressed in the following subsections.

3.5.2.2.1 PWR and BWR Containments

3.5.2.2.1.1 Aging of Inaccessible Concrete Areas

Increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in inaccessible areas of PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. However, the GALL Report recommends further evaluation of plant - specific programs to manage the aging effects for inaccessible areas if the environment is aggressive. Acceptance criteria are described in Branch Technical Position in RLSB-1.

At Salem, ASME Section XI, Subsection IWL program, B.2.1.29, is used to manage aging of accessible Containment Structure concrete elements for increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. The Structures Monitoring Program, B.2.1.33, will be used to manage increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for inaccessible (below grade) areas of the containment.

Evaluation of inaccessible areas follows.

The Structures Monitoring Program, B.2.1.33, will be used to monitor below grade portions of the Containment concrete.

Inaccessible, below-grade reinforced concrete, for the Containment Structures, is subject to an aggressive environment. Groundwater was sampled and tested in 2008 and 2009. Test results revealed that pH values meet the limits to be considered a non-aggressive environment, (i.e., pH > 5.5). The test results for sulfates were variable across the site and between test periods, with test results indicating a non-aggressive environment due to sulfates, (i.e., sulfates level <1500 ppm). The test results for chlorides were variable across the site, with some results indicating an aggressive environment due to chlorides (chloride test results between 7 to 4800 ppm), where limits consist of a chloride level < 500 ppm, indicating a non-aggressive environment. The ground water and river water are, therefore, considered aggressive environments due to chloride levels.

At Salem, the Containment Structure is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. Concrete aggregates conform to the requirements of ASTM C 33-66. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity and were also tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 88-63. The coarse aggregate selected and used on the Salem Project was quarried stone, crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. For the reactor containment wall, in the area adjacent to the equipment and personnel hatches where additional reinforcing steel was specified, a more plastic mix was designed for adequate concrete placement. In this case, the slump was increased to be between 6 and 7 inches. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. Degradation of concrete due to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel has not been experienced at Salem.

Exposed portions of below grade concrete will be examined when excavated for any reason and groundwater chemistry will be monitored periodically in accordance with the Structures Monitoring Program, B.2.1.33. Also the enhanced periodic inspections of the submerged portions of the Service Water Intake Structure will be used as indicators for the condition of below-grade structures. Because groundwater chemistry is bounded by river water chemistry, the use of submerged structures as a leading indicator for the potential degradation of below-grade structures provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. In the event inspection of submerged structures identify significant concrete degradations at the Service Water Intake structure, corrective actions will be initiated to evaluate the condition of inaccessible portions of the Containment Structure and determine if excavation of concrete for inspection is warranted. Operating experience review has not identified significant signs of distress due to aggressive chemical attack or corrosion of embedded steel of submerged concrete components.

In summary, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete. These aging effects will be monitored for submerged reinforced concrete components and used as a leading indicator for the potential degradation to below-grade structures. If the aging effects are significant for submerged structures, corrective actions will be initiated to evaluate inaccessible concrete and determine if excavation to expose and inspect the concrete is warranted. In addition Salem will inspect inaccessible reinforced concrete if excavated for any reason, and monitor groundwater chemistry periodically as required by the Structures Monitoring Program, B.2.1.33. The enhanced program will require periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates, and assessing its impact on buried structures. The Structures Monitoring Program and ASME Section XI, Subsection IWL program are described in Appendix B.

3.5.2.2.1.2 Cracks and Distortion due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, Cracking and Differential Settlement due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program

Cracks and distortion due to increased stress levels from settlement could occur in PWR and BWR concrete and steel containments. Also, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. The existing program relies on Structures Monitoring Program to manage these aging effects. Some plants may rely on a de-watering system to lower the site ground water level. If the plant's CLB credits a de-watering system, the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL Report recommends no further evaluation if this activity is within the scope of the applicant's Structures Monitoring Program.

At Salem, ASME Section XI, Subsection IWL program, B.2.1.29, is used to manage potential cracks and distortion due to increased stress levels from settlement, in accessible areas of the Containment Structure. The Structures Monitoring Program, B.2.1.33, will be used to manage this aging effect/mechanism in inaccessible areas of the Containment Structure. The aging effect/mechanism is expected to be insignificant as explained below.

The foundation of the Containment Structure is established directly in the Paleocene silty sands of the Vincetown Formation or upon lean concrete fill extending to this Formation. The Vincetown soils are preconsolidated and/or cemented as a result of its depositional environment and subsequent erosion of younger sediments. Thus, this formation provides excellent foundation support for Salem structures. Measurements made throughout plant construction and during initial operation indicated a maximum settlement of approximately 0.5 inch. Salem has not experienced cracks and distortion due to increased stress levels from settlement of structures. ASME Section XI, Subsection IWL , B.2.1.29, program will be used to manage aging of accessible Containment Structure concrete elements for cracks and distortion due to increased stress levels from settlement. Inaccessible Containment concrete surfaces which are below grade will be examined using the Structures Monitoring Program when excavated for any reason.

Item Number 3.5.1-3 is not applicable to Salem. Porous concrete is not incorporated into the design and construction of the Containment Structure foundation and a permanent de-watering system does not exist at Salem.

The Structures Monitoring Program and ASME Section XI, Subsection IWL program are described in Appendix B.

3.5.2.2.1.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus of concrete due to elevated temperature. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The GALL Report recommends further evaluation of a plant-specific aging management program if any portion of the concrete containment components exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). Acceptance criteria are described in Branch Technical Position in RLSB-1.

Item Number 3.5.1-4 is not applicable to Salem. The Containment Structure concrete is not exposed to general temperature greater than 150°F and local area temperature greater than 200°F. Technical Specification 3 /4.6.1.5 limits the average air temperature inside the Containment during normal plant operation to 120°F. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through cooling coils. Process piping penetrations in the Containment wall for high temperature piping are insulated and provided with a cooling system to limit concrete temperature to a maximum of 150°F. The Penetration Air Cooling System, evaluated with the Compressed Air System, provides this cooling design feature. No portion of the concrete containment components exceeds specified temperature limits.

3.5.2.2.1.4 Loss of Material due to General, Pitting and Crevice Corrosion

Loss of material due to general, pitting and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging *effect for inaccessible areas if corrosion is significant. Acceptance criteria are described in Branch Technical Position in RLSB-1.*

Item Number 3.5.1-5 is applicable to BWRs only and is not used for Salem.

The following discussion is applicable to Item Number 3.5.1-6.

At Salem, ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50, Appendix J, B.2.1.31, programs will be used to manage aging of accessible and inaccessible areas of the Containment Structure steel elements due to general, pitting, and crevice corrosion. Visual and ultrasonic testing (UT) examinations of the containment liner conducted in accordance with ASME Section XI, Subsection IWE have not identified significant loss of material due to corrosion. Also, as discussed below, the conditions established in the GALL Report are met and thus a further evaluation of plant-specific aging management programs is not required for managing loss of material due corrosion in inaccessible areas of the Containment Structure steel elements.

Concrete in accessible interior areas of the Containment Structure is monitored by the Structures Monitoring Program, B.2.1.33, to ensure penetrating cracks that could provide a path for water seepage to the surface of the containment liner, if identified, are entered in the corrective action process and accepted by evaluation or repaired.

The lower portion of the Containment steel liner at Salem is largely covered by the liner insulation and stainless steel lagging, causing portions of the liner to be considered inaccessible in accordance with ASME Section XI, Subsection IWE-1232. Thus only the portions of the steel liner that are accessible are inspected by general visual examination in accordance with ASME Section XI, Subsection IWE. The inaccessible steel liner areas are accepted based on the condition of adjacent accessible areas.

In 2008, a sample of four (4) Unit 1 insulation panels and lagging were removed to allow inspection of the steel liner plate and the moisture barrier. Inspection of the exposed steel liner in accordance with ASME Section XI, Subsection IWE, identified no degradation of the moisture barrier or significant liner corrosion. The examiner noted minor rust in two areas and a coating blister was noted and determined to be due to an imperfection in the application process. The examiner removed the blister and found no loss of base metal in the area beneath the blister. The examiner identified no recordable indications of the liner and the moisture barrier. Because this area has been identified in the industry as potentially susceptible to corrosion, Salem will remove the insulation and lagging at sample locations, and inspect the liner in accordance with ASME Section XI, Subsection IWE. A sample of the Unit 2 insulation and lagging will be removed and inspected prior to entering the period of extended operation. Thereafter, removal of the sample insulation and lagging panels and the examination of the liner will be done consistent with ASME Section XI, Subsection IWE inspection frequency. Visual inspection of 100% of the moisture barrier, at the junction between the containment concrete floor and the containment liner, will be performed in accordance with ASME Section XI, Subsection IWE program requirements, to the extent practical within the limitation of design, geometry and materials of construction of the components. The bottom edge of the stainless steel insulation lagging will be trimmed, if necessary, to perform the moisture barrier inspections. These inspections are included as an enhancement to ASME Section XI, Subsection IWE, B.2.1.28.

At Salem borated water leakage is monitored in accordance with the Boric Acid Corrosion, B.2.1.4. Plant operating experience review did not identify degradation of the liner due to borated water leakage.

There are only limited potential causes for liner degradation. Leaks inside the containment are limited by Technical Specifications to very small values. Historically, the majority of the leaks were from Service Water piping at el. 130', which has been subsequently upgraded. The replacement of the Service Water piping during the 1990's with a material that is much more resistant to Service Water has significantly reduced leakage. There are multiple barriers to prevent water-induced corrosion of the liner. The lower portion of the liner is covered with insulation that is sealed against moisture intrusion with plastic film covered by stainless steel lagging and sealed flashing. The liner was painted with an epoxy coating to prevent corrosion even if water did penetrate the insulation. There is a moisture barrier at the junction of the concrete floor and the liner. In addition, floors are sloped away from the liner towards the drainage trench. A procedure entitled "Service Water Spill Response in Containment" is implemented to appropriately address and clean up any service water leakage in the containment. Any leakage identified, which could potentially reach the liner, has been investigated for potential effect on the liner. Inspections since the early 1990's have not identified significant liner corrosion due to service water or borated water leakage.

As evaluated above, and based on plant operating experience, loss of material due to corrosion is not significant for inaccessible areas of the Containment Structure. Therefore inspections conducted in accordance with ASME Section XI, Subsection IWE, B.2.1.28, program and testing in accordance with 10 CFR Part 50, Appendix J, B.2.1.31, provide reasonable assurance that loss of material due to corrosion in accessible and inaccessible areas of the Containment Structure will be detected prior to a loss of intended function.

The ASME Section XI, Subsection IWE program, Boric Acid Corrosion, 10 CFR Part 50, Appendix J, and Structures Monitoring Programs are described in Appendix B.

3.5.2.2.1.5 <u>Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature</u>

Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a Time-Limited Aging Analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in section 4.5, " Concrete Containment Tendon Prestress Analysis." of the SRP-LR.

Item Number 3.5.1-7 is not applicable to Salem. Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for the Salem Containment Structure is not applicable since the Salem Containment Structure does not use a prestressed concrete containment design.

3.5.2.2.1.6 <u>Cumulative Fatigue Damage</u>

If included in the current licensing basis, fatigue analyses of suppression pool steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6, "Containment Liner Plates, Metal Containments, and Penetrations Fatigue Analysis."

Item Number 3.5.1-8 is applicable to BWRs only and is not used for Salem.

The following discussion is applicable to Item Number 3.5.1-9.

A TLAA evaluation for the Transfer Tube bellows was performed. The stainless steel Transfer Tube bellows are not part of the containment penetration bellows and are not part of the containment pressure boundary but are a water retaining boundary associated with the Reactor Cavity in the Containment and the Transfer Pool in the Fuel Handling Building. The TLAA evaluation shows that the projected number of cycles for 60 years is less than the design cycles. Thus, cracking of transfer tube bellows due to cyclic loading is not expected to occur through the period of extended operation. The TLAA is evaluated in accordance with 10 CFR 54.21(c). Evaluation of this TLAA is discussed in Section 4.5, "Fuel Transfer Tube Bellows Design Cycles".

Cumulative fatigue damage and associated TLAA evaluations are only applicable to the stainless steel Transfer Tube bellows. Salem is a PWR and the design does not include a suppression pool. Fatigue analysis is not included in the current licensing basis for Containment penetrations (including penetration sleeves and dissimilar metal welds).

Cracking of the Salem Containment penetration bellows, due to cyclic loading is not applicable because the Containment penetration bellows located outside of the Containment are not in-scope for license renewal and are not part of the Containment leakage limiting boundary per UFSAR section, 3.8.1.6.8.10, Piping Penetrations:

" ....Containment piping penetrations designed for Salem are not required to be type "B" tested for 10CFR50 Appendix J (Ref. Safety Evaluation S-C-R700-MSE-0253 Rev. 0). The type "B" test is applicable to Containment piping penetrations that utilize expansion bellows as the leakage limiting boundary. The piping penetrations at Salem rely on partial/full penetration seal welds inside containment as the leakage limiting boundary, which are leak rate tested as part of the Appendix J type "A" Containment Integrated Leak Rate Test (ILRT).....".

3.5.2.2.1.7 Cracking due to Stress Corrosion Cracking (SCC)

Cracking due to stress corrosion cracking of stainless steel penetration sleeves, penetration bellows, and dissimilar metal welds could occur in all types of PWR and BWR containments. Cracking due to SCC could also occur in stainless steel vent line bellows for BWR containments. The existing program relies on ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations/evaluations implemented to detect these aging effects for stainless steel penetration sleeves, penetration bellows and dissimilar metal welds, and stainless steel vent line bellows.

Item Number 3.5.1-11 is applicable to BWRs only and is not used for Salem.

The following discussion is applicable to Item Number 3.5.1-10.

Stress corrosion cracking (SCC) is not an applicable aging mechanism for the Containment Structure carbon steel penetration sleeves, stainless steel penetration bellows, and dissimilar metal welds. The Salem Containment liner and associated penetration sleeves are carbon steel. High temperature piping systems penetrating the containment are generally carbon steel. Stress corrosion cracking is only applicable to stainless steel and is predicted only under certain conditions. There are stainless steel and dissimilar metal welds associated with stainless steel piping welded to penetration sleeve cap plates. Salem aging management reviews concluded SCC, of stainless steel at the penetration sleeves, is not considered credible because stainless steel SCC requires a concentration of chloride or sulfate contaminants, which are not normally present in significant quantities, as well as, high stress, and temperatures greater than 140 degrees F. Leakage of water in the containment, which might contact the penetration sleeves, is event driven. The containment pressure boundary welds between stainless steel piping and penetration sleeves, with normal operating temperatures above 140 degrees F, are not highly stressed. In addition, the Technical Specification limits the average air temperature inside the Containment during normal plant operation to 120 degrees F.

Therefore cracking of these components due to stress corrosion cracking is not applicable.

Cracking of the Containment stainless steel penetration bellows, due to stress corrosion cracking is also not applicable because the containment penetration bellows are not part of the containment leakage limiting boundary per UFSAR section, 3.8.1.6.8.10, Piping Penetrations:

"....Containment piping penetrations designed for Salem are not required to be type "B" tested for 10CFR50 Appendix J (Ref. Safety Evaluation S-C-R700-MSE-0253 Rev. 0). The type "B" test is applicable to piping penetrations that utilize expansion bellows as the leakage limiting boundary. The piping penetrations at Salem rely on partial/full penetration seal welds inside containment as the leakage limiting boundary, which are leak rate tested as part of the Appendix J type "A" Containment Integrated Leak Rate Test (ILRT)..."

The stainless steel transfer tube bellows are located in the reactor cavity pool and are not subject to the combination of high temperature, high stress and the concentration of contaminants required for stress corrosion cracking. The transfer tube bellows are evaluated for cumulative fatigue as addressed in paragraph 3.5.2.2.1.6 above. A TLAA evaluation for the Transfer Tube bellows was performed. The TLAA is evaluated in accordance with 10 CFR 54.21(c). Evaluation of this TLAA is discussed in Section 4.5 "Fuel Transfer Tube Bellows Design Cycles".

3.5.2.2.1.8 Cracking due to Cyclic Loading

Cracking due to cyclic loading of suppression pool steel and stainless steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) could occur for all types of PWR and BWR containments and BWR vent header, vent line bellows and downcomers. The existing program relies on ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J to manage this aging effect. However, VT-3 visual inspection may not detect fine cracks. The GALL Report recommends further evaluation for detection of this aging effect.

Item Number 3.5.1-13 is applicable to BWRs only and is not used at Salem. BWR components including suppression pool, BWR vent header, vent line bellows and downcomers do not exist at Salem.

Item Number 3.5.1-12 is not applicable to Salem. Salem is a PWR and BWR components including suppression pool, BWR vent header, vent line bellows and downcomers are not applicable to Salem. The containment penetration bellows are not in-scope for license renewal because they do not perform a Containment structure pressure boundary or any other intended function. The Containment penetration bellows located outside of the containment are not part of the containment leakage limiting boundary per UFSAR section, 3.8.1.6.8.10.

" ....Containment piping penetrations designed for Salem are not required to be type "B" tested for 10CFR50 Appendix J (Ref. Safety Evaluation S-C-R700-MSE-0253 Rev. 0). The type "B" test is applicable to piping penetrations that utilize expansion bellows as the leakage limiting boundary. The piping penetrations at Salem rely on partial/full penetration seal welds inside containment as the leakage limiting boundary, which are leak rate tested as part of the Appendix J type "A" containment Integrated Leak Rate Test (ILRT)....."

The current licensing basis does not address or include any analysis of cyclic loading for the Containment liner or penetrations (including sleeves and dissimilar welds). Plant operating experience has not identified cracking of the bounding piping, the containment liner or penetrations (including sleeves, dissimilar metal welds, and penetrations bellows) as a concern. The carbon steel containment liner forms a composite structure with the containment concrete shell. The composite containment concrete shell and carbon steel liner, and penetrations (including sleeves and dissimilar metal welds) are not subject to cyclic loading induced cracking as analysis for the piping is bounding and enveloping for stresses in the penetrations (including sleeves and dissimilar welds). Cracking, due to fatigue loads, is addressed where applicable, as a TLAA for the associated piping in section 4.3. Cracking is not predicted in the associated piping due to the low design loads and, therefore, is not expected in the Containment liner and penetrations (including sleeves and dissimilar welds).

Thus, fine cracking of penetration sleeves, dissimilar welds, and the containment carbon steel liner are not expected at Salem; and the use of ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J are adequate to manage the applicable aging effects of these components without supplemental inspection activities. ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J programs are described in Appendix B.

3.5.2.2.1.9 Loss of Material (Scaling, Cracking, and Spalling) due to Freeze-Thaw

Loss of material (scaling, cracking, and spalling) due to freeze-thaw could occur in PWR and BWR concrete containments. The existing program relies on ASME Section XI, Subsection IWL to manage this aging effect. The GALL Report recommends further evaluation of this aging effect for plants located in moderate to severe weathering conditions.

At Salem, ASME Section XI, Subsection IWL program, B.2.1.29, will be used to manage loss of material (scaling, cracking, and spalling) due to freeze-thaw of accessible Containment Structure concrete elements. Evaluation of inaccessible areas follows.

The Salem Containment Structure is located in a region where weathering conditions are considered severe as shown in ASTM C 33-90, Fig. 1. At Salem, the Containment Structure is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. Concrete aggregates conform to the requirements of ASTM C 33-66. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity and were also tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 88-63. The coarse aggregate selected and used on the Salem Project was quarried stone, crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. For the reactor containment wall, in the area adjacent to the equipment and personnel hatches where additional reinforcing steel was specified, a more plastic mix was designed for adequate concrete placement. In this case, the slump was increased to be between 6 and 7 inches. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete.

At Salem, except for the Service Water Intake structure, structures were also designed to minimize exposure to moisture to minimize water absorption, minimizing the potential for damage from freeze-thaw conditions. The Service Water Intake structure is also used as a leading indicator for the condition of inaccessible concrete for other structures.

Exposed portions of below grade concrete will be examined by the Structures Monitoring Program when excavated for any reason and groundwater chemistry will be monitored periodically in accordance with the Structures Monitoring Program, B.2.1.33.

As described above, the design and construction of the Containment Structure concrete is in accordance with ACI standards that preclude significant loss of material (scaling, cracking, and spalling) due to freeze-thaw. Operating experience review has not identified significant loss of material (scaling, cracking, and spalling) of the accessible Containment structure concrete. Inspections conducted in accordance with ASME Section XI, Subsection IWL identified isolated instances of minor local spalling and cracking of above grade concrete and grout. Evaluation of spalling and cracking concluded they have no significant impact on structural integrity of the Containment structure.

Therefore, loss of material (scaling, cracking and spalling) due to freeze-thaw of inaccessible concrete is insignificant and requires no aging management. However, inaccessible concrete will be inspected if exposed for any reason, as required by Salem Structures Monitoring Program. ASME Section XI, Subsection IWL, and Structures Monitoring Programs are described in Appendix B.

3.5.2.2.1.10 <u>Cracking due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability due to Leaching of Calcium Hydroxide</u>

Cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide could occur in concrete elements of PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. The GALL Report recommends further evaluation if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

At Salem, the Containment Structure is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity to preclude expansion and reaction with aggregate. The use of Type II cement and flyash result in concrete resistant to leaching.

The type and size of aggregate, slump, cement and additives have been selected to produce durable concrete. Thus, cracking due to expansion and reaction with aggregate is not applicable and requires no aging management. Increase in porosity and permeability due to leaching of calcium hydroxide is not significant and the ASME Section XI, Subsection IWL program will provide adequate aging management.

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

3.5.2.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the Structures Monitoring Program. This includes (1) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, 9 structures; (2) increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, 9 structures; (3) loss of material due to corrosion for Groups 1-5, 7, 8 structures; (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, 7-9 structures; (5) cracking due to expansion and reaction with aggregates for Groups 1-5, 7-9 structures; (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3, 5-9 structures; and (7) reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the Structures Monitoring Program.

Lock up due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or ASME Section XI, Subsection IWF to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or Structures Monitoring Program.

At Salem, the Structures Monitoring Program, B.2.1.33, is used to manage aging affects applicable to Groups 1, 3, 4, and 5 structures and component supports as discussed below. The GALL structure Groups 2, 7, 8, and 9 do not exist at Salem. Group 2 and Group 9 structures are BWR specific and are not applicable to the Salem PWR design. Salem has no Group 7 concrete tanks. Concrete walls and structural steel with a missile barrier function are associated with some buildings and are addressed as an integral part of those parent structures. Salem has no separate Group 7 or 8 missile barrier structures. Steel Tanks are addressed as a part of the mechanical systems and not as a Group 8 structure.

Salem aging management reviews concluded certain concrete aging effects or mechanisms identified in NUREG-1801 are not applicable to some of Group 1, 3, 4, and 5 structures as explained below and require no aging management. However, Groups 1, 3, 4, and 5 accessible structures will be monitored for loss of material, cracking, increase in porosity and permeability, and loss of bond through the Structures Monitoring Program regardless of the causal mechanism. The Structures Monitoring Program is described in Appendix B.

(1) *Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, 9 structures.*

At Salem, cracking, loss of bond, and loss of material (spalling, scaling) due to embedded steel for Groups 1, 3, 4, and 5 structures are monitored by the Structures Monitoring Program, B.2.1.33, and thus a further evaluation is not necessary. The Structures Monitoring Program is described in Appendix B.

(2) *Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, 9 structures.*

At Salem, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1, 3, 4, and 5 structures are monitored through the Structures Monitoring Program, B.2.1.33, and thus a further evaluation is not necessary. The Structures Monitoring Program is described in Appendix B.

Leakage of treated borated water, from the reactor cavity liners, while contained within the Containment Structures, has come in contact with the supporting concrete, during refueling outages. The effects, on the Containment interior concrete, were evaluated and found to be bounded by the effects due to similar leaks in the Fuel Handling Building, due to leaks from the spent fuel pools. During the investigative phase of the spent fuel pool liner leakage in the Fuel Handling Buildings, Salem conducted a plant specific concrete test immersed in borated water for up to 39 months. Salem, in collaboration with EPRI, also conducted additional tests on concrete samples, obtained from another plant, with longer term exposure to borated water. The results of the tests were used to analyze the impact of potential continuous spent fuel pool concrete exposure to borated water leakage. The analyses show that the effects of borated water on the reinforced concrete and structural margin is not significant and have no impact on structural integrity of the spent fuel pool or the Fuel Handing Building through the period of extended operation.

(3) *Loss of material due to corrosion for Groups 1-5, 7, 8 structures.*

At Salem, loss of material due to corrosion for Groups 1, 3, 4 and 5 structures and component supports is monitored through the Structures Monitoring Program, B.2.1.33, and thus a further evaluation is not necessary. The Structures Monitoring Program is described in Appendix B.

(4) *Loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, 7-9 structures.*

At Salem, loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1, 3 and 5 structures are monitored through the Structures Monitoring Program and thus a further evaluation is not necessary. Salem Group 4 structures are inside the Containment Structure and protected from repeated freeze-thaw; thus not subject to loss of material and cracking due to freeze-thaw. The Structures Monitoring Program is described in Appendix B.

(5) *Cracking due to expansion and reaction with aggregates for Groups 1-5, 7-9 structures.*

Item Number 3.5.1-27 is not applicable. At Salem, cracking due to reaction with aggregates for Groups 1, 3, 4, and 5 structures is not applicable as concrete for Groups 1, 3, 4 and 5 structures was constructed in accordance with ACI 301-66 and aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity. The type and size of aggregate, slump, cement and additives have been selected to produce durable concrete. Thus, cracking due to expansion and reaction with aggregate is not applicable and requires no aging management. Nevertheless, concrete cracking due to any mechanism is monitored through Structures Monitoring Program, B.2.1.33, and thus no further evaluation is necessary. The Structures Monitoring Program is described in Appendix B.

(6) *Cracks and distortion due to increased stress levels from settlement for Groups 1-3, 5-9 structures.*

At Salem, structure Groups 1, 3, 4, and 5 are potentially subject to cracks and distortion due to increased stress levels from settlement. A de-watering system and porous concrete subfoundations are not used. Structures whose foundation is founded on soil or the Vincentown Formation are potentially subject to cracks and distortion due to increased stress levels from settlement. The foundation of the Class 1 station structures are established directly on the Vincetown Formation or upon lean concrete fill extending to this Formation. The Vincetown soils are preconsolidated and/or cemented as a result of its depositional environment and subsequent erosion of younger sediments. Thus, this formation provides excellent foundation support for Salem structures. Measurements made throughout plant construction and during initial operation indicated a maximum settlement of approximately 0.5 inch, which is insignificant. Salem has not experienced cracks and distortion due to increased stress levels from settlement of structures. Certain Group 3 structures are founded on concrete piles, which are encased in steel, and other Group 3 structures are founded on soil. For those structures founded on soil or the Vincentown formation cracks and distortion due to increased stress levels from settlement are applicable and will be monitored under the Structures Monitoring Program. For those Group 3 structures founded on concrete piles, encased in steel, cracks and distortion due to increased stress levels from settlement is not applicable. The Groups 1, 3, 4, and 5 structures are monitored under the Structures Monitoring Program for cracks and distortion due to increased stress levels from settlement. The Structures Monitoring Program is described in Appendix B.

(7) *Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures*

Item Number 3.5.1-29 is not applicable to Salem structures as no porous concrete subfoundations were used at Salem.

At Salem, structures Groups 1, 3, 4, and 5 are not subject to reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation. The structures are not founded on a porous concrete subfoundation.

Lock up due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or ASME Section XI, Subsection IWF to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or Structures Monitoring Program.

Item Number 3.5.1-30 and Item Number 3.5.1-56 were used at Salem for the lubrite material associated with the steam generator supports.

The applicable material for these item numbers is lubrite. The steam generator supports include pinned steel connections and lubrite plates. Lockup due to wear in the indoor air environment is managed using the ASME Section XI, Subsection IWF program, B.2.1.30, therefore no further evaluation is necessary.

Sliding surfaces for other supports are pinned steel connections or carbon steel sliding surfaces for which lubrite is not used and Item Number 3.5.1-30 is not applicable. At Salem, RPV support shoes for the PWR nozzle supports, piping supports, reactor coolant pump supports and heat exchanger supports include sliding steel surfaces. Item Numbers 3.5.1-52 and 3.5.1-54 are applicable and address these items and the ASME Section XI, Subsection IWF program is used to manage for Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads for these sliding and pinned surfaces. The ASME Section XI, Subsection IWF program is described in Appendix B.

3.5.2.2.2.2 <u>Aging Management of Inaccessible Areas</u>

1. *Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures for plants located in moderate to severe weathering conditions.*

   At Salem, structure Groups 1, 3, and 5 structures are located in a region where weathering conditions are considered severe as shown in ASTM C 33-90, Fig. 1. GALL structure Groups 2, 7, 8, and 9 do not exist at Salem. Group 4 structures are Containment internal structures and are not exposed to freeze thaw conditions. Concrete for Groups 1, 3, 4 and 5 structures is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Testing of concrete materials is in accordance with applicable ASTM standards as required by ACI. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. Concrete aggregates conform to the requirements of ASTM C 33-66. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. The coarse aggregate selected and used on the Salem Project was quarried stone, crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. For the reactor containment wall, in the area adjacent to the equipment and personnel hatches where additional reinforcing steel was specified, a more plastic mix was designed for adequate concrete placement. In this case, the slump was increased to be between 6 and 7 inches.

At Salem, except for the Service Water Intake structure, structures were also designed to minimize exposure to moisture to minimize water absorption, minimizing the potential for damage from freeze-thaw conditions. The Service Water Intake structure is also used as a leading indicator for the condition of inaccessible concrete for other structures. These measures provide concrete with good freeze-thaw resistance.

As described above, the design and construction of the concrete for Groups 1, 3, and 5 structures is in accordance with ACI Standards that preclude significant loss of material (spallng, scaling) and cracking due to freeze-thaw. The condition of exposed above grade concrete of Groups 1, 3, and 5, structures are an indicator for inaccessible concrete and provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. Operating experience review has not identified significant loss of material and cracking of the accessible Groups 1, 3, and 5 structures concrete.

In the event inspection of above grade concrete structures identify significant concrete degradation due to freeze-thaw, corrective actions will be initiated to evaluate the condition of inaccessible portions of structures and determine if excavation of concrete for inspection is warranted. Operating experience review has not identified significant signs of distress due to freeze-thaw of concrete components.

Therefore, loss of material (spalling, scaling), and cracking due to freeze-thaw of inaccessible concrete are insignificant and require no aging management. However, inaccessible concrete will be inspected if excavated for any reason, as required by Salem Structures Monitoring Program, B.2.1.33. The Structures Monitoring Program is described in Appendix B.

2. *Cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation of inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.*

   Item Number 3.5.1-27 is not applicable. At Salem, the concrete portions of Groups 1, 3, 4, and 5 Structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66 using the same concrete specification and standards as the Containment structure. Groups 2, 7, 8 and 9 structures are not found at Salem. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity. The Portland cement conforms to ASTM C 150, Type II and flyash was also used The type and size of aggregate, slump, cement and additives have been selected to produce durable concrete.

   As described above, the concrete for Groups 1, 3, 4 and 5 structures is designed and constructed to meet ACI and ASTM Standards. Thus, cracking due to expansion and reaction with aggregates is not significant and requires no aging management. However, inaccessible concrete for Groups 1, 3, and 5 structures will be inspected for cracking due to any mechanism if excavated for any reason, as required by the Salem Structures Monitoring Program, B.2.1.33. Group 4 Containment internal concrete structures are accessible and inspected by the Structures Monitoring Program. The Structures Monitoring Program is described in Appendix B.

3. *Cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The existing program relies on Structures Monitoring Program to manage these aging effects. Some plants may rely on a de-watering system to lower the site ground water level. If the plant's CLB credits a de-watering system, the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL Report recommends no further evaluation if this activity is included in the scope of the applicant's Structures Monitoring Program.*

   At Salem, structure Groups 1, 3, 4, and 5 are potentially subject to cracks and distortion due to increased stress levels from settlement. However, the aging effect/mechanism is not significant. Salem design does not employ a de-watering system to control settlement and does not include porous concrete subfoundation. Structures whose foundation is founded on soil or the Vincentown Formation are subject to cracks and distortion due to increased stress levels from settlement. The foundation of the Class 1 station structures are established directly on the Vincetown Formation or upon lean concrete fill extending to this Formation. This formation provides excellent foundation support for Salem Generating Station structures. Measurements made throughout plant construction and during initial operation indicated a maximum settlement of approximately 0.5 inch which is not significant. The condition of the accessible and above grade concrete are used as an indicator for the condition of the inaccessible and below grade concrete and provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. In the unlikely event of cracks and distortion due to settlement occurring in below grade or inaccessible concrete, they would propagate into the above grade or accessible concrete areas, and corrective actions will be initiated to evaluate the condition of inaccessible portions of structures and determine if excavation of concrete for inspection is warranted. Salem has not experienced cracks and distortion due to increased stress levels from settlement of structures. Inaccessible concrete for Groups 1, 3 and 5 structures will be inspected for cracking and distortion due to settlement if excavated for any reason, as required by the Salem Structures Monitoring Program, B.2.1.33.

Certain group 3 structures are founded on concrete piles, which are encased in steel; other group 3 structures are founded on soil. For those structures founded on soil or the Vincentown formation, cracks and distortion due to increased stress levels from settlement are applicable and will be monitored, as described above, by the Structures Monitoring Program. For those group 3 structures founded on concrete piles encased in steel, cracks and distortion due to increased stress levels from settlement are not applicable. Degradation of piles or foundation mats will manifest in settlement distortion or cracking, and accessible concrete examinations will detect cracks and distortion of Groups 1, 3, 4 and 5 structures. Studies have shown that steel piles driven into undisturbed natural soil are not appreciably affected by corrosion due to the oxygen deficiency in soil at a few feet below grade. Piles driven into disturbed soil, have been shown to experience only minor to moderate corrosion. In either case the observed loss of material due to corrosion was not considered significant enough to impact the intended function of the piles, which is consistent with NUREG-1557.

The Groups 1, 3, 4, and 5 structures are monitored under the Structures Monitoring Program for cracks and distortion due to increased stress levels from settlement and a de-watering system is not used, thus further evaluation is not necessary.

Item Number 3.5.1-29 is not applicable to Salem structures as porous concrete subfoundations were not used for any Salem structures and the Salem design does not employ a de-watering system to control settlement.

The Structures Monitoring Program is described in Appendix B.

4. *Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas of these*

Groups of structures if the environment is aggressive. The acceptance criteria are described in Branch Technical Position RLSB-1.

The Structures Monitoring Program, B.2.1.33, will be used to monitor below grade portions of the Group 1, 3 and 5 structures.

For Group 1, 3 and 5 structures at Salem, inaccessible below-grade reinforced concrete is subject to an aggressive environment. Groundwater was sampled and tested in 2008 and 2009. Test results revealed that pH values meet the limits to be considered a non-aggressive environment, (i.e., pH > 5.5). The test results for sulfates were variable across the site and between test periods, with test results indicating a non-aggressive environment due to sulfates, (i.e., sulfates level <1500 ppm). The test results for chlorides were variable across the site, with some results indicating an aggressive environment due to chlorides (chloride test results between 7 to 4800 ppm), where limits consist of a chloride level < 500 ppm, indicating a non-aggressive environment. The ground water and river water are, therefore, considered aggressive environments due to chloride levels.

The leakage of the spent fuel pools in the Fuel Handling Building has resulted in detectable levels of borated water in the seismic gap between the Auxiliary Building and the Containment Structure. The effect of the borated water on the inaccessible areas of concrete is bounded by the effects of the borated water on the accessible areas of the Fuel Handling Building. During the investigative phase of the spent fuel pool liner leakage in the Fuel Handling Buildings, Salem conducted a plant specific concrete test immersed in borated water for up to 39 months. Salem, in collaboration with EPRI, also conducted additional tests on concrete samples, obtained from another plant, with longer term exposure to borated water. The results of the tests were used to analyze the impact of potential continuous spent fuel pool concrete exposure to borated water leakage. The analyses show that the effects of borated water on the reinforced concrete and structural margin is not significant and have no impact on structural integrity of the spent fuel pool or the Fuel Handing Building through the period of extended operation.

At Salem, the Group 1, 3, and 5 structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. Concrete aggregates conform to the requirements of ASTM C 33-66. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. Aggregates were tested in accordance with ASTM Specification C-289-65 for potential reactivity and were also tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 88-63. The coarse aggregate selected and used on the Salem Project was quarried stone, crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt.

The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. For the reactor containment wall, in the area adjacent to the equipment and personnel hatches where additional reinforcing steel was specified, a more plastic mix was designed for adequate concrete placement. In this case, the slump was increased to be between 6 and 7 inches. At Salem, except for the Service Water Intake structure, structures were also designed to minimize exposure to moisture to minimize water absorption. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. Degradation of concrete due to cracking, loss of bond, and loss of material due to corrosion of embedded steel has not been experienced at Salem.

The Structures Monitoring Program includes inspection of concrete to detect indications of increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Exposed portions of below grade concrete will be examined by the Structures Monitoring Program when excavated for any reason, and groundwater chemistry will also be monitored periodically in accordance with the Structures Monitoring Program. Also the enhanced periodic inspections of the submerged portions of the intake structure will be used as indicators for the condition of below-grade structures. Due to ground water chemistry being bounded by river water chemistry, the use of submerged structures as a leading indicator for the potential degradation below-grade structures provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. In the event inspection of submerged structures identify significant concrete degradations at the Service Water Intake Structure, corrective actions will be initiated to evaluate the condition of inaccessible portions of the Groups 1, 3 and 5 structures and determine if excavation of concrete for inspection is warranted. Operating experience review has not identified significant signs of distress due to aggressive chemical attack or corrosion of embedded steel of submerged concrete components.

Due to the aggressive groundwater, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete. These aging effects will be monitored for submerged reinforced concrete components and used as a leading indicator for the potential degradation to below-grade structures. If the aging effects are significant for submerged structures, corrective actions will be initiated to evaluate inaccessible concrete and determine if excavation to expose and inspect the concrete is warranted. In addition Salem will inspect inaccessible reinforced concrete if excavated for any reason, and monitor groundwater chemistry periodically as required by the Structures Monitoring Program. The enhanced program will require periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates, and assessing its impact on inaccessible, below grade concrete structures. The Structures Monitoring Program is described in Appendix B.

5. *Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.*

   Leaching of calcium hydroxide is applicable for a flowing water environment which may occur to a limited extent in accessible or inaccessible portions of Groups 1, 3, 4, and 5 structures. . Operating experience at Salem has found that increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide, is not significant and is adequately managed by the Structures Monitoring Program, B.2.1.33.

   Inaccessible portions of the Group 5 structures may be subject to leaching of calcium hydroxide due to the known leakage of the borated water from the spent fuel pools. Salem conducted plant specific concrete test immersed in borated water for up to 39 months. Salem, in collaboration with EPRI, also conducted additional tests on concrete samples, obtained from another plant, with longer term exposure to borated water. The results of the tests were used to analyze the impact of potential continuous spent fuel pool concrete exposure to borated water leakage. The analyses show that the effects of borated water on the reinforced concrete and structural margin is not significant and have no impact on structural integrity of the spent fuel pool or the Fuel Handing Building through the period of extended operation.

   In 2006, an inspection was conducted in accordance with ACI 349 to assess the structural condition of the spent fuel pool and the Fuel Handling Building. The inspections identified no significant degradations or areas of structural distress. A similar inspection was conducted in 2009 to determine if any changes have occurred since the 2006 inspection with no significant changes noted.

   During the investigative phase of the spent fuel pool liner leakage, it was determined that leakage through small cracks in the stainless steel liner seam and plug welds did not drain properly because of clogged drains. As a result, water pressure behind the liner increased and forced borated water through small cracks in concrete and in the small gap between the liner and concrete. Maintenance activities were established to ensure the leak-chase system drains are cleared to allow drainage of the leakage. These activities will continue through the period of extended operation. This reduces amount of concrete exposed to borated water and ensures that the analysis performed to determine the impact of the borated water on the reinforced concrete remains bounding. The Structures Monitoring Program, B.2.1.33, includes the reinforced concrete trench that collects the borated water drainage from the spent fuel pool tell tale drains. This is addressed with Item Number 3.5.1-37 for the accessible trench concrete. Monitoring the structural condition of the reinforced concrete trench provides an indication of the actual concrete degradation in the Group 5 inaccessible areas, due to exposure to borated water and provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. In the event inspection of the concrete trench identifies significant concrete degradation, corrective actions will be initiated to evaluate the condition of inaccessible portions of the Groups 5 structure potentially exposed to borated water leakage and determine if excavation of concrete for inspection is warranted.

At Salem, the Portland cement conforms to ASTM C 150, Type II and flyash was also used. The use of Type II cement and flyash results in concrete resistant leaching of calcium hydroxide. Concrete is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete.

Salem will continue periodic groundwater testing and will examine exposed portions of the below-grade concrete, when excavated for any reason in accordance with the Structures Monitoring Program. The Structures Monitoring Program is described in Appendix B.

3.5.2.2.2.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas, which are allowed to have increased temperatures not to exceed 200°F. The GALL Report recommends further evaluation of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). The acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-33 is not applicable to Salem. Group 2 structures are BWR specific. Group 1, 3, 4, and 5 concrete structures are not subject to general area temperature greater than 150°F.

Group 1 structures (Control Room Area) and Group 3 structures, which include areas within the Environmental Qualification program, are exposed to indoor conditioned air temperatures not greater than 120°F during normal operation.

Group 4 structures are exposed to air temperature inside the Containment Structure. The Technical Specification and UFSAR limit the bulk air temperature inside the building during normal plant operation to 120°F. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through cooling coils and by forced air through the reactor shield and reactor nozzle support areas.

Group 3 structures, which include areas not within the Environmental Qualification program, and Group 5 structures (Fuel Handling Building) are structures with limited heat sources. Therefore, normal temperatures are less than 150°F.

Group 1, 3, 4 and 5 concrete structures are not subject to local temperature greater 200°F. Penetration seal technology is designed to prevent surrounding concrete from exceeding 200°F (Penetration Seal Specification).

Plant operating experience has not identified elevated local temperature as a concern for the Group 1, 3, 4 and 5 concrete structures.

3.5.2.2.2.4 <u>Aging Management of Inaccessible Areas for Group 6 Structures</u>

The GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance.

1. *Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas if the environment is aggressive. The acceptance criteria are described in Branch Technical Position RLSB-1.*

   At Salem the RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.34, aging management program is implemented through the Structures Monitoring Program, B.2.1.33, which will be used to manage cracking, loss of bond, and loss of material due to corrosion of embedded steel in accessible above grade and submerged areas of water-control structures (Group 6 structures).

   Evaluation of inaccessible areas follows:

   Inaccessible areas of Group 6 structures which are below-grade are monitored using the Structures Monitoring Program because the groundwater water environment is aggressive.

   Underground, reinforced concrete structures and structures in contact with river water (raw water) are subject to an aggressive environment. Groundwater was sampled and tested in 2008 and 2009. Test results revealed that pH values meet the limits to be considered a non-aggressive environment, (i.e., pH > 5.5). The test results for sulfates were variable across the site and between test periods, with test results indicating a non-aggressive environment due to sulfates, (i.e., sulfates level <1500 ppm). The groundwater test results for chlorides were variable across the site, with some results indicating an aggressive environment due to chlorides (chloride test results between 7 to 4800 ppm), where limits consist of a chloride level < 500 ppm, indicating a non-aggressive environment. River water chloride content is also variable and ranges from 10000 to 15000 ppm. The ground water and river water are, therefore, considered aggressive environments due to chloride levels. At Salem, the reinforced concrete for Group 6 structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used Concrete aggregates conform to the requirements of ASTM C 33-66. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. Aggregates were tested in accordance with ASTM Specification C-289-65 for potential reactivity and were also tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 88-63. The coarse aggregate selected and used on the Salem Project was quarried stone,crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete.

Exposed portions of below grade concrete will be examined by the Structures Monitoring Program when excavated for any reason and groundwater chemistry will be monitored periodically in accordance with the Structures Monitoring Program. Also the enhanced periodic inspections of the submerged portions of the intake structure will be used as indicators for the condition of below-grade portion of the structures. Because ground water chemistry is bounded by river water chemistry, the use of submerged structures as a leading indicator for the potential degradation below-grade structures provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. In the event inspection of submerged structures identify significant concrete degradations at the Service Water Intake Structure, corrective actions will be initiated to evaluate the condition of inaccessible below grade portions of the Group 6 structures and determine if excavation of concrete for inspection is warranted. Operating experience review has not identified significant signs of distress due to aggressive chemical attack or corrosion of embedded steel of submerged concrete components.

Therefore, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete. These aging effects will be monitored for submerged reinforced concrete components and used as a leading indicator for the potential degradation to below-grade structures. If the aging effects are significant for submerged structures, corrective actions will be initiated to evaluate inaccessible concrete and determine if excavation to expose and inspect the concrete is warranted. In addition Salem will inspect inaccessible reinforced concrete if excavated for any reason, and monitor groundwater chemistry periodically as required by the Structures Monitoring Program. The enhanced program will require periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates, and assessing its impact on buried structures. The RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants, and Structures Monitoring Programs are described in Appendix B.

2. *Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions.*

At Salem, the RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.34, as implemented by Structures Monitoring Program, B.2.1.33, will be used to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in accessible areas of water-control structures (Group 6 structures).

Evaluation of inaccessible areas follows:

Group 6 structures are located in a region where weathering conditions are considered severe as shown in ASTM C 33-90, Fig. 1.

Operating experience review has not identified significant loss of material and cracking of reinforced concrete in Group 6 structures. Concrete for Group 6 structures is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Testing of concrete materials is in accordance with applicable ASTM standards as required by ACI. The Portland cement conforms to ASTM C 150, Type II and flyash was also used Concrete aggregates conform to the requirements of ASTM C 33-66. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. The coarse aggregate selected and used on the Salem Project was quarried stone, crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/

cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. These measures provide concrete with good freeze-thaw resistance.

The design and construction of the concrete for Groups 6 structures is in accordance with ACI Standards that preclude significant loss of material (spallng, scaling) and cracking due to freeze-thaw. The condition of exposed above grade and submerged concrete of Groups 6 structures are an indicator for inaccessible concrete and provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function. Operating experience review has not identified significant loss of material and cracking of the accessible concrete for Groups 6 structures.

In the event inspection of above grade concrete structures or submerged structures identify significant concrete degradation due to freeze-thaw, corrective actions will be initiated to evaluate the condition of inaccessible below grade portions of Group 6 structures and determine if excavation of concrete for inspection is warranted. Operating experience review has not identified significant signs of distress due to freeze-thaw of Group 6 structure concrete components.

Therefore, loss of material (spalling, scaling) and cracking due to freeze-thaw of inaccessible concrete are insignificant and require no aging management. However, inaccessible concrete will be inspected if excavated for any reason, as required by Structures Monitoring Program. The RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants and Structures Monitoring Programs are described in Appendix B.

3. *Cracking due to expansion and reaction with aggregates and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible reinforced concrete areas of Group 6 structures. The GALL Report recommends further evaluation of inaccessible areas if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.*

Item Number 3.5.1-36 is not applicable for both accessible and inaccessible areas. Cracking due to expansion and reaction with aggregates has not been experienced at Salem. Concrete aggregates have been tested and the concrete was designed to preclude expansion and reaction with aggregates. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity.

Reinforced concrete for Group 6 structures is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. The use of Type II cement and flyash result in concrete resistant to increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide. Concrete aggregates also conform to the requirements of ASTM C 33-66. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete.

For Item Number 3.5.1-37 the RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to manage cracking and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide of reinforced concrete in accessible and inaccessible areas of water-control structures (Group 6 structures) subject to a flowing water environment. The RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants program, and Structural Monitoring Program are described in Appendix B.

Evaluation of inaccessible areas follows:

Reinforced concrete for Group 6 structures is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C 150, Type II and flyash was also used. The use of Type II cement and flyash result in concrete resistant to increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide. Concrete aggregates conform to the requirements of ASTM C 33-66. The concrete specification used to construct Group 6 structures is the same concrete specification used to construct the Containment Structure. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity and were also tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 88-63. The coarse aggregate selected and used on the Salem Project was quarried stone,
crushed and graded to meet the detail specifications. The stone, commonly known as traprock, was a basic igneous rock consisting of diabase and basalt. The dry density of the concrete mixes used for construction exceeded 144 lbs/ cu ft. The flyash contains no calcium chloride to cause corrosion. The 1970 edition of "Concrete Industries Year Book" states that concrete made with flyash is more resistant to weak acids and sulfates, which cause corrosion. For structural concrete, the maximum allowable slump for concrete placed was 4 inches. In areas with closely spaced reinforcing bars, the detail specification allowed the use of a concrete mix with a coarse aggregate of 3/8 inch and a maximum slump of 5 inches. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete.

Leaching is a potential aging mechanism applicable to submerged portions of Group 6 structures exposed to flowing water. However, these areas are accessible for underwater inspection and for inspections when dewatered. The enhanced periodic inspections of the submerged portions of the intake structure of the Structures Monitoring Program, B.2.1.33, will be used to manage this aging effect and mechanism. Leaching is also applicable to inaccessible concrete which is buried as it may be subject to a flowing water environment through cracks.

Operating experience at Salem has not identified increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide for inaccessible below grade portions of Group 6 structures as significant and this aging effect is managed by the RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33. Inaccessible concrete will be inspected if excavated for any reason, as required by the Structures Monitoring Program. The Structures Monitoring Program is described in Appendix B.

3.5.2.2.2.5 Cracking due to Stress Corrosion Cracking and Loss of Material due to Pitting and Crevice Corrosion

Cracking due to stress corrosion cracking and loss of material due to pitting and crevice corrosion could occur for Group 7 and 8 stainless steel tank liners exposed to standing water. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects. The acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-38 is not applicable. Salem does not have Group 7 and 8 stainless steel tank liners.

3.5.2.2.2.6 Aging of Supports Not Covered by Structures Monitoring Program

The GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the Structures Monitoring Program. This includes (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; (2) loss of material due to general and pitting corrosion, for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the Structures Monitoring Program.

At Salem, (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports, (2) loss of material for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements for Group B4 supports are covered under the Structures Monitoring Program, B.2.1.33. Therefore further evaluation is not necessary. The Structures Monitoring Program is described in Appendix B.

3.5.2.2.2.7 Cumulative Fatigue Damage due to Cyclic Loading

Fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with

10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of NUREG-1800, revision 1, the SRP-LR.

Item Number 3.5.1-42 is not applicable to Salem. The Salem current licensing basis contains no fatigue analysis for component supports members, anchor bolts, and welds of Groups B1.1, B1.2, and B1.3 component supports. Therefore a TLAA is not evaluated in accordance with 10 CFR 54.21(c) for these components.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to license renewal are discussed in Section B.1.3.

3.5.2.3 Time-Limited Aging Analyses

The time-limited aging analyses identified below are associated with the Containment and Fuel Handling Building Structures:

- Section 4.5, Fuel Transfer Tube Bellows Design Cycles

3.5.3 CONCLUSION

The Containments, Structures, and Component Supports that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Containments, Structures, and Component Supports are identified in the summaries in Section 3.5.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Containments, Structures and Component Supports will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the current licensing basis during the period of extended operation.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-1	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment (as applicable)	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	ISI (IWL) and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes, plant-specific, if the environment is aggressive	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL, B.2.1.29, aging management program will be used to manage corrosion of embedded steel of the Containment Structure reinforced concrete in accessible areas. Aggressive chemical attack is not applicable to accessible areas of the containment because the environment is not aggressive in those areas. Groundwater testing conducted in 2008 and 2009 show that chloride contents exceed the threshold limit of 500 ppm. Thus the environment in inaccessible below grade environment is aggressive. The Structures Monitoring Program, B.2.1.33, will be added to manage Containment Structure concrete aging effects due to aggressive chemical attack and corrosion of embedded steel in below grade areas. See Subsection 3.5.2.2.1.1.
3.5.1-2	Concrete elements; All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended	Yes, if not within the scope of the applicant's Structures Monitoring Program or a de-watering system is relied upon.	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage cracks and distortion due to increased stress levels from settlement for the Containment Structure reinforced concrete in the inaccessible areas. A de-watering system does not exist for control of settlement at Salem. For accessible areas of the Containment Structure that are potentially susceptible to cracks and distortion due to increased stress levels from settlement, The ASME Section XI, Subsection IWL, B.2.1.29, will be added to manage the aging effect/mechanism. Inspections conducted in accordance with the program will detect cracking in accessible areas regardless of the

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
			operation.		mechanism. See Subsection 3.5.2.2.1.2.
3.5.1-3	Concrete elements: foundation, sub-foundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program If a de-watering system is relied upon for control of erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if not within the scope of the applicant's Structures Monitoring Program or a de-watering system is relied upon.	Not Applicable. This aging effect/mechanism does not apply to the Containment Structure concrete foundation as porous concrete is not incorporated into the design and construction of the foundation. A de-watering system does not exist at Salem. See Subsection 3.5.2.2.1.2
3.5.1-4	Concrete elements: dome, wall, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific aging management program is to be evaluated	Yes, plant-specific if temperature limits are exceeded.	Not Applicable. The reduction of strength and modulus of concrete due to elevated temperature does not apply to the Containment Structure concrete. The Containment Structure concrete is not exposed to general temperature greater than 150 degrees F and local area temperature greater than 200 degrees F. Technical Specification 3 /4.6.1.5 limits the average air temperature inside the Containment during normal plant operation to 120 degrees F. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through cooling coils. Process

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					penetrations in the Containment wall for high temperature piping are insulated and provided with a cooling system to limit concrete temperature to a maximum of 150 degrees F. The Penetration Air Cooling System, evaluated with the Compressed Air System, provides this cooling design feature. See Subsection 3.5.2.2.1.3.
3.5.1-5	BWR Only				
3.5.1-6	Steel elements: steel liner, liner anchors, integral attachments	Loss of material due to general, pitting and crevice corrosion	ISI (IWE), and 10 CFR Part 50, Appendix J.	Yes, if corrosion is significant for inaccessible areas	Consistent with NUREG-1801 . The ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50 Appendix J, B.2.1.31, will be used to manage loss of material due to general, pitting and crevice corrosion of the Containment Structure steel liner, liner anchors, and integral attachments. The ASME Section XI, Subsection IWE will also be used to manage loss of material due to general, pitting and crevice corrosion of Containment Structure steel bolting (containment closure). 10 CFR Part 50 Appendix J, B.2.1.31, aging management program is consistent with the NUREG-1801 recommendations for implementation. Loss of material due to corrosion is not significant for inaccessible areas of the Containment Structure steel elements as discussed in further evaluation. See Subsection 3.5.2.2.1.4
3.5.1-7	Prestressed containment tendons	Loss of prestress due to relaxation, shrinkage,	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Not Applicable. The Containment Structure is not prestressed concrete and prestressed containment tendons do not exist at Salem.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
		creep, and elevated temperature			See Subsection 3.5.2.2.1.5
3.5.1-8	BWR Only				
3.5.1-9	Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Not Applicable for the containment pressure boundary components listed for this item number. Salem is a PWR and the design does not include a suppression pool. Cracking of the Salem Containment penetration bellows, due to cyclic loading is not applicable because the Containment penetration bellows, located outside of the Containment, are not in-scope for license renewal and are not part of the Containment leakage limiting boundary per UFSAR section, 3.8.1.6.8.10, Piping Penetrations. Fatigue analysis is not included in the current licensing basis for Containment penetrations (including penetration sleeves and dissimilar metal welds). The TLAA for fatigue of the Transfer Tube bellows was aligned to this item number based upon material, environment, and aging effect. The stainless steel Transfer Tube bellows are not part of the containment penetration bellows and are not part of the containment pressure boundary but are a water retaining boundary associated with the Reactor Cavity in the Containment and the Transfer Pool in the Fuel Handling Building. See Subsection 3.5.2.2.1.6.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-10	Stainless steel penetration sleeves, penetration bellows, dissimilar metal welds	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examinations/evaluations for bellows assemblies and dissimilar metal welds.	Yes, detection of aging effects is to be evaluated	Not Applicable. Stress corrosion cracking will not occur at these components, within the scope of license renewal, because the normal stress and environmental exposure conditions are not conducive to the development of stress corrosion cracking. See Subsection 3.5.2.2.1.7.
3.5.1-11	BWR Only				
3.5.1-12	Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes, detection of aging effects is to be evaluated	Not applicable. Salem is a PWR and BWR components including suppression pool, BWR vent header, vent line bellows and downcomers are not applicable to Salem. The containment penetration bellows are not in-scope for License Renewal because they do not perform a Containment structure pressure boundary or any other intended function. The containment penetration bellows are located outside of the containment and are not part of the containment leakage limiting boundary per UFSAR section, 3.8.1.6.8.10. Plant operating experience has not identified cracking of the bounding piping or of the containment liner or penetrations (including sleeves, dissimilar metal welds, and penetrations bellows) as a concern. Cracking due to cyclic loading will not occur at the penetrations because the normal stress and environmental exposure conditions are not conducive to the development of cyclic cracking. Cracking is not predicted in the associated piping, due to

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					low design stresses, and, therefore, is not expected in the Containment liner and penetrations (including sleeves and dissimilar welds) since the piping is bounding and enveloping for the stresses in the penetration sleeves. See Subsection 3.5.2.2.1.8
3.5.1-13	BWR Only				
3.5.1-14	Concrete elements: dome, wall, basemat ring girder, buttresses, containment (as applicable)	Loss of material (Scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions	Consistent with NUREG-1801. ASME Section XI, Subsection IWL, B.2.1.29, will be used to manage loss of material (Scaling, cracking, and spalling) due to freeze-thaw of concrete elements in accessible areas of the Containment structures. See subsection 3.5.2.2.1.9
3.5.1-15	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable).	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R.	Yes, if concrete was not constructed as stated for inaccessible areas	Consistent with NUREG-1801. ASME Section XI, Subsection IWL, B.2.1.29, will be used to manage cracking and increase in porosity, permeability due to leaching of calcium hydroxide in accessible areas of the Containment structures. At Salem, cracking due to expansion and reaction with aggregate is not applicable. The aggregates in the Containment structures were tested in accordance with ASTM Specification C 289-65 for potential reactivity and conform to the requirements of ASTM C 33-66. Increase in porosity, permeability due leaching of calcium hydroxide is potentially applicable. The Containment

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					Structure concrete could be exposed to a flowing water environment, which is the cause of this aging effect/mechanism. The Containment structures are constructed of durable concrete which is managed for the aging effects by the ASME Section XI, Subsection IWL program. See Subsection 3.5.2.2.1.10.
3.5.1-16	Seals, gaskets, and moisture barriers	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50 Appendix J, B.2.1.31, will be used to manage loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers. ASME Section XI, Subsection IWE is the applicable aging management program for the containment moisture barrier component; 10 CFR 50 Appendix J testing is not applicable to this component based on ASME Section XI, 1998 and later ASME Codes. 10 CFR 50 Appendix J is the applicable aging management program for the seals and gasket components; ASME Section XI, Subsection IWE is not applicable based on the ASME Section XI, 1998 and later ASME Codes.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-17	Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure mechanisms	Loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanisms	10 CFR Part 50, Appendix J and Plant Technical Specifications	No	Consistent with NUREG-1801. 10 CFR Part 50 Appendix J, B.2.1.31, and Plant Technical Specifications surveillance testing requirements will be used to manage loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanisms of the personnel airlocks and the equipment hatches.
3.5.1-18	Steel penetration sleeves and dissimilar metal welds; personnel airlock, equipment hatch and CRD hatch	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J.	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50 Appendix J, B.2.1.31, will be used to manage loss of material due to general, pitting and crevice corrosion of Containment Structure steel penetration sleeves, dissimilar metal welds, personnel airlock, and equipment hatch.
3.5.1-19	BWR Only				
3.5.1-20	BWR Only				
3.5.1-21	BWR Only				
3.5.1-22	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion	ISI (IWL)	No	Not Applicable. Salem design does not include prestressed containment tendons and anchorage components.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-23	All Groups except Group 6: interior and above grade exterior concrete	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Yes, if not within the scope of the applicant's Structures Monitoring Program.	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for interior and above grade exterior concrete for Groups 1, 3, 4 and 5. Groups 2, 7, 8 and 9 do not apply to Salem. Interior and exterior masonry walls with reinforcing steel were also addressed under this item number as this aging effect and mechanism was determined during aging management reviews to be applicable to reinforced masonry walls. Components in the Fire Protection System (Fire barrier concrete and masonry wall components) have been aligned to this item number based on material, environment and aging effect. The Fire Protection Program, B2.1.15, will be added to manage cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for the concrete and masonry wall components for these systems and /or structures. See Subsection 3.5.2.2.2.1

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-24	All Groups except Group 6: interior and above grade exterior concrete	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Structures Monitoring Program	Yes, if not within the scope of the applicant's Structures Monitoring Program.	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for interior and above grade exterior concrete for Group 1, 3, 4 and 5 structures. See Subsection 3.5.2.2.2.1.
3.5.1-25	All Groups except Group 6: steel components: all structural steel	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the Structures Monitoring Program is to include provisions to address protective coating monitoring and maintenance.	Yes, if not within the scope of the applicant's Structures Monitoring Program	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage loss of material due to corrosion of all structural steel components. Protective coatings are not credited for managing the aging effects of steel components. Coatings inside the Containment Structure are credited to maintain adhesion to protect against failure of the coating which may block the suction strainers. The Protective Coating Monitoring and Maintenance Program, B.2.1.35, will manage the aging of coatings inside the Containment Structure. See Subsection 3.5.2.2.2.1.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-26	All Groups except Group 6: accessible and inaccessible concrete: foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, if not within the scope of the applicant's Structures Monitoring Program or for inaccessible areas of plants located in moderate to severe weathering conditions	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage loss of material (spalling, scaling) and cracking due to freeze-thaw for accessible exterior concrete structures and concrete foundations. Exterior masonry walls with reinforcing steel were also addressed under this item number as this aging effect and mechanism was determined during aging management reviews to be applicable to reinforced masonry walls. Components in the Fire Protection System (fire barrier masonry wall components) have been aligned to this item number based on material, environment and aging effect. The Fire Protection Program, B2.1.15, will be added to manage the loss of material (spalling, scaling) and cracking due to freeze-thaw for the exterior masonry wall components for the Fire Protection system. See subsection 3.5.2.2.2.2.1
3.5.1-27	All Groups except Group 6: accessible and inaccessible interior/exterior concrete	Cracking due to expansion due to reaction with aggregates	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if not within the scope of the applicant's Structures Monitoring Program or concrete was not constructed as stated for inaccessible areas	Not Applicable. At Salem, Groups 1, 3, 4, and 5 structures are monitored for concrete cracking due to any mechanisms through the Structures Monitoring Program, B.2.1.33, and thus a further evaluation is not necessary. See Subsection 3.5.2.2.2.1. At Salem, the concrete portions of Groups 1, 3, 4 and 5 Structures (Groups 2, 7, 8 and 9 structures do not exist at Salem) is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Aggregates were tested in accordance with ASTM Specification C-289-65 for potential reactivity. The type and size of

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					aggregate, slump, cement and additives have been established to produce durable concrete and determined to preclude cracking and expansion due to reaction with aggregates. Thus, cracking due to expansion and reaction with aggregates in both accessible and inaccessible areas of Groups 1, 3, 4, and 5 structures is not significant and requires no aging management. See subsection 3.5.2.2.2.2.2 Further evaluation of inaccessible areas is provided in Subsection 3.5.2.2.2.2.2.
3.5.1-28	Groups 1-3, 5-9: All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if not within the scope of the applicant's Structures Monitoring Program or a de-watering system is relied upon	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage cracks and distortion due to increased stress levels from settlement for structures founded on soil. Salem does not utilize a de-watering system to control settlement. Interior and exterior masonry walls were also addressed under this item number as this aging effect and mechanism was determined during aging management reviews to be applicable to masonry walls. Fire barrier concrete and masonry wall components have been aligned to this item number based on material, environment and aging effect. The Fire Protection Program, B2.1.15, will be added to manage cracks and distortion due to increased stress levels from settlement for the concrete fire barrier and masonry wall components.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					See subsections 3.5.2.2.2.1 and 3.5.2.2.2.2.3.
3.5.1-29	Groups 1-3, 5-9: foundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if not within the scope of the applicant's Structures Monitoring Program or a de-watering system is relied upon	Not Applicable. Salem design does not utilize a de-watering system to control settlement and does not include porous concrete subfoundation. See subsections 3.5.2.2.2.1 and 3.5.2.2.2.2.3.
3.5.1-30	Group 4: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports	Lock-up due to wear	ISI (IWF) or Structures Monitoring Program	Yes, if not within the scope of ISI or Structures Monitoring Program	Consistent with NUREG 1801. The ASME Section XI, Subsection IWF program, B.2.1.30, is used to manage lock-up due to wear for the sliding lubrite surfaces at the steam generator supports. See Subsection 3.5.2.2.2.1.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-31	Groups 1-3, 5, 7-9: below-grade concrete components, such as exterior walls below grade and foundation	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack; Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Structures Monitoring Program; Examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes, plant-specific, if environment is aggressive	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack; cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel in accessible areas. A representative sample of below-grade concrete will be inspected, if excavated for any reason, and periodic groundwater monitoring will be done as required by the Structures Monitoring Program. Components in the Circulating Water System and Service Water System have been aligned to this item number based on material, environment and aging effect. The Buried Non-Steel Piping Inspection, B.2.2.4, aging management program will be substituted to manage the Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel of the (concrete) piping and fittings for these systems. See Subsection 3.5.2.2.2.2.4.
3.5.1-32	Groups 1-3, 5, 7-9: exterior above and below grade reinforced concrete foundations	Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide	Structures Monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if concrete was not constructed as stated for inaccessible areas	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in accessible areas. Salem may have a flowing water environment in accessible or in inaccessible areas of exterior below grade reinforced concrete foundations for Groups 1, 3, 4 and 5 structures. Groups 2, 7, 8 and 9 structures do not exist at Salem. At Salem, the Portland cement conforms to ASTM C 150, Type II and flyash was also used. The use of Type II cement and flyash result in concrete resistant to increase in porosity and

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					permeability, and loss of strength due to leaching of calcium hydroxide. Concrete is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. See subsection 3.5.2.2.2.2.5.
3.5.1-33	Groups 1-5: concrete	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific aging management program is to be evaluated	Yes, plant-specific if temperature limits are exceeded.	Not Applicable. Salem Group 1, 3, 4 and 5 concrete structures are not subject to general area temperature greater than 150°F. Groups 2, 7, 8 and 9 structures do not exist at Salem. See subsection 3.5.2.2.2.3.
3.5.1-34	Group 6: Concrete; all	Increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of representative samples of below-grade concrete,	Yes, plant-specific if environment is aggressive	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to manage cracking, loss of bond, and loss of material due to corrosion of embedded steel and increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack for concrete in accessible above grade and submerged concrete surfaces. A representative sample of below-grade concrete will be inspected, if excavated for any reason, and periodic groundwater monitoring will be done as required by the Structures Monitoring Program.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
			and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.		See subsection 3.5.2.2.2.4.1. Components in the Circulating Water System and Service Water System have been aligned to this item number based on material, environment and aging effect. The Buried Non-Steel Piping Inspection Program, B.2.2.4, will be substituted to manage increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack for reinforced concrete piping and fittings for these systems.
3.5.1-35	Group 6: exterior above and below grade concrete foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in accessible areas of Group 6 structures. See subsection 3.5.2.2.2.4.2.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-36	Group 6: all accessible/ inaccessible reinforced concrete	Cracking due to expansion/ reaction with aggregates	Accessible areas: Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes, if concrete was not constructed as stated for inaccessible areas	Not applicable. Reinforced concrete for Group 6 structures is designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. Aggregates were tested in accordance with ASTM Specification C 289-65 for potential reactivity. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete and determined to preclude cracking and expansion due to reaction with aggregates. However, accessible and inaccessible concrete for Group 6 structures will be inspected for cracking due to any mechanism as required by the RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, B.2.1.34, and for below grade portions, as required by the Structures Monitoring Program, B.2.1.33, if excavated for any reason. See subsection 3.5.2.2.2.4.3.
3.5.1-37	Group 6: exterior above and below grade reinforced concrete foundation interior slab	Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide	For accessible areas, inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with	Yes, if concrete was not constructed as stated for inaccessible areas	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to manage increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide for reinforced concrete in accessible areas of Group 6 structures (i.e., Service Water Intake and Shoreline Dike structures). Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide is not significant in the inaccessible below grade areas of these structures as these areas are constructed with durable concrete. .

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
			the recommendations in ACI 201.2R-77.		See subsection 3.5.2.2.2.4.3. Components in the Circulating Water System and the Service Water System have been aligned to this item number based on material, environment and aging effect. The Open-Cycle Cooling Water System Program, B.2.1.11, will be substituted to manage increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide for reinforced concrete piping and fittings for these systems. Components in the Fuel Handling Building have been aligned to this item based on material, environment and aging effect. The Structures Monitoring Program will be substituted to manage the increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide for the accessible concrete trench, exposed to a flowing water environment, in the Fuel Handling Building.
3.5.1-38	Groups 7, 8: Tank liners	Cracking due to stress corrosion cracking; loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated	Yes, plant specific	Not Applicable. Salem does not have Group 7 and 8 stainless steel tank liners. See subsection 3.2.2.2.5.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-39	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Yes, if not within the scope of the applicant's Structures Monitoring Program	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage loss of material due to general, pitting, and crevice corrosion for steel support members; welds; bolted connections; support anchorage to building structure. See subsection 3.5.2.2.2.6
3.5.1-40	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	Yes, if not within the scope of the applicant's Structures Monitoring Program	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms in building concrete at locations of expansion and grouted anchors; grout pads for support base plates. See subsection 3.5.2.2.2.6
3.5.1-41	Vibration isolation elements	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	Structures Monitoring Program	Yes, if not within the scope of the applicant's Structures Monitoring Program	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage elastomers for reduction or loss of isolation function due to exposure to radiation hardening, temperature, humidity, or sustained vibratory loading for vibration isolation elements in the Component Supports Commodity Group. See subsection 3.5.2.2.2.6

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-42	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Not Applicable. Salem current licensing basis contains no fatigue analysis for component supports members, anchor bolts, and welds of Groups B1.1, B1.2, and B1.3 component supports. Therefore a TLAA is not evaluated in accordance with 10 CFR 54.21(c) for these components. See subsection 3.5.2.2.2.7.
3.5.1-43	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	No	Consistent with NUREG-1801. The Masonry Wall Program, B.2.1.32, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to manage cracking due to restraint shrinkage, creep, and aggressive environment of all masonry block walls. Components in the Fire Protection system have been aligned to this item number based on material, environment and aging effect. The Fire Protection Program, B.2.1.15, will be added to manage cracking due to restraint shrinkage, creep, and aggressive environment of fire barrier masonry block walls for this system.
3.5.1-44	Group 6 elastomer seals, gaskets, and moisture barriers	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	No	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage loss of sealing due to deterioration of elastomer seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) of structures.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-45	Group 6: exterior above and below grade concrete foundation; interior slab	Loss of material due to abrasion, cavitation	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to monitor loss of material due to abrasion and cavitation in water control structures (Group 6 structures). Components in the Service Water System have been aligned to this item number based on material, environment and aging effect. The Open-Cycle Cooling Water System Program, B.2.1.11, will be substituted to manage loss of material due to abrasion and cavitation for reinforced concrete piping and fittings for this system exposed to (flowing) raw water. Components in the Fuel Handling Building have been aligned to this item number based on material, environment and aging effect. The Structures Monitoring Program, B.2.1.33, will be substituted to manage the loss of material due to abrasion and cavitation for the accessible concrete trench exposed to flowing water in the Fuel Handling Building.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-46	Group 5: Fuel pool liners	Cracking due to stress corrosion cracking; loss of material due to pitting and crevice corrosion	Water Chemistry and monitoring of spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	No	Consistent with NUREG-1801. The Water Chemistry program, B.2.1.2, monitoring of spent fuel pool water level per Technical Specification requirements, and monitoring leakage from the leak chase channels in accordance with Salem procedures, will be used to manage loss of material due to pitting and crevice corrosion of the Fuel Handling Building spent fuel pool liner and components.
3.5.1-47	Group 6: all metal structural members	Loss of material due to general (steel only), pitting and crevice corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to monitor loss of material due to general (steel only), pitting and crevice corrosion in water control structures (Group 6 structures). Protective coatings are not credited for managing the effects of aging of steel components. Components in Group 3 Structures (Auxiliary Building, Penetration Areas, Turbine Building and Yard Structures) have been aligned to this item number based on material, environment, and aging effect. The Structures Monitoring Program, B.2.1.33, will be substituted to manage the loss of material due to general, pitting and crevice corrosion of the copper flashing, and cast iron hatches or manhole covers, and steel (sump) liner and integral attachments in these structures and component supports.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-48	Group 6: earthen water control structures - dams, embankments, reservoirs, channels, canals, and ponds	Loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, Seepage	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants program, B.2.1.34, as implemented by the Structures Monitoring Program, B.2.1.33, will be used to monitor loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage in earthen water control structures (Group 6 structures).
3.5.1-49	Support members; welds; bolted connections; support anchorage to building structure	Loss of material/ general, pitting, and crevice corrosion	Water Chemistry and ISI(IWF)	No	Not Applicable. This component, material, environment, and aging effect/mechanism does not apply. These support members, welds, bolted connections, and support anchorages to building structure are addressed under Item Number 3.3.1-91.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-50	Groups B2, and B4: galvanized steel, aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	No	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.33, will be used to manage loss of material due to general, pitting, and crevice corrosion in galvanized steel, aluminum, and stainless steel support members exposed to outdoor air for Group B2 and Group B4 Component Supports. The ASME Section XI, Subsection IWF program, B.2.1.30, will be substituted to manage loss of material due to pitting and crevice corrosion for stainless steel supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; and support anchorage to building structure) exposed to outdoor air . The Periodic Inspection, B.2.2.2, program will be substituted to manage the loss of material due to pitting and crevice corrosion for aluminum and stainless steel Insulation jacketing (includes wire mesh, straps, clips) exposed to outdoor air for the Piping and Component Insulation Commodity Group. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program, B.2.1.34, will be substituted to manage loss of material due to general, pitting, and crevice corrosion of the stainless steel and stainless steel bolting exposed to outdoor air at the Service Water Intake Structure. Components in the Auxiliary Systems, Engineered Safety Features, Steam and Power Conversion Systems, and Electrical Components have been aligned to this item number based on material, environment and aging effect. The Periodic Inspection Program, B.2.2.2, Aboveground

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					Non-Steel Tanks Program, B.2.2.3, and Bolting Integrity Program, B.2.1.9, will be substituted to monitor loss of material due to general, pitting, and crevice corrosion of galvanized steel, aluminum, and stainless steel piping, tanks, birdscreens, and other miscellaneous components for these systems in the outdoor air environment. Metal Enclosed Bus components in the Electrical Commodities System have been aligned to this item number based on material, environment and aging effect. Consistent with NUREG-1801, the Structures Monitoring Program, B.2.1.33, will be used to manage loss of material due to general, pitting, and crevice corrosion in aluminum Metal Enclosed Bus members exposed to the outdoor air environment.
3.5.1-51	Group B1.1: high strength low-alloy bolts	Cracking due to stress corrosion cracking; loss of material due to general corrosion	Bolting Integrity	No	Components in the Component Supports Commodity Group have been aligned to this item number based on material, environment and aging effect. The ASME Section XI, Subsection IWF program, B.2.1.30, will be substituted to manage loss of material due to general corrosion for high strength low-alloy steel bolts used for Groups B1.1 component supports for these structures in the air indoor environment. Salem does have high strength low-alloy bolts associated with supports for ASME Class 1 piping and components. However, cracking due to stress corrosion cracking (SCC) is not applicable due to low preload stress levels. Supports for the Reactor Coolant Pumps and Unit 1 Steam Generators have high strength maraging steel bolts (Vascomax 200, 300) with actual yield strength greater than 150 ksi. The bolts are not preloaded (not torqued) and are not subject to high tensile stress or a

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					corrosive environment. A review of plant operating experience has not identified any instances of SCC for the bolts. Therefore cracking due to stress corrosion cracking is not an aging effect requiring aging management. Loss of material is the only aging effect requiring aging management. Supports for the Unit 2 Steam Generators are a different material (high strength stainless steel bolts) where this line item is not applicable and stress corrosion cracking is not applicable due to low preload stress levels and also loss of material due to corrosion in the indoor air environment is not applicable for stainless steel.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-52	Groups B2, and B4: sliding support bearings and sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	No	Components in the Component Supports Commodity Group have been aligned to this item number based on material, environment and aging effect. The ASME Section XI, Subsection IWF program, B.2.1.30, will be substituted to manage loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads in Group B1 sliding support bearings and sliding support surfaces that were aligned to this item number based on material, environment, and aging effect. There were no Group B2 or B4 components associated with this item number.
3.5.1-53	Groups B1.1, B1.2, and B1.3: support members: welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	ISI (IWF)	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWF program, B.2.1.30, will be used to manage loss of material due to general, pitting and crevice corrosion in Groups B1.1, B1.2, and B1.3 steel component supports.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-54	Groups B1.1, B1.2, and B1.3: Constant and variable load spring hangers; guides; stops;	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWF program, B.2.1.30, will be used to manage loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads in Groups B1.1, B1.2, and B1.3 steel component supports.
3.5.1-55	Steel, galvanized steel, and aluminum support members; welds; bolted connections; support anchorage to building structure	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Consistent with NUREG-1801. The Boric Acid Corrosion program, B.2.1.4, will be used to manage loss of material due to boric acid corrosion in steel, galvanized steel, and aluminum support members, welds, bolted connections and support anchorage to building structure.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-56	Groups B1.1, B1.2, and B1.3: Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWF program, B.2.1.30, will be used to manage loss of mechanical function due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads in Group B1.2 sliding surfaces.
3.5.1-57	Groups B1.1, B1.2, and B1.3: Vibration isolation elements	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	ISI (IWF)	No	Not Applicable. This component, material, environment, and aging effect/mechanism does not apply. Salem design does not include vibration isolation elements in B1.1, B1.2, and B1.3 component supports. Salem does have vibration isolation elements which are not associated with ASME piping supports. These non ASME vibration isolation elements are addressed under Item Number 3.5.1-41 and managed using the Structures Monitoring Program, B.2.1.33.

Table 3.5.1 Summary of Aging Management Evaluations for Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-58	Galvanized steel and aluminum support members; welds; bolted connections; support anchorage to building structure exposed to air - indoor uncontrolled	None	None	NA - No AEM or AMP	Consistent with NUREG-1801. The galvanized steel and aluminum support members, welds, bolted connections, and support anchorages to building structure exposed to indoor air for the material/environment combination has no aging effect/mechanism that requires aging management. Metal Enclosed Bus components in the Electrical Commodities System have been aligned to this item number based on material, environment and aging effect. No AMPs are required as no aging effects are applicable to the aluminum items exposed to indoor air for the Electrical Commodities System associated with this item number.
3.5.1-59	Stainless steel support members; welds; bolted connections; support anchorage to building structure	None	None	NA - No AEM or AMP	Consistent with NUREG-1801. The stainless steel material exposed to the indoor air and indoor air with borated water leakage environment combination has no aging effect/mechanism that requires aging management. Components in Containment Ventilation and Control Area Ventilation Systems have been aligned to this item number based on material, environment and aging effect. No AMPs are required as no aging effects are applicable to the stainless steel components for the systems associated with this item number.

Table 3.5.2-1
Auxiliary Building
Summary of Aging Management Evaluation

Table 3.5.2-1 Auxiliary Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Blowout Panel	Pressure Relief	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Blowout Panel	Pressure Relief	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Blowout Panel	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Blowout Panel	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	A
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Cable Trays	Structural Support	Aluminum	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Compressible Joints and Seals (Seismic Gap)	Expansion / Separation	Elastomers	Air - Indoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	Structures Monitoring Program	VII.G-1	3.3.1-61	E, 2
Compressible Joints and Seals (Seismic Gap)	Expansion / Separation	Elastomers	Air - Outdoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	Structures Monitoring Program	VII.G-2	3.3.1-61	E, 2

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete Curbs	Direct Flow	Concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete Curbs	Direct Flow	Concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete Curbs	Direct Flow	Concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete Curbs	Direct Flow	Concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete Curbs	Direct Flow	Concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Doors	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Doors	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Hatches/Plugs	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Hatches/Plugs	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs	Missile Barrier	Reinforced concrete	Encased in Steel	None	None			G, 3
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Shelter, Protection	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Encased in Steel	None	None			G, 3

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs	Structural Support	Reinforced concrete	Encased in Steel	None	None			G, 3
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 4

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	C
Masonry walls: Interior	Shielding	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shielding	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 4
Masonry walls: Interior	Shielding	Concrete block	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	C
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 4
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Penetration seals	Flood Barrier	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Flood Barrier	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Flood Barrier	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 6
Penetration seals	Flood Barrier	Grout	Groundwater/soil	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 6
Penetration seals	HELB/MELB Shielding	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	HELB/MELB Shielding	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 6
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 6
Penetration seals	Shielding	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shielding	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration sleeves	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Flood Barrier	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Flood Barrier	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Flood Barrier	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 2
Penetration sleeves	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	HELB/MELB Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	HELB/MELB Shielding	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 2
Pipe Whip Restraints and Jet Impingement Shields (including Pipe Encapsulation and Spray Shields)	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Pipe Whip Restraints and Jet Impingement Shields (including Pipe Encapsulation and Spray Shields)	HELB/MELB Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Pipe Whip Restraints and Jet Impingement Shields (including Pipe Encapsulation and Spray Shields)	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Pipe Whip Restraints and Jet Impingement Shields (including Pipe Encapsulation and Spray Shields)	Pipe Whip Restraint	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Roofing membrane	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Flood Barrier	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Flood Barrier	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Copper	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 7
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel components: All structural steel	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel components: All structural steel	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel components: All structural steel	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Steel components: Sump Screen Trench Cover	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Steel components: Sump Screen Trench Cover	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Steel components: Sump Screen Trench Cover	Structural Support	Stainless Steel	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.H2-18	3.3.1-80	E, 1
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Carbon Steel	Raw Water	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 7
Tube Track	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Tube Track	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Tube Track	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Tube Track	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Structures Monitoring Program is the applicable aging management program for this component.

3. Concrete encased in steel is protected from environments that promote age related degradations.

4. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5)

5. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless, the aging effect will be monitored through the Structures Monitoring Program.

6. The aging effects and aging management program identifed for this material/environments combination are consistent with industry guidance.

7. The Structures Monitoring Program includes the ten attributes of NUREG 1801 Regulatory Guide 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants (XI.S7)

Table 3.5.2-2
Component Supports Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-2 Component Supports Commodity Group

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B1.1-1	3.5.1-40	A
Supports for ASME Class 1 piping and components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF	III.B1.1-2	3.5.1-54	A
Supports for ASME Class 1 piping and components (High strength bolting for NSSS component supports)	Structural Support	High Strength Low Alloy Steel Bolting with Yield Strength Greater 150 ksi	Air - Indoor	Loss of Material/General Corrosion	ASME Section XI, Subsection IWF	III.B1.1-4	3.5.1-51	E, 1, 5, 6
Supports for ASME Class 1 piping and components (High strength bolting for NSSS component supports)	Structural Support	High Strength Low Alloy Steel Bolting with Yield Strength Greater 150 ksi	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.1-14	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (High strength bolting for NSSS component supports)	Structural Support	High Strength Stainless Steel Bolting with Yield Strength Greater 150 ksi	Air - Indoor	None	None			G, 6, 7
Supports for ASME Class 1 piping and components (High strength bolting for NSSS component supports)	Structural Support	High Strength Stainless Steel Bolting with Yield Strength Greater 150 ksi	Air with Borated Water Leakage	None	None	III.B1.1-10	3.5.1-59	A
Supports for ASME Class 1 piping and components (Sliding Surfaces - NSSS component supports)	Structural Support	Graph-Air tool steel	Air - Indoor	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF	III.B2-2	3.5.1-52	E, 1
Supports for ASME Class 1 piping and components (Sliding Surfaces - NSSS component supports)	Structural Support	Lubrite	Air - Indoor	Lock-up due to wear	ASME Section XI, Subsection IWF	III.A4-6	3.5.1-30	A
Supports for ASME Class 1 piping and components (Sliding Surfaces - NSSS component supports)	Structural Support	Lubrite	Air - Indoor	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF	III.B1.1-5	3.5.1-56	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-13	3.5.1-53	A
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.1-14	3.5.1-55	A
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-13	3.5.1-53	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF	VII.I-5	3.3.1-45	E, 1, 2
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.1-14	3.5.1-55	A
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B1.1-9	3.5.1-59	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.1-10	3.5.1-59	A
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			H, 1, 2
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B1.1-10	3.5.1-59	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	C
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF	III.B1.2-2	3.5.1-54	A
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	C
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF	III.B1.2-2	3.5.1-54	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.2-11	3.5.1-55	C
Supports for ASME Class 2 and 3 (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 2 and 3 piping and components (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B1.2-1	3.5.1-40	A
Supports for ASME Class 2 and 3 piping and components (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Outdoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B1.2-1	3.5.1-40	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.2-11	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF	VII.I-5	3.3.1-45	E, 1, 2

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			H, 1, 2
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B1.2-11	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B1.2-7	3.5.1-59	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B2-7	3.5.1-50	E, 1

Table 3.5.2-2 Component Supports Commodity Group *(Continued)*

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2-8	3.5.1-59	A
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			G, 3
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	VII.A2-1	3.3.1-91	C

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VII.A2-1	3.3.1-91	C
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B2-1	3.5.1-40	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Outdoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B2-1	3.5.1-40	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-10	3.5.1-39	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-10	3.5.1-39	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B2-11	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-10	3.5.1-39	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-10	3.5.1-39	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B2-11	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B2-5	3.5.1-58	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B2-6	3.5.1-55	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B2-6	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B2-8	3.5.1-59	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B2-9	3.5.1-59	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B2-9	3.5.1-59	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B4-1	3.5.1-40	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Outdoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B4-1	3.5.1-40	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B4-11	3.5.1-55	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B4-11	3.5.1-55	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B4-5	3.5.1-58	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B4-6	3.5.1-55	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B4-6	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Vibration isolation elements)	Vibration Isolation	Elastomers	Air - Indoor	Reduction or Loss of Isolation Function/Radiation Hardening, Temperature, Humidity, Sustained Vibratory Loading	Structures Monitoring Program	III.B4-12	3.5.1-41	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B5-1	3.5.1-40	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Outdoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B5-1	3.5.1-40	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Indoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B3-1	3.5.1-40	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Building concrete at locations of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete; Grout	Air - Outdoor	Reduction in Concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	III.B3-1	3.5.1-40	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B3-7	3.5.1-39	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B3-7	3.5.1-39	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B3-8	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B3-7	3.5.1-39	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B3-7	3.5.1-39	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B3-8	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B3-3	3.5.1-58	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	*Intended Function*	*Material*	*Environment*	*Aging Effect Requiring Management*	*Aging Management Programs*	**NUREG-1801 Vol. 2 Item**	**Table 1 Item**	**Notes**
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B3-4	3.5.1-55	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2, 4

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-7	3.5.1-50	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2, 4
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B3-4	3.5.1-55	A

Table 3.5.2-2 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. ASME Section XI, Subsection IWF is the applicable aging management program for this component.

2. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the applicable aging management program.

3. Air with steam or water leakage environment is applicable to local areas inside the containment that are exposed to potential service water leakage or spray. Plant operating experience showed that metal components in this environment exhibit aging effects observed in Air-Outdoor environment.

4. Structures Monitoring Program is the applicable aging management program for this component.

5. Supports for the Reactor Coolant Pumps and Unit 1 Steam Generators have high strength maraging steel bolts (Vascomax 200, 300) with actual yield strength greater than 150 ksi. The bolts are not preloaded (not torqued) and are not subject to high tensile stress or a corrosive environment. A

review of plant operating experience has not indentified any instances of SCC for the bolts. Therefore, cracking due to stress corrosion cracking is not an aging effect requiring aging management. Loss of material is the only aging effect requiring aging management.

6. Loss of preload/self-loosening is not applicable because the bolts are not required to be preloaded by design. Also, the bolt nuts are either tack welded or lock wired to prevent undesirable self-loosening.

7. Supports for the Unit 2 Steam Generators have high strength stainless steel bolts (Carpenter Custom alloy 455 H900), with actual yield strength greater than 150 ksi. The bolts are not preloaded (not torqued) and are not subject to high tensile stress or a corrosive environment. Therefore, cracking due to stress corrosion cracking is not an aging effect requiring aging management. Also, loss of material due to corrosion is not an aging effect requiring aging management for the bolt material (stainless steel) consistent with NUREG-1801, Volume 2 Item No. III.B1.1-9.

Table 3.5.2-3
Containment Structure
Summary of Aging Management Evaluation

Table 3.5.2-3 Containment Structure

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Containment Closure)	Pressure Boundary	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A1-11	3.5.1-6	C
Bolting (Containment Closure)	Pressure Boundary	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	10 CFR Part 50, Appendix J	V.E-5	3.2.1-24	E, 1
Bolting (Containment Closure)	Pressure Boundary	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWE	V.E-5	3.2.1-24	E, 1
Bolting (Containment Closure)	Pressure Boundary	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Bolting (Containment Closure)	Pressure Boundary	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	10 CFR Part 50, Appendix J			H; 1
Bolting (Containment Closure)	Pressure Boundary	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWE			H, 1
Bolting (Containment Closure)	Pressure Boundary	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 2
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 2
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	A
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Cable Trays	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Coatings	Maintain Adhesion	Paint	Air - Indoor	Cracking, blistering, flaking, peeling, and delamination	Protective Coating Monitoring and Maintenance Program			J
Coatings	Maintain Adhesion	Paint	Air With Borated Water Leakage	Cracking, blistering, flaking, peeling, and delamination	Protective Coating Monitoring and Maintenance Program			J
Coatings	Maintain Adhesion	Paint	Air with Borated Water Leakage	Cracking, blistering, flaking, peeling, and delamination	Boric Acid Corrosion			J

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Compressible Joints and Seals (Seismic Gap)	Expansion / Separation	Elastomers	Air - Outdoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	Structures Monitoring Program	VII.G-2	3.3.1-61	E, 4
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Concrete embedments	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Concrete embedments	Structural Support	Stainless Steel	Air With Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Concrete embedments	Structural Support	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Missile Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Pressure Boundary	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Shielding	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	ASME Section XI, Subsection IWL	II.A1-7	3.5.1-1	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	ASME Section XI, Subsection IWL	II.A1-5	3.5.1-2	E, 5
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	ASME Section XI, Subsection IWL	II.A1-2	3.5.1-14	A
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	II.A1-7	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	II.A1-5	3.5.1-2	A
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	II.A1-4	3.5.1-1	A, 6
Concrete: Dome; wall; basemat	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	ASME Section XI, Subsection IWL	II.A1-6	3.5.1-15	A
Concrete: Above-grade exterior (Heavy Equipment Platform)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Heavy Equipment Platform)	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (Heavy Equipment Platform)	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Heavy Equipment Platform)	Shielding	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A, 6
Concrete: Below-grade exterior (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A, 6
Concrete: Foundation (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A, 6

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation (Heavy Equipment Platform)	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A, 6
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A4-4	3.5.1-24	A, 13
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air with Steam or Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			G, 3
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A4-4	3.5.1-24	A,13
Concrete: Interior	Missile Barrier	Reinforced concrete	Air with Steam or Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			G, 3
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A4-4	3.5.1-24	A, 13
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air with Steam or Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			G, 3
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A4-4	3.5.1-24	A, 13
Concrete: Interior	Shielding	Reinforced concrete	Air with Steam or Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			G, 3
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A4-4	3.5.1-24	A, 13
Concrete: Interior	Structural Support	Reinforced concrete	Air with Steam or Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			G, 3
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Conduit	Shelter, Protection	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Conduit	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Hatches/Plugs	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Hatches/Plugs	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A4-3	3.5.1-23	A
Insulation (Liner Plate)	Thermal Insulation	Asbestos	Air - Indoor	None	None			J, 14
Insulation jacketing (Liner Plate Insulation lagging)	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Insulation jacketing (Liner Plate Insulation lagging)	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Insulation jacketing (Liner Plate Insulation lagging)	Shelter, Protection	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Moisture barriers (caulking, flashing and other sealants)	Water retaining boundary	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	ASME Section XI, Subsection IWE	II.A3-7	3.5.1-16	A, 9
Moisture barriers (caulking, flashing and other sealants)	Water retaining boundary	Elastomers	Air With Borated Water Leakage	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	ASME Section XI, Subsection IWE			G

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Penetration sleeves	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-1	3.5.1-18	A
Penetration sleeves	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-1	3.5.1-18	A
Penetration sleeves	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Penetration sleeves	Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Shelter, Protection	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Non-Steel Piping Inspection	VII.C1-18	3.3.1-19	E, 11
Penetration sleeves	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration sleeves	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Penetration sleeves	Shelter, Protection	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-1	3.5.1-18	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-1	3.5.1-18	A
Penetration sleeves	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration sleeves	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Penetration sleeves (cap plates)	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-1	3.5.1-18	A
Penetration sleeves (cap plates)	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-1	3.5.1-18	A
Penetration sleeves (cap plates)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves (cap plates)	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves (cap plates)	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves (cap plates)	Pressure Boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration sleeves (cap plates)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Penetration sleeves (cap plates)	Pressure Boundary	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves (cap plates)	Pressure Boundary	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Penetration sleeves (cap plates)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-1	3.5.1-18	A
Penetration sleeves (cap plates)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-1	3.5.1-18	A
Penetration sleeves (cap plates)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves (cap plates)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves (cap plates)	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Penetration sleeves (cap plates)	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Penetration sleeves (cap plates)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves (cap plates)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Penetration sleeves (cap plates)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Penetration sleeves (cap plates)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A2-1	3.3.1-91	C
Personnel airlock, equipment hatch: Locks, hinges, and closure mechanisms	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Leaktightness/Mechanical Wear of Locks, Hinges and Closure Mechanisms	10 CFR Part 50, Appendix J	II.A3-5	3.5.1-17	A, 7
Personnel airlock, equipment hatch	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-6	3.5.1-18	A
Personnel airlock, equipment hatch	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-6	3.5.1-18	A
Personnel airlock, equipment hatch	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Personnel airlock, equipment hatch	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A3-6	3.5.1-18	A
Personnel airlock, equipment hatch	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A3-6	3.5.1-18	A
Personnel airlock, equipment hatch	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Piles (heavy equipment platform foundation)	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Piles (heavy equipment platform foundation)	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 4
Piles (heavy equipment platform foundation)	Structural Support	Concrete	Encased in Steel	None	None			G, 8
Pipe Whip Restraints, and Jet Impingement Shields	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Pipe Whip Restraints, and Jet Impingement Shields	HELB/MELB Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Pipe Whip Restraints, and Jet Impingement Shields	HELB/MELB Shielding	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Pipe Whip Restraints, and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Pipe Whip Restraints, and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Pipe Whip Restraints, and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Seals, and gaskets	Pressure Boundary	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	10 CFR Part 50, Appendix J	II.A3-7	3.5.1-16	A, 10
Seals, and gaskets	Pressure Boundary	Elastomers	Air with Borated Water Leakage	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	10 CFR Part 50, Appendix J			G
Steel Components: All structural steel	Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: All structural steel	Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Steel Components: All structural steel	Shielding	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Steel Components: All structural steel	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Steel Components: All structural steel	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Reactor cavity liner, Fuel Transfer Canal liner	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel Components: Reactor cavity liner, Fuel Transfer Canal liner	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel Components: Reactor cavity liner, Fuel Transfer Canal liner	Water retaining boundary	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A2-1	3.3.1-91	C
Steel Components: Sump Liner	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Steel Components: Sump Liner	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Steel Components: Sump Liner	Water retaining boundary	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Steel Components: Sump Liner	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel Components: Sump Liner	Water retaining boundary	Stainless Steel	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.H2-18	3.3.1-80	E, 4
Steel Components: Sump Screen	Filter	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Steel Components: Sump Screen	Filter	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Steel Components: Sump Screen	Filter	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection			G, 3
Steel Components: Sump Screen	Filter	Stainless Steel	Raw Water	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion, and Fouling	Periodic Inspection	VIII.F-2	3.4.1-33	E, 12
Steel Components: Trench cover	Filter	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel Components: Trench cover	Filter	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Steel Components: Trench cover	Filter	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Steel Components: Trench cover	Filter	Stainless Steel	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.H2-18	3.3.1-80	E, 4
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A1-11	3.5.1-6	A
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A1-11	3.5.1-6	A
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Steel elements: Liner; Liner anchors; Integral attachments	Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.A1-11	3.5.1-6	A

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.A1-11	3.5.1-6	A
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J			G, 3
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE			G, 3
Steel elements: Liner; Liner anchors; Integral attachments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C

Table 3.5.2-3 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel elements: Liner; Liner anchors; Integral attachments	Water retaining boundary	Stainless Steel	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.H2-18	3.3.1-80	E, 4
Transfer Tube: Bellows (excludes containment penetration bellows)	Water retaining boundary	Stainless Steel	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.A3-4	3.5.1-9	C, 15
Transfer Tube: Bellows (excludes containment penetration bellows)	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Transfer Tube: Bellows (excludes containment penetration bellows)	Water retaining boundary	Stainless Steel	Treated Borated Water	Cumulative Fatigue Damage/Fatigue	TLAA			G, 15
Transfer Tube: Bellows (excludes containment penetration bellows)	Water retaining boundary	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A2-1	3.3.1-91	C
Tube Track	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Tube Track	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Tube Track	Structural Support	Galvanized Steel	Air with Steam or Water Leakage	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3
Tube Track	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Tube Track	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Tube Track	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program			G, 3

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J are the applicable aging management program for this component.

2. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

3. Air with steam or water leakage environment is applicable to local areas inside the containment that are exposed to potential service water leakage or spray. Plant operating experience showed that metal components in this environment exhibit aging effects observed in Air-Outdoor environment.

4. Structures Monitoring Program is the applicable aging management program for this component.

5. ASME Section XI, Subsection IWL is the applicable aging management program for this component.

6. Exposed portions of below grade concrete will be examined when excavated for any reason and groundwater chemistry will be monitored periodically in accordance with the Structures Monitoring Program.

7. Technical Specifications establish allowable leakage limits through the Containment Structure to maintain primary containment integrity.

8. Concrete encased in steel is protected from environments that promote age related degradations.

9. ASME Section XI, Subsection IWE, is the applicable aging management program for this component. 10 CFR 50 Appendix J testing is not applicable to this component based on 1998 and later ASME Codes.

10. 10 CFR 50 Appendix J testing is the applicable aging management program for this component. ASME Section XI, Subsection IWE, is not applicable based on the 1998 and later ASME Code.

11. The Buried Non-Steel Piping Inspection program is substituted to manage the aging effect(s) applicable for this component type, material, and environment combination. The buried carbon steel sleeve will be inspected in conjunction with the associated buried stainless steel bellows assembly located between the Fuel Handling Building and the Containment Building.

12. Periodic Inspection is the applicable aging management program for this component.

13. Plant operating experience showed that the treated borated water leakage, from leaks in the reactor cavity liner, could come in contact with reinforced concrete.

14. Asbestos is a mineral fiber. The asbestos material located indoors and subject to an air-indoor environment is not subject to significant aging effects. Asbestos materials do not experience aging effects unless exposed to temperatures, radiation, or chemical capable of attacking the specific inorganic chemical composition. Asbestos materials are selected for compatibility with the environment during the design. Asbestos material in this non-aggressive air environment is not expected to experience significant aging effects. This is consistent with plant operating experience.

15. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.5.

Table 3.5.2-4
Fire Pump House
Summary of Aging Management Evaluation

Table 3.5.2-4 Fire Pump House

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior (Precast Roofing Panels)	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (Precast Roofing Panels)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Precast Roofing Panels)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior (Precast Roofing Panels)	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Precast Roofing Panels)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior (Precast Roofing Panels)	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Conduit	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration seals	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Cracking /Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 4
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-4 Fire Pump House (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 5
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 6
Roofing membrane	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Tube Track	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5).

3. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless, the aging effect will be monitored through the Structures Monitoring Program.

4. The aging effects and Aging Management Program identified for this material/environment combination are consistent with industry practice.

5. Structures Monitoring Program is the applicable aging management program for this component.

6. Concrete encased in steel is protected from environments that promote age related degradations.

Table 3.5.2-5
Fuel Handling Building
Summary of Aging Management Evaluation

Table 3.5.2-5 Fuel Handling Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Compressible Joints and Seals	Expansion / Separation	Elastomer	Air - Outdoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	Structures Monitoring Program	VII.G-2	3.3.1-61	E, 2
Concrete Curb	Direct Flow	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Concrete embedments	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Concrete embedments	Structural Support	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Concrete embedments	Structural Support	Stainless Steel	Treated Borated Water	Cracking/Stress Corrosion Cracking	Water Chemistry	III.A5-13	3.5.1-46	A, 3
Concrete embedments	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	A, 3
Concrete embedments	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Concrete embedments	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Concrete embedments	Water retaining boundary	Stainless Steel	Treated Borated Water	Cracking/Stress Corrosion Cracking	Water Chemistry	III.A5-13	3.5.1-46	A, 3
Concrete embedments	Water retaining boundary	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	A, 3
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A5-6	3.5.1-26	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A5-6	3.5.1-26	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A5-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A5-6	3.5.1-26	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A5-7	3.5.1-32	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Interior	Missile Barrier	Concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Interior	Missile Barrier	Concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior (Spent fuel storage pool, Transfer pool)	Structural Support	Reinforced concrete	Air - Indoor	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A5-10	3.5.1-24	A, 4
Concrete: Interior (Trench)	Direct Flow	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A6-6	3.5.1-37	E, 2
Concrete: Interior (Trench)	Direct Flow	Reinforced concrete	Water - flowing	Loss of Material/ Abrasion; Cavitation	Structures Monitoring Program	III.A6-7	3.5.1-45	E, 2
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Doors	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Doors	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Doors	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Doors	Pressure Boundary	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A5-9	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A5-3	3.5.1-28	A
Expansion Joint	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Expansion Joint	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Expansion / Separation	Stainless Steel	Groundwater/soil	Cumulative Fatigue Damage/Fatigue	TLAA			G, 10
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Expansion / Separation	Stainless Steel	Groundwater/soil	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Non-Steel Piping Inspection			H, 8

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Shelter, Protection	Stainless Steel	Groundwater/soil	Cumulative Fatigue Damage/Fatigue	TLAA			G, 10
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Shelter, Protection	Stainless Steel	Groundwater/soil	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Non-Steel Piping Inspection			H, 8
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Water retaining boundary	Stainless Steel	Treated Borated Water	Cumulative Fatigue Damage/Fatigue	TLAA			G, 10
Penetration bellows (2 bellows for Transfer tube; excluding containment penetration bellows)	Water retaining boundary	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A2-1	3.3.1-91	C
Penetration seals	Flood Barrier	Elastomer	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration seals	Flood Barrier	Elastomer	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Flood Barrier	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 6
Penetration seals	Pressure Boundary	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Pressure Boundary	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Pressure Boundary	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 6
Penetration sleeves	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Penetration sleeves	Pressure Boundary	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Penetration sleeves	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Shelter, Protection	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Non-Steel Piping Inspection	VII.C1-18	3.3.1-19	E, 9

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Penetration sleeves	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Penetration sleeves	Structural Support	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Penetration sleeves	Structural Support	Stainless Steel	Treated Borated Water	Cracking/Stress Corrosion Cracking	Water Chemistry	III.A5-13	3.5.1-46	C
Penetration sleeves	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	C
Penetration sleeves	Water retaining boundary	Carbon Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection			G
Roofing membrane	Shelter, Protection	Elastomer	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	A
Steel components: Leak chase system	Direct Flow	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A5-12	3.5.1-25	C
Steel components: Leak chase system	Direct Flow	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel components: Leak chase system	Direct Flow	Carbon Steel	Treated Borated Water (External)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection			G, 4

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel components: Leak chase system	Direct Flow	Carbon Steel	Treated Borated Water (External)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry			G, 4
Steel components: Leak chase system	Direct Flow	Carbon Steel	Treated Borated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection			G, 4
Steel components: Leak chase system	Direct Flow	Carbon Steel	Treated Borated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry			G, 4
Steel components: Leak chase system	Direct Flow	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel components: Leak chase system	Direct Flow	Stainless Steel	Treated Borated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A3-8	3.3.1-91	C
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Treated Borated Water (External)	Cracking/Stress Corrosion Cracking	Water Chemistry	III.A5-13	3.5.1-46	A, 4, 7
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Treated Borated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	A, 4, 7

Table 3.5.2-5 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Treated Borated Water (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	III.A5-13	3.5.1-46	A, 7
Steel components: Spent fuel storage pool liner, Transfer pool liner, sump liner	Water retaining boundary	Stainless Steel	Treated Borated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	A, 7

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Structures Monitoring Program is the applicable aging management program for this component.

3. The stainless steel embedments are welded to the liner plate and are an integral part of the water-retaining boundary. Water Chemistry and monitoring of the spent pool water level in accordance with technical specifications and monitoring leakage from the leak chase channels recommended in NUREG-1801 for the liner plate are also applicable to the embedments.

4. Plant operating experience showed that treated borated water leakage through indications in the liner plate welds could overflow the leak chase channels if the drain lines are clogged and come in contact with reinforced concrete, exterior surfaces of the stainless steel liner, and the leak chase system. The leak chase channels drain lines will be monitored for blockage and cleared as required to ensure proper drainage is maintained.

5. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless, the aging effect will be monitored through the Structures Monitoring Program.

6. The aging effects and aging management program identified for this material/environment combination are consistent with industry guidance.

7. The spent fuel pool water level is monitored in accordance with technical specifications. Leakage from the leak chase channels is monitored in accordance with plant procedures.

8. The Buried Non-Steel Piping Inspection Program is used to manage the aging effect(s) applicable tor this component type, material, and environment combination.

9. The Buried Non-Steel Piping Inspection program is substituted to manage the aging effect(s) applicable for this component type, material, and environment combination. The buried carbon steel sleeve will be inspected in conjunction with the associated buried stainless steel bellows assembly located between the Fuel Handling Building and the Containment Building.

10. The TLAA designation in the Aging Management Program Column idicates fatigue of this component is evaluated in Section 4.5.

Table 3.5.2-6
Office Buildings
Summary of Aging Management Evaluation

Table 3.5.2-6 Office Buildings

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete Embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete Embedments	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Metal components: Wire mesh net	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal decking	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Metal decking	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal decking	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Metal decking	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration seals	Shelter, Protection	Elastomer	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Elastomer	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration seals	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Shelter, Protection	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-6 Office Buildings (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 4
Roofing membrane	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5).

3. Structures Monitoring Program is the applicable aging management program for this component.

4. Concrete encased in steel is protected from environments that promote age related degradations.

Table 3.5.2-7
Penetration Areas
Summary of Aging Management Evaluation

Table 3.5.2-7 Penetration Areas

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Blowout Panel	Pressure Relief	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Blowout Panel	Pressure Relief	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Blowout Panel	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Blowout Panel	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Compressible Joints and Seals (Seismic Gap)	Expansion / Separation	Copper	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 2
Compressible Joints and Seals (Seismic Gap)	Expansion / Separation	Elastomers	Air - Outdoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	Structures Monitoring Program	VII.G-2	3.3.1-61	E, 3

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Compressible Joints and Seals (Seismic Gap)	Shelter, Protection	Copper	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 2
Compressible Joints and Seals (Seismic Gap)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	HELB/MELB Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Doors	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Missile Barrier	Reinforced concrete	Encased in Steel	None	None			G, 4
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Shelter, Protection	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Encased in Steel	None	None			G, 4
Metal components: Bird Screen	Filter	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration seals	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-7 Penetration Areas (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration seals	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Pipe Whip Restraints and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Tube Track	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.
2. Water control structures are monitored in accordance with the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Regulatory Guide 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants (XI.S7).
3. Structures Monitoring Program is the applicable aging management program for this component.
4. Concrete encased in steel is protected from environments that promote age related degradations.

Table 3.5.2-8
Pipe Tunnel
Summary of Aging Management Evaluation

Table 3.5.2-8 Pipe Tunnel

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	A
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	None			G, 2
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	A
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete anchors	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Concrete anchors	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	A
Concrete anchors	Structural Support	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Concrete curb	Direct Flow	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete curb	Direct Flow	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete curb	Direct Flow	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Conduit	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Manhole cover	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Manhole cover	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Manhole cover	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Penetration seals	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration seals	Shelter, Protection	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Penetration seals	Shelter, Protection	Elastomer	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Elastomer	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 4
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 4
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 5
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Cracking/Shrinkage	Structures Monitoring Program			F, 4
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 5

Table 3.5.2-8 Pipe Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-8	3.5.1-55	C
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Groundwater/Soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. An aging management program is not required for loss of preload because the nuts are tack welded.

3. Structures Monitoring Program is the applicable aging management program for this component.

4. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless, the aging effect will be monitored through the Structures Monitoring Program.

5. The aging effects and Aging Management Program identified for this material/environment are consistent with industry guidance.

Table 3.5.2-9
Piping and Component Insulation Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-9 Piping and Component Insulation Commodity Group

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Insulation	Thermal Insulation	Calcium Silicate	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	Calcium Silicate	Air - Outdoor	None	None			J, 1
Insulation	Thermal Insulation	Ceramic Fiber	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	Ceramic Fiber	Air - Outdoor	None	None			J, 1
Insulation	Thermal Insulation	Fiberglass	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	Fiberglass	Air - Outdoor	None	None			J, 1
Insulation	Thermal Insulation	Fiberglass	Air with Borated Water Leakage	None	None			J, 1
Insulation	Thermal Insulation	Min "K"	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	NUKON	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	NUKON	Air with Borated Water Leakage	None	None			J, 1
Insulation	Thermal Insulation	NUKON	Air with Steam or Water Leakage	None	None			J, 1
Insulation	Thermal Insulation	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Insulation	Thermal Insulation	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Insulation	Thermal Insulation	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection			G, 2
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3

Table 3.5.2-9 Piping and Component Insulation Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Aluminum	Air with Borated Water Leakage	Loss of Material/Boric Acid Corrosion	Boric Acid Corrosion	III.B5-4	3.5.1-55	C
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Fiberglass blanket	Air - Indoor	None	None			J, 1
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Fiberglass blanket	Air with Borated Water Leakage	None	None			J, 1
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Fiberglass blanket	Air with Steam or Water Leakage	None	None			J, 1
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Insulation jacketing (includes wire mesh, straps, clips)	Shelter, Protection	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection			G, 2
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Fiberglass blanket	Air - Indoor	None	None			J, 1

Table 3.5.2-9 Piping and Component Insulation Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Fiberglass blanket	Air with Borated Water Leakage	None	None			J, 1
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Fiberglass blanket	Air with Steam or Water Leakage	None	None			J, 1
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 3
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5-6	3.5.1-59	C
Insulation jacketing (includes wire mesh, straps, clips)	Structural Support	Stainless Steel	Air with Steam or Water Leakage	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection			G, 2

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on plant operating experience, there are no aging effects requiring management for this material and environment combination. This material does not experience aging effects unless exposed to temperatures, radiation, or chemical capable of attacking the specific chemical composition. The material in this non-aggressive air environment is not expected to experience significant aging effects.

2. Air with Steam or Water Leakage environment is applicable to local areas inside the containment that are exposed to potential service water leakage or spray. Plant operating experience showed that metal components in this environment exhibit aging effects observed in Air-Outdoor environment. Periodic Inspection Program is the applicable aging management program for this component.

3. Periodic Inspection Program is the applicable aging management program for this component.

Table 3.5.2-10
SBO Compressor Building
Summary of Aging Management Evaluation

Table 3.5.2-10 SBO Compressor Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Interior (includes precast prestressed concrete roof slab)	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior (includes precast prestressed concrete roof slab)	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior (includes precast prestressed concrete roof slab)	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior (includes precast prestressed concrete roof slab)	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	C
Masonry walls: Above-grade exterior	Structural Support	Concrete block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C
Metal components: All structural members	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal components: All structural members	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-10 SBO Compressor Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	C

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5).

Table 3.5.2-11
Service Building
Summary of Aging Management Evaluation

Table 3.5.2-11 Service Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-11 Service Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A

Table 3.5.2-11 Service Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Interior	Shelter, Protection	Reinforced Concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-11 Service Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Hatches/Plugs	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Hatches/Plugs	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Hatches/Plugs	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C

Table 3.5.2-11 Service Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Miscellaneous steel (louvers, curbs, rain shields, hood)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (louvers, curbs, rain shields, hood)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 4
Precast Panels	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-11 Service Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Precast Panels	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Precast Panels	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Roofing membrane	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Trench	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5).

3. Structures Monitoring Program is the applicable aging management program for this component.

4. Concrete encased in steel is protected from environments that promote age related degradations.

Table 3.5.2-12
Service Water Accumulator Enclosures
Summary of Aging Management Evaluation

Table 3.5.2-12 Service Water Accumulator Enclosures

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-12 Service Water Accumulator Enclosures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-12 Service Water Accumulator Enclosures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-12 Service Water Accumulator Enclosures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-12 Service Water Accumulator Enclosures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel Components: All structural steel	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Steel Components: All structural steel	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: Pre-fabricated roof panels	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Steel Components: Pre-fabricated roof panels	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

Table 3.5.2-13
Service Water Intake
Summary of Aging Management Evaluation

Table 3.5.2-13 Service Water Intake

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.B2-7	3.5.1-50	E, 2
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.H2-18	3.3.1-80	E, 2
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Raw Water	Loss of Preload/Self-Loosening	Structures Monitoring Program			G, 1
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Concrete anchors	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Concrete anchors	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete anchors	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Concrete anchors	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.B2-7	3.5.1-50	E, 2
Concrete anchors	Structural Support	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Concrete anchors	Structural Support	Stainless Steel	Raw Water (External)	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.H2-18	3.3.1-80	E, 2
Concrete embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Foundation	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Interior	Direct Flow	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Interior	Direct Flow	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Interior	Direct Flow	Reinforced concrete	Water - flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Interior	Direct Flow	Reinforced concrete	Water - flowing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Direct Flow	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Interior	Direct Flow	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Interior	Direct Flow	Reinforced concrete	Water - flowing	Loss of Material/ Abrasion; Cavitation	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-7	3.5.1-45	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Water - flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Interior	Structural Support	Reinforced concrete	Water - flowing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 3
Concrete: Interior	Structural Support	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Interior	Structural Support	Reinforced concrete	Water - flowing	Loss of Material/ Abrasion; Cavitation	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-7	3.5.1-45	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Doors	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Doors	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Hatches/Plugs	Flood Barrier	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Hatches/Plugs	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Carbon Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Elastomers	Air - Outdoor	Increased Hardness, Shrinkage and Loss of Strength/Weathering	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.G-2	3.3.1-61	E, 2
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Elastomers	Water - flowing	Hardening and Loss of Strength/Elastomer Degradation	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.C1-1	3.3.1-75	E, 2

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Galvanized Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Treated Wood	Air - Outdoor	Change in Material Properties, Loss of Material/ Insect Damage, and Moisture Damage	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			J
Ice Barrier, Marine Dock Bumper	Shelter, Protection	Treated Wood	Water - flowing	Change in Material Properties, Loss of Material/ Insect Damage, and Moisture Damage	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			J
Metal panels (Support Extension for Air Intake Penthouse)	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Metal panels (Support Extension for Air Intake Penthouse)	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Metal panels (Support Extension for Air Intake Penthouse)	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Metal panels (Support Extension for Air Intake Penthouse)	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Metal panels (Support Extension for Air Intake Penthouse)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Metal panels (Support Extension for Air Intake Penthouse)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (vortex suppressors)	Direct Flow	Stainless Steel	Raw Water	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.H2-18	3.3.1-80	E, 4
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration seals	Flood Barrier	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Flood Barrier	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Flood Barrier	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 3
Penetration seals	Flood Barrier	Grout	Groundwater/soil	Cracking/Shrinkage	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 3
Penetration seals	Flood Barrier	Grout	Water - flowing	Cracking/Shrinkage	Structures Monitoring Program			F, 5

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration seals	Flood Barrier	Grout	Water - flowing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 3
Penetration seals	Flood Barrier	Grout	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program			F, 3
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.C1-18	3.3.1-19	E, 2
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)(including at hatches)	Flood Barrier	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)(including at hatches)	Flood Barrier	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-13 Service Water Intake (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Steel components: (Trash Racks)	Filter	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: (Trash Racks)	Filter	Carbon Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: (Trash Racks)	Filter	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: (Trash Racks)	Filter	Galvanized Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: All structural steel (Includes Windbreak steel on roof & Travelling Screen Support Structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: All structural steel (Includes Windbreak steel on roof & Travelling Screen Support Structure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Steel components: All structural steel (Includes Windbreak steel on roof & Travelling Screen Support Structure)	Structural Support	Carbon Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, is the applicable aging management program for environment and aging effect/mechanisim combination for this component.

3. The aging effects and Aging Management Program identified for this material/environments combination are consistent with industry guidance.

4. Structures Monitoring Program is the applicable aging management program for this component.

5. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless the aging effect will be monitored through the Structures Monitoring Program.

Table 3.5.2-14
Shoreline Protection and Dike
Summary of Aging Management Evaluation

Table 3.5.2-14 Shoreline Protection and Dike

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-1	3.5.1-34	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-5	3.5.1-35	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Water - flowing	Loss of Material/ Abrasion; Cavitation	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-7	3.5.1-45	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A, 1
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A

Table 3.5.2-14 Shoreline Protection and Dike (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-3	3.5.1-34	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
Concrete: Below-grade exterior	Flood Barrier	Reinforced concrete	Water - flowing	Loss of Material/ Abrasion; Cavitation	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-7	3.5.1-45	A
Earthen water-control structures: Embankments (dikes)	Flood Barrier	Soil, rip-rap, sand, gravel	Air - Outdoor	Loss of Material, Loss of Form/Erosion, Settlement, Sedimentation, Frost Action, Waves, Currents, Surface Runoff, Seepage	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			G, 2
Earthen water-control structures: Embankments (dikes)	Flood Barrier	Soil, rip-rap, sand, gravel	Water - flowing	Loss of Material, Loss of Form/Erosion, Settlement, Sedimentation, Frost Action, Waves, Currents, Surface Runoff, Seepage	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-9	3.5.1-48	A
Piles (Sheet Piles)	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A
Piles (Sheet Piles)	Flood Barrier	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Piles (Sheet Piles)	Flood Barrier	Carbon Steel	Water - flowing	Loss of Material/General, Pitting and Crevice Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Water control structures are monitored in accordance with the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Regulatory Guide 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants (XI.S7).

2. Based on industry standards and guidelines, earthen water-control structures are susceptible to loss of material and loss of form in Air- Outdoor environment.

3. Structures Monitoring Program is the applicable aging management program for this component.

Table 3.5.2-15
Switchyard
Summary of Aging Management Evaluation

Table 3.5.2-15 Switchyard

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Shelter, Protection	Galvanized Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 2
Conduit	Shelter, Protection	PVC	Concrete	None	None			J, 3
Conduit	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Manholes & Duct banks	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Water - Standing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Water - Standing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Shelter, Protection	Reinforced concrete	Water - Standing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Manholes & Duct banks	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Manholes & Duct banks	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Water - Standing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Manholes & Duct banks	Structural Support	Reinforced concrete	Water - Standing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes & Duct banks	Structural Support	Reinforced concrete	Water - Standing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 2
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 4
Transmission towers	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Transmission towers	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Transmission towers	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Trench	Structural Support	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Trench	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Trench	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Trench	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Trench	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Trench	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Trench	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Trench	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Trench	Structural Support	Reinforced concrete	Groundwater/soil	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Trench	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A

Table 3.5.2-15 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Trench	Structural Support	Reinforced concrete	Water - Standing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Trench	Structural Support	Reinforced concrete	Water - Standing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Trench	Structural Support	Reinforced concrete	Water - Standing	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Trench	Structural Support	Reinforced concrete	Water - Standing	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Structures Monitoring Program is the applicable aging management program for this component.

3. Polyvinyl Chloride (PVC) is encased in concrete and has no aging effects for the identified environment.

4. Concrete encased in steel is protected from environments that promote age related degradations.

Table 3.5.2-16
Turbine Building
Summary of Aging Management Evaluation

Table 3.5.2-16 Turbine Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete Embedments	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	C
Masonry walls: Interior	Structural Support	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 2
Metal decking	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Metal siding	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration seals	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Penetration seals	Shelter, Protection	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Shelter, Protection	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 4
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Shelter, Protection	Grout	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 4

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 5
Penetration sleeves	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration sleeves	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Support	Galvanized Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 5
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 5
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 6
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Precast Panel	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Precast Panel	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Precast Panel	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Roofing membrane	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Copper	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 7
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-16 Turbine Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Tube Track	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Tube Track	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Tube Track	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Tube Track	Structural Support	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	*Component is different, but consistent with* NUREG-1801 *item for material, environment, and aging effect.* AMP *takes some exceptions* to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Wall Program (XI.S5).

3. Based on industry standards and guidelines, grout is susceptible to cracking due to shrinkage in this environment. However, shrinkage cracking occurs early in plant life and is not expected to be significant for the extended period of operation. Nevertheless, the aging effect will be monitored through the Structures Monitoring Program.

4. The aging effects and Aging Management Program identified for this material/environment combination are consistent with industry practice.

5. Structures Monitoring Program is the applicable aging management program for this component.

6. Concrete encased in steel is protected from environments that promote age related degradations.

7. The Structures Monitoring Program includes the ten elements of NUREG-1801 Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (XI.S7).

Table 3.5.2-17
Yard Structures
Summary of Aging Management Evaluation

Table 3.5.2-17 Yard Structures

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 1
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Cable Trays	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete Embedments	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete Embedments	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Concrete Embedments	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Missile Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Foundation	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Foundation	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Concrete: Foundation	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A3-7	3.5.1-32	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Shelter, Protection	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Conduit	Shelter, Protection	PVC	Concrete	None	None			J, 2
Conduit	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Conduit	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Conduit	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Equipment foundations	Structural Support	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Equipment foundations	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Equipment foundations	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Hatches/Plugs (Manhole/handhole covers)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Hatches/Plugs (Manhole/handhole covers)	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs (Manhole/handhole covers)	Shelter, Protection	Cast Iron	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	A, 3
Hatches/Plugs (Manhole/handhole covers)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs (Manhole/handhole covers)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Hatches/Plugs (Manhole/handhole covers)	Structural Support	Cast Iron	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	E, 3
Hatches/Plugs (Manhole/handhole covers)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Hatches/Plugs (Manhole/handhole covers)	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-9	3.5.1-23	A
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	A
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Groundwater/soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A3-4	3.5.1-31	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Groundwater/soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes, Handholes & Duct Banks	Structural Support	Reinforced concrete	Groundwater/soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A3-5	3.5.1-31	A
Metal decking	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal decking	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal decking	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal decking	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Metal siding	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Piles	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles	Structural Support	Carbon Steel	Groundwater/soil	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Structures Monitoring Program	VII.C1-18	3.3.1-19	E, 3
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 4
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Indoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A

Table 3.5.2-17 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomers	Air - Outdoor	Loss of Sealing/Deterioration of Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	III.A6-12	3.5.1-44	A
Steel Components: All structural steel	Pipe Whip Restraint	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on industry standards and operating experience age related loss of preload/self-loosening of structural bolting could be caused by vibration, flexing of the joint or cyclic shear loads that could occur in any environment. However, these causes are considered in the design of structural connections and eliminated by the initial preload bolt torquing. Thus, loss of preload/self-loosening of structural bolting is not significant and will not impact structural intended functions. Nevertheless, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Polyvinyl Chloride (PVC) is encased in concrete and has no aging effects for the identified environment.

3. Water control structures are monitored in accordance with the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Regulatory Guide 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants (XI.S7).

4. Concrete encased in steel is protected from environments that promote age related degradations.

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3.6 AGING MANAGEMENT OF ELECTRICAL AND INSTRUMENTATION AND CONTROLS

3.6.1 INTRODUCTION

This section provides the results of the aging management review for the electrical commodity groups identified in Section 2.5, Scoping and Screening Results: Electrical Systems/Commodity Groups. The electrical commodity groups requiring aging management review are listed below. The following sections identify materials, environments, aging effects requiring management and associated aging management programs for each electrical commodity group.

- Cable Connections - Metallic Parts (2.5.2.5.1)
- Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage (2.5.2.5.2)
- Fuse Holders (Not Part of a Larger Assembly): Fuse Holders - Metallic Clamp (2.5.2.5.4)
- High Voltage Insulators (2.5.2.5.5)
- Insulated Cables and Connections (2.5.2.5.6)
- Metal Enclosed Bus (2.5.2.5.7)
- Switchyard Bus and Connections (2.5.2.5.8)

Electrical Penetrations (2.5.2.5.3) are not subject to their own aging management review in this section in that they are addressed 1) as a TLAA in the environmental qualification program, 2) as part of the insulated cables and connections commodity group and 3) in the Containment Structure aging management review (Table 3.5.2-3).

3.6.2 RESULTS

3.6.2.1 Materials, Environments, Aging Effects Requiring Management and Aging Management Programs

3.6.2.1.1 Cable Connections - Metallic Parts

Materials

The materials of construction for the Cable Connections (Metallic Parts) are:

- Various Metals Used for Electrical Connections

Environments

The Cable Connections (Metallic Parts) are exposed to the following environments:

- Air – Indoor
- Air – Outdoor

Aging Effects Requiring Management

The following aging effect associated with the Cable Connections (Metallic Parts) requires management:

- Loosening of Bolted Connections/Thermal Cycling, Ohmic Heating, Electrical Transients, Vibration, Chemical Contamination, Corrosion, and Oxidation

Aging Management Programs

The following aging management program manages the aging effects for the Cable Connections (Metallic Parts):

- Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.40)

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the Cable Connections (Metallic Parts).

3.6.2.1.2 <u>Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage</u>

Materials

The materials of construction for the Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage are:

- Various Metals Used for Electrical Connections

Environments

The Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage are exposed to the following environment:

- Air with Borated Water Leakage

Aging Effects Requiring Management

The following aging effect associated with Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage requires management:

- Corrosion of Connector Contact Surfaces/Intrusion of Borated Water

Aging Management Programs

The following aging management program manages the aging effects for the Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage:

- Boric Acid Corrosion (B.2.1.4)

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the

Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage.

3.6.2.1.3 Fuse Holders (Not Part of a Larger Assembly): Fuse Holders - Metallic Clamp

Materials

The materials of construction for the metallic clamp portions of Fuse Holders are:

- Copper Alloy

Environments

The fuse holders are exposed to the following environment:

- Air – Indoor

Aging Effects Requiring Management

The metallic clamp portions of Fuse Holders have no aging effects requiring management. See Subsection 3.6.2.3.1 for additional information.

Aging Management Programs

Because there are no aging effects requiring management, no AMPs are required for the metallic clamp portion of Fuse Holders.

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the metallic clamp portions of Fuse Holders.

3.6.2.1.4 High Voltage Insulators

Materials

The materials of construction for the High Voltage Insulators are:

- Cement
- Metal
- Porcelain

Environments

The High Voltage Insulators are exposed to the following environment:

- Air - Outdoor

Aging Effects Requiring Management

The following aging effect associated with the high voltage insulators requires management:

- Degradation of Insulator Quality/Presence of Salt Deposits and Surface Contamination

See Subsection 3.6.2.2.2 for further evaluation.

Aging Management Programs

The following plant-specific aging management program will be implemented to manage the degradation of insulator quality due to the presence of salt deposits and surface contamination on insulators.

- High-Voltage Insulators Program (B.2.2.1)

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the High Voltage Insulators.

3.6.2.1.5 <u>Insulated Cables and Connections</u>

The insulated cables and connections commodity group was broken down for aging management review of insulation into subcategories based on categorization in NUREG 1801:

- Insulated Cables and Connections
- Insulated Cables and Connections Used In Instrumentation Circuits
- Insulated Inaccessible Medium Voltage Cables

The types of connection insulation included in this review were splices, electrical penetration pigtails, terminal blocks, and fuse holders.

Materials

The materials of construction for the Insulated Cables and Connections are:

- Various Organic Polymers

Environments

Insulated Cables and Connections are exposed to the following environment:

- Adverse Localized Environment

Aging Effects Requiring Management

The following aging effects associated with Insulated Cables and Connections require management:

- Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion
- Localized Damage and Breakdown of Insulation Leading to Electrical Failure/Moisture Intrusion, Water Trees

Aging Management Programs

The following aging management programs manage the aging effects for the Insulated Cables and Connections:

- Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.36)
- Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B.2.1.37)
- Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.38)

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of Insulated Cables and Connections.

3.6.2.1.6 Metal Enclosed Bus

Materials

The materials of construction for the Metal Enclosed Bus are:

- Aluminum
- Copper
- Elastomer
- Porcelain, Various Organic Polymers

Environments

The Metal Enclosed Bus are exposed to the following environments:

- Air - Indoor
- Air - Outdoor

Aging Effects Requiring Management

The following aging effects associated with the Metal Enclosed Bus require management:

- Loosening of Bolted Connections/Thermal Cycling and Ohmic Heating
- Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion
- Loss of Material/Pitting and Crevice Corrosion
- Hardening and Loss of Strength/Elastomer Degradation

Aging Management Programs

The following aging management programs manage the aging effects for the Metal Enclosed Bus:

- Metal Enclosed Bus (B.2.1.39)
- Structures Monitoring Program (B.2.1.33)

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the Metal Enclosed Bus.

3.6.2.1.7 Switchyard Bus and Connections

Materials

The materials of construction for the Switchyard Bus and Connections are:

- Aluminum
- Stainless Steel
- Copper

Environments

The Switchyard Bus and Connections are exposed to the following environment:

- Air - Outdoor

Aging Effects Requiring Management

The Switchyard Bus and Connections have no aging effects requiring management. See Subsection 3.6.2.2.3 for further evaluation.

Aging Management Programs

Because there are no aging effects requiring management, no AMPs are required for the Switchyard Bus and Connections.

Table 3.6.2-1, Electrical Commodities - Summary of Aging Management Evaluation, summarizes the results of the aging management review of the Switchyard Bus and Connections.

3.6.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the LRA. For the Electrical and Instrumentation and Controls Systems' commodities, those programs are addressed in the following subsections.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1).

The evaluation of this TLAA is addressed in Section 4.7, "Environmental Qualification (EQ) of Electrical Equipment," of this application.

3.6.2.2.2 Degradation of Insulator Quality due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear

Degradation of insulator quality due to presence of any salt deposits and surface contamination could occur in high voltage insulators. The GALL Report recommends further evaluation of a plant-specific aging management program for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Loss of material due to mechanical wear caused by wind blowing on transmission conductors could occur in high voltage insulators. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

The high voltage insulators evaluated for Salem are those used to support in-scope, uninsulated, high voltage electrical commodities such as switchyard bus. The supported commodities are those credited for supplying power to in-scope components for recovery of offsite power following a station blackout.

Salt Deposits and Surface Contamination

Various airborne materials such as dust, salt and industrial effluents can contaminate insulator surfaces. The buildup of surface contamination is gradual and in most areas such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near the seacoast where salt spray is prevalent.

Salem is located in a rural area, not near heavy industry that would provide a source for contaminants, and is not in close proximity to the Atlantic Ocean. The station is located at the end of the Delaware River (at the head of Delaware Bay), 50 miles from the Atlantic Ocean. Therefore, Salem is not considered to be a seacoast plant, where salt spray is prevalent. The majority of insulators in scope for license renewal at Salem is of a vertical configuration, and is designed with an increased creepage distance that is able to withstand "medium" pollution levels. Vertical insulators with increased creepage distance are less susceptible to flashover due to surface contamination.

Site-specific operating experience has shown that flashover of insulators due to contamination from salt spray is an applicable aging mechanism that requires management. One plant-specific event occurred at Salem in September 2003, when Hurricane Isabel passed a considerable distance to the south and west of the site. Strong winds with gusts in excess of 60 mph caused switchyard insulators to become coated with salt. Therefore, a plant-specific High Voltage Insulators Program will be implemented to detect the buildup of surface contamination on high voltage insulators in the Salem Switchyard.

Mechanical Wear

Mechanical wear is an aging effect for strain and suspension insulators in that they are subject to movement. There are no strain and suspension insulators in scope for license renewal at Salem. Therefore, aging management activities for loss of material due to wear are not required for the period of extended operation.

Conclusion

A plant-specific High Voltage Insulators Program will be implemented to manage the degradation of insulator quality due to the presence of salt deposits and surface contamination on high voltage insulators in the Salem Switchyard. The High Voltage Insulators program is described in Appendix B.

3.6.2.2.3 Loss of Material due to Wind Induced Abrasion and Fatigue; Loss of Conductor Strength due to Corrosion, and Increased Resistance of Connection due to Oxidation or Loss of Pre-load

Loss of material due to wind induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

1. Transmission Conductors and Connections

There are no transmission conductors and connections in scope for license renewal at Salem. Therefore, aging management activities for loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload associated with transmission conductors and connections are not required for the period of extended operation.

2. Switchyard Bus and Connections

The switchyard bus and connections evaluated for Salem are those credited for supplying power to in-scope components for recovery of offsite power following a station blackout. The switchyard buses within the scope of this review are constructed of rigid 4-inch, schedule 80 aluminum pipe.

Wind Induced Abrasion and Fatigue

Switchyard buses at Salem are connected to flexible conductors that do not normally vibrate and are supported by insulators and ultimately by static, structural components such as concrete footings and structural steel. Since there are no connections to moving or vibrating equipment, wind-induced abrasion and fatigue is not an applicable aging mechanism.

Corrosion

Salem switchyard bus is not subject to an ocean environment or industrial air pollution. Salem is located in a rural area, not near heavy industry that would provide a source for contaminants, and is not in close proximity to the Atlantic Ocean. The station is located at the end of the Delaware River (at the head of Delaware Bay), 50 miles from the Atlantic Ocean. Therefore, Salem is not considered to be a seacoast plant, where salt spray is prevalent. Aluminum bus material does not experience any appreciable aging effects in this environment. Therefore, corrosion is not an applicable aging mechanism.

Oxidation or Loss of Preload

Switchyard bus connections employ good bolting practices consistent with the recommendations of EPRI 1003471, "Electrical Connector Application Guidelines." The connections are treated with corrosion inhibitors to avoid connection oxidation and torqued to avoid loss of pre-load, at the time of installation. The switchyard bus bolted connections are designed and installed using lock washers and stainless steel Belleville washers (not electroplated) that provide vibration absorption and prevent loss of preload. Therefore, oxidation and loss of preload are not applicable aging mechanisms.

Finally, transmission and distribution personnel perform normal maintenance activities on all portions of the switchyard, including switchyard bus and connections. These maintenance activities have not revealed significant aging effects or mechanisms associated with this equipment to date.

Conclusion

Aging management activities for Salem switchyard bus and connections are not required for the period of extended operation.

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.6.2.3 AMR Results Not Consistent with or Not Addressed in the GALL Report

3.6.2.3.1 Fuse Holders (Not Part of a Larger Assembly): Fuse Holders – Metallic Clamp

At Salem, there are thirteen enclosed electrical panels that contain only fuse holders and terminal blocks that are in scope for license renewal and are not part of a larger assembly. The enclosed electrical panels that contain only fuse holders and terminal blocks are located in the Auxiliary Building.

The potential aging effects as discussed in NUREG-1801 are not applicable to the fuse holders in these enclosed electrical panels. The evaluation of aging effects is discussed below.

Moisture, Chemical Contamination, Oxidation, and Corrosion

These enclosed electrical panels are located in an environment that does not subject them to environmental aging mechanisms. The panels are located in various rooms inside the auxiliary building. Access into these rooms is restricted. The environment inside these rooms is air-conditioned. Oxidation and corrosion are not a concern since the fuse holders are not located in or near humid areas nor are they exposed to industrial or oceanic environments.

The fuse panels are not subject to outside weather conditions and are therefore not subject to moisture from precipitation. Their indoor location in the Auxiliary Building mean they do not experience high relative humidity during normal conditions. A second barrier that protects the fuse holders from exposure to moisture is their location inside an enclosed electrical panel.

All of the fuse holders are protected from chemical contamination by their location and are enclosed within metal box in a mild environment inside a building. There are no sources of chemicals in the vicinity of the electrical panels.

A walkdown of these enclosed electrical panels confirmed that the operating conditions for the fuse holders are clean and dry, with no evidence of moisture intrusion, chemical contamination, oxidation or corrosion.

Fatigue, Mechanical Stresses, and Manipulation

Fuse holders for circuits that carry significant current in power applications could potentially be exposed to thermal fatigue in the form of high resistance caused by thermal cycling and ohmic heating. Instrumentation and control circuits characteristically operate at low currents where no appreciable thermal cycling or ohmic heating occurs.

The fuse holders located in the auxiliary building are for 115-volt AC control power. The loads are instrumentation and control circuits that operate at low currents where no appreciable thermal cycling or ohmic heating occurs. Therefore, electrical and thermal cycling is not considered an applicable aging mechanism for these fuse holders.

Mechanical stress due to forces associated with electrical faults and transients are mitigated by the fast action of the circuit protective devices at high currents. Also, mechanical stress due to electrical faults is not considered a credible aging mechanism since such faults are infrequent and random in nature. The corrective action process is used to document adverse conditions and provides corrective actions associated with electrical faults and transients that cause the actuation of circuit protective devices.

Wear and fatigue is caused by repeated insertion and removal of fuses. The fuses in these fuse holders are not subject to frequent manipulation (i.e. removal and reinsertion) because they are neither clearance nor isolation points which support periodic testing or preventative maintenance. Additionally, if fuses are manipulated for non-routine inspection or maintenance, proceduralized good work practices would identify any abnormal condition such as loose or corroded fuse clips.

These fuse holders are located in electrical panels that are not mounted on moving or rotating equipment such as compressors, fans or pumps. Because the electrical panels are mounted with no attached sources of vibration, vibration is not an applicable aging mechanism. Therefore, the metallic clamps of these fuse holders will not exhibit the aging effect of fatigue due to mechanical stresses and/or frequent manipulation.

<u>Conclusion</u>

Based on their installed location, design configuration, and operating service conditions, fuse holders inside of the thirteen panels within the scope of this aging management review are not susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities for fuse holders are not required for the period of extended operation.

3.6.3 CONCLUSION

The electrical commodity groups that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the electrical commodity groups are identified in the summaries in Section 3.6.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the electrical commodity groups will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the current licensing basis during the period of extended operation.

Table 3.6.1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-1	Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental Qualification Of Electric Components	Yes, TLAA	Environmental Qualification is a TLAA. Further evaluation is documented in Section 4.7 and Subsection 3.6.2.2.1.
3.6.1-2	Electrical cables, connections and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject To 10 CFR 50.49 EQ Requirements	No	Consistent with NUREG-1801. The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program, B.2.1.36, will be used to manage reduced insulation resistance and electrical failure due to various mechanisms, in adverse localized environments, for insulated cables and connections, including connection insulation for splices, electrical penetration pigtails, terminal blocks and fuse holders.
3.6.1-3	Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (IR)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables And Connections Used In Instrumentation Circuits Not Subject To 10 CFR 50.49 EQ Requirements	No	Consistent with NUREG-1801. The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used In Instrumentation Circuits program, B.2.1.37, will be used to manage reduced insulation resistance and electrical failure, due to various mechanisms, in adverse localized environments, for insulated cables and connections used in nuclear instrumentation and radiation monitoring circuits.

Table 3.6.1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-4	Conductor insulation for inaccessible medium voltage (2 kV to 35 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion, water trees	Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 EQ Requirements	No	Consistent with NUREG-1801. The Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements program, B.2.1.38, will be used to manage localized damage and breakdown of insulation leading to electrical failure, due to moisture intrusion and water trees, in adverse localized environments, for medium voltage cables.
3.6.1-5	Connector contacts for electrical connectors exposed to borated water leakage	Corrosion of connector contact surfaces due to intrusion of borated water	Boric Acid Corrosion	No	Consistent with NUREG-1801. The Boric Acid Corrosion program, B.2.1.4, will be used to manage corrosion of connector contacts for electrical connectors exposed to borated water leakage.
3.6.1-6	Fuse Holders (Not Part of a Larger Assembly): Fuse holders – metallic clamp	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	No	NUREG-1801 aging effects for fuse holders (metallic clamp) are not applicable to Salem. There are no fuse holders located outside of active devices that are susceptible to the aging effects and mechanisms associated with metallic clamps. See subsection 3.6.2.3.1 for additional evaluation.

Table 3.6.1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-7	Metal enclosed bus - Bus/connections	Loosening of bolted connections due to thermal cycling and ohmic heating	Metal Enclosed Bus	No	Consistent with NUREG-1801. The Metal Enclosed Bus program, B.2.1.39, will be used to manage the aging effect of loosening of bolted connections for the metal enclosed bus – bus/connections.
3.6.1-8	Metal enclosed bus – Insulation/ insulators	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Metal Enclosed Bus	No	Consistent with NUREG-1801. The Metal Enclosed Bus program, B.2.1.39, will be used to manage the aging effect of reduced insulation resistance for metal enclosed bus – insulation/insulators.
3.6.1-9	Metal enclosed bus – Enclosure assemblies	Loss of material due to general corrosion	Structures Monitoring Program	No	Not applicable. Salem predicts the aging effect of loss of material to be caused by the mechanisms of pitting and crevice corrosion for aluminum metal enclosed bus – enclosure assemblies. The Salem metal enclosed bus materials, environments and aging effects/mechanisms are addressed in Item Numbers 3.5.1-50 and 3.5.1-58.
3.6.1-10	Metal enclosed bus – Enclosure assemblies	Hardening and loss of strength due to elastomers degradation	Structures Monitoring Program	No	Consistent with NUREG-1801. The Structures Monitoring program, B.2.1.33, will be used to manage hardening and loss of strength due to elastomers degradation of elastomer metal enclosed bus – enclosure assemblies.

Table 3.6.1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-11	High voltage insulators	Degradation of insulation quality due to presence of any salt deposits and surface contamination, Loss of material caused by mechanical wear due to wind blowing on transmission conductors	Plant Specific	Yes, plant specific	The High Voltage Insulators program (B.2.2.1) will be used to manage the degradation of insulation quality due to presence of any salt deposits and surface contamination for porcelain high voltage insulators. Based on design and operating experience, loss of material is not applicable for Salem high voltage insulators. In-scope high voltage insulators are not subject to wind-induced abrasion. See subsection 3.6.2.2.2 for further evaluation.
3.6.1-12	Transmission conductors and connections, switchyard bus and connections	Loss of material due to wind induced abrasion and fatigue; loss of conductor strength due to corrosion, increased resistance of connection due to oxidation or loss of preload	Plant Specific	Yes, plant specific	There are no transmission conductors in scope at Salem, and are therefore not subject to aging management review. Based on design and operating experience, loss of material, loss of conductor strength, and increased resistance of connection are not applicable aging effects for Salem switchyard bus and connections. See subsection 3.6.2.2.3 for further evaluation.

Table 3.6.1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-13	Cable Connections – Metallic parts	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	No	Consistent with NUREG-1801 with exceptions. The Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements program, B.2.1.40, will be used to manage loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation of the metallic parts of cable connections. Exceptions apply to the NUREG-1801 recommendations for this program, and are in accordance with Draft ISG 2007-02 recommending a one-time inspection, on a representative sampling basis.
3.6.1-14	Fuse Holders (Not Part of a Larger Assembly) Insulation Material	None	None	NA-No AEM or AMP	Consistent with NUREG-1801.

Table 3.6.2-1
Electrical Commodities
Summary of Aging Management Evaluation

Table 3.6.2-1 Electrical Commodities

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Cable Connections - Metallic Parts	Electrical Continuity	Various Metals Used for Electrical Connections	Air - Indoor (External)	Loosening of Bolted Connections/Thermal Cycling, Ohmic Heating, Electrical Transients, Vibration, Chemical Contamination, Corrosion, and Oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	VI.A-1	3.6.1-13	B, 1
Cable Connections - Metallic Parts	Electrical Continuity	Various Metals Used for Electrical Connections	Air - Outdoor (External)	Loosening of Bolted Connections/Thermal Cycling, Ohmic Heating, Electrical Transients, Vibration, Chemical Contamination, Corrosion, and Oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	VI.A-1	3.6.1-13	B, 1
Connector Contacts for Connectors Exposed to Borated Water	Electrical Continuity	Various Metals Used for Electrical Connections	Air with Borated Water Leakage (External)	Corrosion of Connector Contact Surfaces/Intrusion of Borated Water	Boric Acid Corrosion	VI.A-5	3.6.1-5	A
Electrical Equipment Subject to 10 CFR 50.49 EQ Requirements	Electrical Continuity	Various Polymeric and Metallic Materials	Adverse localized environment	Various Degradation/Various Aging Mechanisms	Environmental Qualification (EQ) of Electrical Components	VI.B-1	3.6.1-1	A
Fuse Holders	Electrical Continuity	Copper Alloy	Air - Indoor (External)	None	None	VI.A-8	3.6.1-6	I, 2

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Fuse Holders	Electrical Continuity	Various Organic Polymers	Adverse localized environment	Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	VI.A-6	3.6.1-2	A
Fuse Holders	Electrical Continuity	Various Organic Polymers	Air - Indoor (External)	None	None	VI.A-7	3.6.1-14	A
High Voltage Insulators	Insulation - Electrical	Cement	Air - Outdoor (External)	None	None	VI.A-10	3.6.1-11	I, 3
High Voltage Insulators	Insulation - Electrical	Metal	Air - Outdoor (External)	None	None	VI.A-10	3.6.1-11	I, 3
High Voltage Insulators	Insulation - Electrical	Porcelain	Air - Outdoor (External)	Degradation of Insulation Quality/Presence of Salt Deposits and Surface Contamination	High Voltage Insulators	VI.A-9	3.6.1-11	E, 4
Insulated Cables and Connections	Electrical Continuity	Various Organic Polymers	Adverse localized environment	Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	VI.A-2	3.6.1-2	A

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Insulated Cables and Connections Used in Instrumentation Circuits	Electrical Continuity	Various Organic Polymers	Adverse localized environment	Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	VI.A-3	3.6.1-3	A
Insulated Inaccessible Medium-Voltage Cables	Electrical Continuity	Various Organic Polymers	Adverse localized environment	Localized Damage and Breakdown of Insulation Leading to Electrical Failure/Moisture Intrusion, Water Trees	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	VI.A-4	3.6.1-4	A
Metal-enclosed Bus	Electrical Continuity	Aluminum, Copper	Air - Indoor (External)	Loosening of Bolted Connections/Thermal Cycling and Ohmic Heating	Metal-Enclosed Bus	VI.A-11	3.6.1-7	A
Metal-enclosed Bus	Electrical Continuity	Aluminum, Copper	Air - Outdoor (External)	Loosening of Bolted Connections/Thermal Cycling and Ohmic Heating	Metal-Enclosed Bus	VI.A-11	3.6.1-7	A
Metal-enclosed Bus	Insulation - Electrical	Porcelain, Various Organic Polymers	Air - Indoor (External)	Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion	Metal-Enclosed Bus	VI.A-14	3.6.1-8	A

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Metal-enclosed Bus	Insulation - Electrical	Porcelain, Various Organic Polymers	Air - Outdoor (External)	Embrittlement, Cracking, Melting, Discoloration, Swelling, or Loss of Dielectric Strength Leading to Reduced Insulation Resistance and Electrical Failure/Degradation, Radiolysis and Photolysis of Organics; Radiation-Induced Oxidation; Moisture Intrusion	Metal-Enclosed Bus	VI.A-14	3.6.1-8	A
Metal-enclosed Bus	Shelter, Protection	Aluminum	Air - Indoor (External)	None	None	III.B2-4	3.5.1-58	C
Metal-enclosed Bus	Shelter, Protection	Aluminum	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Metal-enclosed Bus	Shelter, Protection	Elastomer	Air - Indoor (External)	Hardening and Loss of Strength/Elastomer Degradation	Structures Monitoring Program	VI.A-12	3.6.1-10	A
Metal-enclosed Bus	Shelter, Protection	Elastomer	Air - Outdoor (External)	Hardening and Loss of Strength/Elastomer Degradation	Structures Monitoring Program	VI.A-12	3.6.1-10	A
Switchyard Bus and Connections	Electrical Continuity	Aluminum, Stainless Steel, Copper	Air - Outdoor (External)	None	None	VI.A-15	3.6.1-12	I, 5

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NRC LR interim Staff guidance (ISG) 2007-02 (September 2007 draft) will revise NUREG-1801, XI.E6, Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements recommending a one-time inspection, on a representative sampling basis.

2. NUREG-1801 specifies an aging management program for fuse holders. Based on Salem design and operating experience, aging effects and mechanisms are not applicable for Salem fuse holders. The metallic clamp portion of in scope fuse holders that are not part of a larger assembly are not subject to frequent manipulation or environment conditions that could result in aging effects.

3. NUREG-1801 specifies a plant-specific program for high voltage insulators. Based on Salem design and operating experience, loss of material is not applicable for Salem high voltage insulators. In-scope high voltage insulators are not subject to wind-induced mechanical wear.

4. NUREG-1801 specifies a plant-specific program. The High Voltage Insulator Program is used to manage the aging affects applicable to this component type, material, and environment combination.

5. NUREG-1801 specifies a plant-specific program for switchyard bus and connections. Based on Salem design and operating experience, loss of material, loss of conductor strength, and increased resistance of connection are not applicable for Salem switchyard bus and connections. In-scope switchyard bus and connections are not subject to wind-induced abrasion and fatigue, corrosion, oxidation, or loss of pre-load.

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4.0 TIME-LIMITED AGING ANALYSES

4.1 INTRODUCTION

This section presents descriptions of the Time-Limited Aging Analyses (TLAAs) for Salem Generating Station, Units 1 and 2 (Salem) in accordance with 10 CFR 54.3(a) and 10 CFR 54.21(c). Section 4.0 is divided into Subsections 4.1 – 4.7. Subsection 4.1 describes the process used to identify TLAAs and exemptions based on TLAAs. Each of Subsections 4.2 – 4.7 evaluates the TLAAs associated with a common fatigue TLAA category for the period of extended operation. Table 4.1-1 lists the TLAAs in each category and provides a reference to the subsection where they are evaluated.

The TLAAs in each category are described and evaluated within each subsection using the following description method:

Summary Description: A description of the TLAA topic is provided.

Analysis: An evaluation of the TLAA for 60 years is provided.

Disposition: The disposition is classified in accordance with one or more of the following methods from 10 CFR 54.21(c)(1):

- **Validation - 10 CFR 54.21(c)(1)(i)** – The analysis remains valid for the period of extended operation, or
- **Revision - 10 CFR 54.21(c)(1)(ii)** – The analysis has been projected to the end of the period of extended operation, or
- **Aging Management - 10 CFR 54.21(c)(1)(iii)** – The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

4.1.1 IDENTIFICATION OF TLAAS

The scope and methods for identifying TLAAs at Salem are consistent with the NUREG-1800 Standard Review Plan (SRP) for Review of License Renewal Applications for Nuclear Power Plants and with the License Renewal Rule, 10 CFR 54, which states that an analysis, calculation, or evaluation is a "Time-Limited Aging Analysis" (TLAA) only if it meets all six of the following criteria per 10 CFR 54.3(a):

1. Involves systems, structures, and components within the scope of license renewal;
2. Considers the effects of aging;
3. Involves time-limited assumptions defined by the current operating term, for example, 40 years;
4. Was determined to be relevant by the licensee in making a safety determination;
5. Involves conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended functions; and

6. Is contained or incorporated by reference in the CLB (current licensing basis).

A list of potential generic TLAAs was assembled from the SRP, industry guidance and experience, including:

- NUREG-1800, Standard Review Plan for License Renewal
- NUREG-1801, The Generic Aging Lessons Learned (GALL) report
- NEI 95-10, Industry Guideline for Implementing the Requirements of 10 CFR 54 the License Renewal Rule
- The 10 CFR 54 Final Rule "Statement of Considerations," and
- Prior license renewal applications.

The Salem current licensing basis (CLB) was searched to confirm the existence of generic and plant-specific TLAAs. The CLB search included the following documents:

- Updated Final Safety Analysis Report (UFSAR)
- Operating License and License Conditions
- Technical Specifications
- Safety Evaluation Reports (SERs)
- Salem and NRC Licensing Correspondence
- Licensing basis program documents, such as the In-Service Inspection (ISI) reports and Environmental Qualification (EQ) reports.

The resulting list of potential TLAAs was reviewed (screened) against the six 10 CFR 54.3(a) criteria with the aid of supporting documents, such as:

- Environmental Qualification Binders
- Design Basis Documents
- Specifications
- Calculations

The Rule requires that identified TLAAs must be evaluated to demonstrate that:

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

(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.

One or more of these three methods was used to disposition each TLAA identified for Salem, and the methods used are identified in each TLAA evaluation section.

4.1.2 IDENTIFICATION OF EXEMPTIONS

10 CFR 54.21(c)(2) requires 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 upon TLAAs as defined in 10 CFR 54.3. The applicant shall provide an evaluation that justifies the continuation of these exemptions for the period of extended operation. A search of docketed correspondence, the operating license, and the Updated Final Safety Analysis Report (UFSAR) identified the exemptions in effect, which were evaluated to determine if they were based upon a TLAA as defined in 10 CFR 54.3.

The search identified one exemption granted pursuant to 10 CFR 50.12 that remains in effect through the period of extended operation that is based upon a TLAA. This is an exemption from the requirement of 10 CFR 50 Appendix A, General Design Criterion 4 to assume a break "...equivalent ... to the double-ended rupture of the largest pipe in the reactor coolant system." The supporting leak-before-break analysis is based in part upon an evaluation of fatigue effects for the original 40-year licensed operating period. This TLAA is described in Section 4.4.3. This TLAA was evaluated for 60 years and provides justification for continuation of this exemption for the period of extended operation.

4.1.3 SUMMARY OF RESULTS

Several categories of TLAAs were identified within the current licensing basis of Salem Units 1 and 2. These are grouped together by affected component and aging effect/mechanism analyzed, as shown in the TLAA Summary in Table 4.1-1. The table includes a reference to the applicable subsection that describes and evaluates each TLAA. Subsections 4.2 through 4.7 provide descriptions of the TLAAs, evaluate them for the period of extended operation, and specify the disposition method applied.

NUREG-1800, Tables 4.1-2 and 4.1-3, list examples of potential TLAAs, depending upon the applicant's current licensing basis (CLB). Table 4.1-2 summarizes the results of the Salem applicability review of these potential TLAAs identified in NUREG-1800 Tables 4.1-2 and 4.1-3.

Table 4.1-1
Time-Limited Aging Analyses Applicable to Salem

TLAA Category	Description	Disposition Method(s)	LRA Section
1.	**Reactor Vessel Neutron Embrittlement**		**4.2**
	Neutron Fluence Analyses	§54.21(c)(1)(ii)	4.2.1
	Upper Shelf Energy Analyses	§54.21(c)(1)(ii)	4.2.2
	Pressurized Thermal Shock Analyses	§54.21(c)(1)(ii)	4.2.3
	Reactor Vessel Pressure – Temperature Limits, including Low Temperature Overpressure Protection Limits	§54.21(c)(1)(iii)	4.2.4
2.	**Metal Fatigue of Piping and Components**		**4.3**
	Nuclear Steam Supply System (NSSS) Pressure Vessel and Component Fatigue Analyses	§54.21(c)(1)(i)	4.3.1
	Pressurizer Safety Valve and Pilot-Operated Relief Valve Fatigue Analyses	§54.21(c)(1)(i)	4.3.2
	ASA / USAS B31.1 Piping Fatigue Analyses	§54.21(c)(1)(i)	4.3.3
	Supplementary ASME Section III, Class 1 Piping and Component Fatigue Analyses	§54.21(c)(1)(i) §54.21(c)(1)(ii) §54.21(c)(1)(iii)	4.3.4
	Reactor Vessel Internals Fatigue Analyses	§54.21(c)(1)(i)	4.3.5
	Spent Fuel Pool Bottom Plates Fatigue Analyses	§54.21(c)(1)(i)	4.3.6
	Environmentally-Assisted Fatigue Analyses	§54.21(c)(1)(ii)	4.3.7
3.	**Other Plant-Specific Analyses**		**4.4**
	Reactor Vessel Underclad Cracking Analyses	§54.21(c)(1)(i)	4.4.1
	Reactor Coolant Pump Flywheel Fatigue Crack Growth Analyses	§54.21(c)(1)(i)	4.4.2
	Leak-Before-Break Analyses	§54.21(c)(1)(i)	4.4.3
	Applicability of ASME Code Case N-481 to the Salem Units 1 and 2 Reactor Coolant Pump Casings	§54.21(c)(1)(i)	4.4.4
	Salem Unit 1 Volume Control Tank Flaw Growth Analysis	§54.21(c)(1)(i)	4.4.5
4.	**Fuel Transfer Tube Bellows Design Cycles**		**4.5**
	Fuel Transfer Tube Bellows Design Cycles	§54.21(c)(1)(i)	4.5
5.	**Crane Load Cycle Limits**		**4.6**
	Polar Gantry Crane	§54.21(c)(1)(i)	4.6.1
	Fuel Handling Crane	§54.21(c)(1)(i)	4.6.2
	Cask Handling Crane	§54.21(c)(1)(i)	4.6.3
6.	**Environmental Qualification of Electrical Equipment**		**4.7**
	Environmental Qualification of Electrical Equipment	§54.21(c)(1)(iii)	4.7

Table 4.1-2 Review of Analyses Listed in NUREG-1800, Tables 4.1-2 and 4.1-3		
NUREG-1800 Examples	**Applicability to Salem**	**LRA Section**
NUREG-1800, Table 4.1-2 – Examples of Potential TLAAs		
Reactor vessel neutron embrittlement	Yes	4.2
Concrete containment tendon prestress	No	N/A
Metal fatigue	Yes	4.3
Environmental qualification of electrical equipment	Yes	4.7
Metal corrosion allowance	No	N/A
Inservice flaw growth analyses that demonstrate structure stability for 40 years	Yes	4.4.2 and 4.4.3
Inservice local metal containment corrosion analyses	No	N/A
High-energy line-break postulation based on fatigue CUF	No	N/A
NUREG-1800, Table 4.1-3 – Additional Examples of Plant-Specific TLAAs		
Intergranular separation in the heat-affected zone of reactor vessel low-alloy steel under austenitic SS cladding	Yes	4.4.1
Low-temperature overpressure (LTOP) analyses	Yes	4.2.4
Fatigue analysis for the main steam supply lines to the turbine driven auxiliary feedwater lines	No	N/A
Fatigue analysis for the reactor coolant pump flywheel	Yes	4.4.2
Fatigue analysis of polar crane	Yes	4.6.1
Flow-induced vibration endurance limit, transient cycle count assumptions, and ductility reduction of fracture toughness for the reactor vessel internals	Yes	4.3.5
Leak-before-break	Yes	4.4.3
Fatigue analysis for the containment liner plate	No	N/A
Containment penetration pressurization cycles	No	N/A
Reactor vessel circumferential weld inspection relief (BWR)	N/A – BWR	N/A

4.2 REACTOR VESSEL NEUTRON EMBRITTLEMENT

Carbon and low-alloy steels exposed to high levels of high-energy neutron irradiation exposure (fluence) are susceptible to reduction of fracture toughness, decrease in material strength, and resultant decreased low-cycle fatigue resistance known as neutron embrittlement. Fracture toughness is temperature dependent, and is indirectly measured in foot-pounds of absorbed energy in a Charpy impact test. In most materials, toughness increases with temperature up to a maximum value called Upper Shelf Energy (USE). Neutron embrittlement is typically measured in terms of Charpy transition temperature shift, Charpy upper-shelf energy decrease, and yield and ultimate tensile strength increase. Neutron embrittlement varies with material but is directly dependent upon the integrated total neutron exposure for energy levels above 1 MeV. Based upon the materials and projected fluence levels, the only reactor vessel shell items expected to be susceptible to neutron embrittlement are the reactor vessel shell components in the beltline region immediately surrounding the core.

In order to reduce the potential for brittle fracture during reactor vessel operation, Pressure-Temperature limit curves (P-T limit curves) are developed that require the reactor vessel temperature to reach specified minimum limits prior to the application of significant pressure loading to assure the materials have adequate ductility to resist the loads. Since these minimum temperatures are increased as a function of predicted cumulative fluence, the reduced material toughness as a function of fluence is offset. Adequate fracture toughness is assured at or above the minimum temperatures specified by the P-T limit curves.

In order to develop P-T limit curves, a number of tests and calculations must first be performed. The initial nil-ductility reference temperature (RT_{NDT}) is the temperature at which a material transitions from brittle to ductile behavior, and this temperature is determined for each reactor vessel beltline material prior to neutron exposure. Samples of each material are tested again after various degrees of neutron exposure up to end-of-life (EOL) fluence levels to determine how much this transition temperature will increase during plant operation as a function of neutron irradiation. This is performed as part of the reactor vessel surveillance program, and the acceptable fluence intervals for these tests are specified by ASTM E-185 requirements. This increase or shift in the nil-ductility reference temperature (ΔRT_{NDT}) is the amount of temperature increase required for the material to continue to act in a ductile manner for a given fluence level. The P-T curves are periodically updated for an incremental fluence increase using the initial RT_{NDT} and ΔRT_{NDT} values associated with the fluence value used, along with appropriate uncertainty margins. As the actual plant exposure approaches the fluence value used in a particular set of P-T limit curves, new curves are prepared for higher fluence values, up to the EOL fluence value.

For Salem, the reactor vessel material ΔRT_{NDT} and USE values, calculated on the basis of predicted 40-year EOL neutron fluence (32 Effective Full Power Years), are part of the current licensing basis, and support safety determinations. Therefore, these calculations are TLAAs. For license renewal, these must be updated to account for the fluence expected to occur during 60 years of plant operation (50 Effective Full Power Years). The governing requirements for these updated analyses are summarized below.

NRC Regulations 10 CFR 50.60 and 10 CFR 50.61 provide the fracture toughness requirements and acceptance criteria applicable to the Salem reactor vessels. NRC Regulation 10 CFR 50.60, “Acceptance criteria for fracture prevention measures for light water nuclear power reactors for normal operation,” requires that all light water nuclear power reactors meet the requirements of 10 CFR 50 Appendix G, “Fracture Toughness Requirements,” and 10 CFR 50 Appendix H, “Reactor Vessel Material Surveillance Program Requirements.” Appendix G specifies fracture toughness requirements for the reactor coolant pressure boundary to provide margins of safety against fracture during any condition of normal plant operation, including anticipated operational occurrences and system hydrostatic tests. The Salem Reactor Vessel Surveillance program (B.2.1.19) is required to monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region of light water nuclear power reactors resulting from exposure of these materials to neutron irradiation and the thermal environment. Materials and fluence data obtained from this program are used in these fracture toughness analyses.

NRC Regulation 10 CFR 50.61, “Fracture toughness requirements for protection against pressurized thermal shock events,” provides requirements for computing the reference temperature, RT_{PTS}, for the end-of-life (EOL) fluence for each of the reactor vessel beltline materials, which is a measure of the fracture toughness after exposure to EOL fluence. It also provides a Pressurized Thermal Shock (PTS) screening criterion for each type of beltline material, which is a limit on how high the minimum reference temperature can be raised. The RT_{PTS} screening criteria serve as limits on the degree of ΔRT_{NDT} that can be applied to account for neutron embrittlement. The RT_{PTS} values are a function of material composition and neutron fluence, and they increase as cumulative fluence increases, possibly approaching the screening criterion if the material is highly susceptible to neutron embrittlement. If the RT_{PTS} value is projected to exceed the screening criterion using the EOL fluence, licensees are required to implement flux reduction programs to prevent this from occurring.

4.2.1 NEUTRON FLUENCE ANALYSES

Summary Description

The current reactor vessel embrittlement analyses that evaluate reduction of fracture toughness of the Salem reactor vessel beltline materials are based on predicted 40-year end-of-license (EOL) fluence values of 32 Effective Full Power Years (EFPY). These current analyses also incorporate the effects of a 1.4% power uprate. The fluence analysis and the neutron embrittlement analyses that are based upon the fluence analysis are Time-Limited Aging Analyses (TLAAs) as defined by 10 CFR 54.21(c) that must be evaluated for the increased neutron fluence associated with 60 years of operation. These TLAAs include the analyses for fracture toughness, or upper shelf energy (USE), Pressurized Thermal Shock (PTS) limits, RT_{NDT} (nil-ductility transition temperature), Adjusted Reference Temperatures (ART), Low-Temperature Overpressure Protection (LTOP) limits, and Reactor Vessel Pressure-Temperature Limit curves (P-T limit curves). The neutron fluence TLAA is evaluated in this subsection, and the others are evaluated in subsections 4.2.2 – 4.2.4.

Analysis

Estimation of EFPY for Salem Units 1 and 2 Based on 60-years of Plant Life

End-of-life fluence is based on a predicted value of Effective Full Power Years (EFPY) over the life of the plant. Salem Unit 1 began operation on August 13, 1976 and Salem Unit 2 began operation on April 18, 1980. The following section provides 60-year EFPY estimates for each Salem Unit.

As of 11/20/2007, Salem Unit 1 had been operated for approximately 19 EFPY. If Salem Unit 1 is operated at the maximum licensed power level at a 100% capacity factor during future non-outage years, and at a 95% capacity factor during future outage years until the end of period of extended operation, August 13, 2036, Salem Unit 1 will reach approximately 47 EFPY. This capacity factor is based on assumed outage durations of seventeen (17) days during outage years and 100 percent power levels at all times other than during these outages.

As of 11/20/2007, Salem Unit 2 had been operated for approximately 16 EFPY. If Salem Unit 2 is operated at the maximum licensed power level at a 100% capacity factor during non-outage years, and at 95% capacity factor during outage years until the end of period of extended operation, April 18, 2040, Salem Unit 2 will reach approximately 48 EFPY. The capacity factor is based on outage durations of seventeen (17) days during outage years and 100 percent power levels at all times other than outages.

60-Year Neutron Fluence Projections

For license renewal, updated fluence projections based upon 50 EFPY were prepared for use as inputs, to provide margin, in the neutron embrittlement analyses prepared for 60 years of operation.

The reactor vessel beltline neutron fluence values applicable for 60 years of operation were calculated for each Salem reactor pressure vessel beltline material. The analysis methods used to calculate the predicted 60-year Salem vessel fluence values satisfy the requirements set forth in Regulator Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence".

In accordance with 10 CFR 50, Appendix H, any materials exceeding 1.0 E+17 n/cm^2 (E > 1.0 MeV) must be monitored to evaluate their changes in fracture toughness. Reactor pressure vessel materials that are not traditionally thought of as being plant limiting because of low levels of neutron radiation were evaluated to determine their cumulative fluence values at 50 EFPY. Therefore, fluence calculations were performed for the reactor pressure vessel upper shell and nozzle forgings of Salem Units 1 and 2 to determine if they will exceed 1.0 E+17 n/cm^2 (E > 1.0 MeV) at 50 EFPY. The materials that exceed this threshold are referred to as the extended beltline materials.

Tables 4.2.1-1 and 4.2.1-2 summarize the results of the fluence projections to 50 EFPY for Salem Units 1 and 2, respectively. Refer to Tables 4.2.3-1 and 4.2.3-2 for the Heat Numbers associated with the Salem Units 1 and 2 vessel materials, respectively.

Table 4.2.1-1 50 EFPY Surface Fluence Projections for Beltline and Extended Beltline Materials For Salem Unit 1

Reactor Vessel Location	Salem Unit 1 50 EFPY Fluence (n/cm², E > 1.0 MeV)
Lower Shell Plates	1.83E+19
Lower to Intermediate Shell Circumferential Weld	1.83E+19
Intermediate Shell Plates	1.84E+19
Intermediate to Upper Shell Circumferential Weld (1)	3.57E+17
Upper Shell Plates(1)	3.57E+17
Lower Shell Longitudinal Weld (105/345) (2)	1.12E+19
Lower Shell Longitudinal Weld (225) (2)	1.83E+19
Intermediate Shell Longitudinal Weld (60/300) (2)	1.35E+19
Intermediate Shell Longitudinal Weld (180) (2)	6.94E+18
Upper Shell Longitudinal Weld (7) (1)(2)	1.54E+17
Upper Shell Longitudinal Weld (127) (1)(2)	2.61E+17
Upper Shell Longitudinal Weld (247) (1)(2)	3.17E+17
Inlet and Outlet Nozzles	<1.0E+17
Nozzle to Shell Welds	<1.0E+17
Lower Shell to Lower Head Weld	<1.0E+17

(1) Extended Beltline Region
(2) Radial Location

Table 4.2.1-2 50 EFPY Surface Fluence Projections for Beltline and Extended Beltline Materials For Salem Unit 2	
Reactor Vessel Location	Salem Unit 2 50 EFPY Fluence (n/cm², E > 1.0 MeV)
Lower Shell Plates	1.96E+19
Lower to Intermediate Shell Circumferential Weld	1.96E+19
Intermediate Shell Plates	1.95E+19
Intermediate to Upper Shell Circumferential Weld (1)	3.41E+17
Upper Shell Plates (1)	3.41E+17
Lower Shell Longitudinal Weld (60/300) (2)	1.43E+19
Lower Shell Longitudinal Weld (180) (2)	7.27E+18
Intermediate Shell Longitudinal Weld (0) (2)	7.22E+18
Intermediate Shell Longitudinal Weld (120/240) (2)	1.41E+19
Upper Shell Longitudinal Weld (60/30) (1)(2)	2.48E+17
Upper Shell Longitudinal Weld (180) (1)(2)	1.26E+17
Inlet and Outlet Nozzles	<1.0E+17
Nozzle to Shell Welds	<1.0E+17
Lower Shell to Lower Head Weld	<1.0E+17

(1) Extended Beltline Region
(2) Radial Location

Disposition: Revision, 10 CFR 54.21(c)(1)(ii) – The fluence analyses have been projected to the end of the period of extended operation.

4.2.2 UPPER SHELF ENERGY ANALYSES

Summary Description

The current Charpy Upper Shelf Energy (USE) analyses were prepared for each reactor vessel beltline material for Salem based upon projected neutron fluence values for 40 years of service (32 EFPY). These are TLAAs requiring evaluation using 60-year fluence values.

Analysis

Appendix G of 10 CFR 50 contains screening criteria that establish limits on how far the USE value for a reactor pressure vessel material may be allowed to decrease due to neutron irradiation exposure. The regulations requires the initial USE value to be greater than 75 ft-lbs in the non-irradiated condition and that the value be greater than 50 ft-lbs in the fully irradiated conditions as determined by Charpy V-notch testing on pulled capsules throughout the licensed life of the plant. USE values of less than 50 ft-lbs may be acceptable to the NRC if it can be demonstrated that these lower values will provide margins of safety against brittle fracture equivalent to those required by ASME Section XI, Appendix G.

Per Regulatory Guide 1.99, Revision 2, the Charpy USE should be assumed to decrease as a function of fluence according to Figure 2 of the Regulatory Guide when surveillance data is not used. If surveillance data is used, the decrease in USE may be obtained by plotting the reduced plant surveillance data on Figure 2 of the Regulatory Guide and fitting the data with a line drawn parallel to the existing lines as the upper bound of all of the data. Charpy USE for the beltline forgings and welds were determined using surveillance data (Position 2.2 of the Regulatory Guide), and the Charpy USE for the extended beltline materials was determined without the use of surveillance data (Position 1.2 of the Regulatory Guide).

Predictions of the Charpy USE for EOL (50 EFPY) are summarized in Tables 4.2.2-1 and Table 4.2.2-2 for Salem Units 1 and 2, respectively, using the corresponding 1/4T fluence projection, the copper and nickel content of the beltline materials, and the results of the capsules tested to date, where applicable, using Figure 2 in Regulatory Guide 1.99.

The USE values for the beltline and extended beltline materials are projected to remain above the 50 ft-lb requirement through the period of extended operation as indicated in Tables 4.2.2-1 and Table 4.2.2-2 for Salem Unit 1 and Salem Unit 2, respectively.

Table 4.2.2-1 Predicted USE Values at 50 EFPY for Salem Unit 1					
RPV Material	Cu (%)	1/4T Fluence (E+19 n/cm²)	Initial USE (ft-lb)	USE Decrease (%)	USE (ft-lb)
Upper Shell B2401-1	0.25	0.021	74.3	14	64
Upper Shell B2401-2	0.25	0.021	79.3	14	68
Upper Shell B2401-3	0.25	0.021	62.2	14	53
Intermediate Shell B2402-1	0.24	1.097	91	28(1)	66(1)
Intermediate Shell B2402-2	0.24	1.097	98	18(1)	80(1)
Intermediate Shell B2402-3	0.22	1.097	104	22(1)	81(1)
Lower Shell B2403-1	0.19	1.091	93	29	66
Lower Shell B2403-2	0.19	1.091	83	29	59
Lower Shell B2403-3	0.19	1.091	85	29	60
Intermediate to Upper Shell Circumferential Weld Seam 8-042	0.27	0.021	97	18	80
Intermediate to Lower Shell Circumferential Weld Seam 9-042	0.22	1.091	112	39	68
Upper Shell Longitudinal Weld Seam 1-042 A	0.213	0.019	97	16(2)	81
Upper Shell Longitudinal Weld Seam 1-042 B	0.213	0.009	97	16(2)	81
Upper Shell Longitudinal Weld Seam 1-042 C	0.213	0.016	97	16(2)	81
Intermediate Shell Longitudinal Weld Seams 2-042 A&B	0.18	0.805	96.2	33	64
Intermediate Shell Longitudinal Weld Seam 2-042 C	0.18	0.414	96.2	28	69
Lower Shell Longitudinal Weld Seams 3-042 A&B	0.1826	0.668	112	31	77
Lower Shell Longitudinal Weld Seam 3-042 C	0.1826	1.091	112	35	73

(1) Projected USE was determined using credible plant surveillance data (Position 2.2 of Regulatory Guide 1.99, Revision 2. Capsules containing this material for this component were removed and analyzed. Use of this capsule data to predict USE is allowed by Section 2.0 of Regulatory Guide 1.99.

(2) Figure 2 of Regulatory Guide 1.99, Rev. 2 is used to estimate the upper shelf energy decrease. In Figure 2, the fluence ranges from 2.0E+17 n/cm^2 to 6.0E+19 n/cm^2. The Upper Shell Longitudinal Welds have a projected fluence below the 2.0E+17 n/cm^2. To estimate the upper shelf energy decrease using Figure 2 in Regulatory Guide 1.99, Rev. 2, and the projected fluence for the Upper Shell Longitudinal Welds was conservatively raised to match the lower limit of the figure.

Table 4.2.2-2 Predicted USE Values at 50 EFPY for Salem Unit 2

RPV Material	Cu (%)	1/4T Fluence (E+19 n/cm²)	Initial USE (ft-lb)	USE Decrease (%)	USE (ft-lb)
Upper Shell B4711-1	0.11	0.020	87.1	9	79
Upper Shell B4711-2	0.14	0.020	79.3	10	71
Upper Shell B4711-3	0.12	0.020	69.3	9	63
Intermediate Shell B4712-1	0.13	1.162	106	25	80
Intermediate Shell B4712-2	0.12	1.162	97	16	81(1)
Intermediate Shell B4712-3	0.11	1.162	107	25	80
Lower Shell B4713-1	0.12	1.168	98	25	74
Lower Shell B4713-2	0.12	1.168	103	25	77
Lower Shell B4713-3	0.12	1.168	121	25	91
Intermediate to Upper Shell Circumferential Weld Seam 8-442	0.27	0.020	97	18	80
Intermediate to Lower Shell Circumferential Weld Seam 9-442	0.197	1.168	99.7	35	65
Upper Shell Longitudinal Weld Seams 1-442 A&C	0.21	0.015	97	16(2)	81
Upper Shell Longitudinal Weld Seam 1-442 B	0.21	0.008	97	16(2)	81
Intermediate Shell Longitudinal Weld Seam 2-442 A	0.221	0.430	96.2	33	64
Intermediate Shell Longitudinal Weld Seam 2-442 B&C	0.221	0.840	96.2	38	60
Lower Shell Longitudinal Weld Seams 3-442 A&C	0.213	0.852	114	38	71
Lower Shell Longitudinal Weld Seam 3-442 B	0.213	0.433	114	33	76

(1) Projected USE was determined using credible plant surveillance data (Position 2.2 of Regulatory Guide 1.99, Revision 2. Capsules containing this material for this component were removed and analyzed. Use of this capsule data to predict USE is allowed by Section 2.0 of Regulatory Guide 1.99.

(2) Figure 2 of Regulatory Guide 1.99, Rev. 2 is used to estimate the upper shelf energy decrease. In Figure 2, the fluence ranges from 2.0E+17 n/cm^2 to 6.0E+19 n/cm^2. The Upper Shell Longitudinal Welds have a projected fluence below the 2.0E+17 n/cm^2. To estimate the upper shelf energy decrease using Figure 2 in Regulatory Guide 1.99, Rev. 2, and the projected fluence for the Upper Shell Longitudinal Welds was conservatively raised to match the lower limit of the figure.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii) – The USE analyses have been projected to the end of the period of extended operation and the resulting USE values have each been demonstrated to exceed the minimum acceptance limit of 50 ft-lbs.

4.2.3 PRESSURIZED THERMAL SHOCK ANALYSES

Summary Description

10 CFR 50.61(b)(1) provides rules for the protection of pressurized water reactors against pressurized thermal shock. Licensees are required to assess the projected values of nil ductility reference temperature whenever a significant change occurs in the projected values of RT_{PTS}, or upon request for a change in the expiration date for the facility operating license. The current RT_{PTS} analyses, evaluated for 32 EFPY fluence values predicted for 40 years of operation, are TLAAs requiring evaluation for 60 years.

Analysis

Reactor vessel beltline fluence is one of the factors used in determining the margin of acceptability of the reactor vessel to pressurized thermal shock as a result of neutron embrittlement. The margin is the difference between the maximum nil ductility reference temperature in the limiting beltline material and the screening criteria established in accordance with 10 CFR 50.61(b)(2). The screening criteria for the limiting reactor vessel materials are 270°F for beltline plates, forgings, and axial weld materials, and 300°F for beltline circumferential weld materials.

The results of new RT_{PTS} analyses, evaluated for 50 EFPY fluence values predicted for 60 years of operation, are presented in Tables 4.2.3-1 and 4.2.3-2 for Salem Units 1 and 2, respectively.

The limiting RT_{PTS} value for the Salem Unit 1 axially-oriented welds and plates is 258°F, which corresponds to the Lower Shell Longitudinal Weld Seam 3-042C. The limiting RT_{PTS} value for the Salem Unit 1 circumferentially oriented welds and plates is 229°F, which corresponds to the Intermediate-to-Lower Shell Circumferential Weld Seam 9-042.

The limiting RT_{PTS} value for the Salem Unit 2 axially-oriented welds and plates is 239°F, which corresponds to the Lower Shell Longitudinal Weld Seams 3-442 A&C. The limiting RT_{PTS} value for the Salem Unit 2 circumferentially-oriented welds is 118°F, which corresponds to the Intermediate Shell-to-Lower Shell Circumferential Weld Seam 9-442.

Each Salem Unit 1 and Unit 2 reactor vessel material that has a surface fluence value that exceeds 1.0E+17 n/cm^2 (E > 1.0 MeV) at 50 EFPY has been demonstrated to have an RT_{PTS} value less than the applicable screening criterion, which is 270°F for plates, forgings, and axially-oriented welds (longitudinal welds), and is 300°F for circumferentially-oriented welds. Therefore, the RT_{PTS} analyses have been satisfactorily projected for 60 years of operation.

Table 4.2.3-1 Calculation of RT_{PTS} Values for 50 EFPY at the Clad/Base Metal Interface for Salem Unit 1

Reactor Vessel Beltline Region Location	Heat	Cu (%)	Ni (%)	Chem Factor (°F)	Surface Fluence (E19 /cm²)	ΔRT_{PTS} (°F)	$RT_{NDT(U)}$ (°F)	Margin (°F)	RT_{PTS} (°F)	RT_{PTS} (°F) Acceptance Criteria
Upper Shell B2401-1	A-0497-1	0.25	0.47	157.8	0.0357	38.32	90	34	162	270
Upper Shell B2401-2	A-0495-1	0.25	0.48	159.2	0.0357	38.66	60	34	133	270
Upper Shell B2401-3	A-0512-1	0.25	0.51	163.4	0.0357	39.68	130	34	204	270
Intermediate Shell B2402-1	C-1354-1	0.24	0.53	155.8	1.84	181.85	45	17	244	270
Intermediate Shell B2402-2	C-1354-2	0.24	0.53	142.8	1.84	166.67	-5	17	179	270
Intermediate Shell B2402-3	C-1397-2	0.22	0.51	107.7	1.84	125.70	-3	17	140	270
Lower Shell B2403-1	C-1356-1	0.19	0.48	128.8	1.83	150.15	4	34	188	270
Lower Shell B2403-2	C-1356-2	0.19	0.49	129.9	1.83	151.43	18	34	203	270
Lower Shell B2403-3	C-1356-3	0.19	0.48	128.8	1.83	150.15	6	34	190	270
Intermediate to Upper Shell Circumferential Weld Seam 8-042	12420, Linde 1092, Lot 3708	0.27	1.035	254.4	0.0357	61.77	-56	65.51	71	300
Intermediate to Lower Shell Circumferential Weld Seam 9-042	13253, Linde 1092, Lot 3791	0.22	0.73	188.5	1.83	219.74	-56	65.51	229	300
Upper Shell Longitudinal Weld Seam 1-042 A	W5214 with NI-200, Linde 1092, Lot 3617	0.213	1.007	230.7	0.0317	52.32	-56	62.40	59	270
Upper Shell Longitudinal Weld Seam 1-042 B	W5214 with NI-200, Linde 1092, Lot 3617	0.213	1.007	230.7	0.0154	33.65	-56	47.84	25	270
Upper Shell Longitudinal Weld Seam 1-042 C	W5214 with NI-200, Linde 1092, Lot 3617	0.213	1.007	230.7	0.0261	46.67	-56	57.74	48	270

Table 4.2.3-1 Calculation of RT_{PTS} Values for 50 EFPY at the Clad/Base Metal Interface for Salem Unit 1

Reactor Vessel Beltline Region Location	Heat	Cu (%)	Ni (%)	Chem Factor (°F)	Surface Fluence (E19 /cm²)	ΔRT_{PTS} (°F)	$RT_{NDT(U)}$ (°F)	Margin (°F)	RT_{PTS} (°F)	RT_{PTS} (°F) Acceptance Criteria
Intermediate Shell Longitudinal Weld Seams 2-042 A & B	39B196/34B009+Ni-200, Linde 1092, Lot 3692	0.18	1.04	217.2	1.35	235.32	-56	65.51	245	270
Intermediate Shell Longitudinal Weld Seam 2-042 C	39B196/34B009+Ni-200, Linde 1092, Lot 3692	0.18	1.04	217.2	0.694	194.95	-56	65.51	204	270
Lower Shell Longitudinal Weld Seams 3-042 A & B	13253/34B009+Ni-200, Linde 1092, Lot 3708	0.1826	0.9825	213.2	1.12	219.95	-56	65.51	229	270
Lower Shell Longitudinal Weld Seam 3-042 C	13253/34B009+Ni-200, Linde 1092, Lot 3708	0.1826	0.9825	213.2	1.83	248.53	-56	65.51	258	270

Table 4.2.3-2 Calculation of RT_{PTS} Values for 50 EFPY at the Clad/Base Metal Interface for Salem Unit 2										
Reactor Vessel Beltline Region Location	Heat	Cu (%)	Ni (%)	Chem Factor (°F)	Surface Fluence (E19 n/cm²)	ΔRT_{PTS} (°F)	$RT_{NDT(U)}$ (°F)	Margin (°F)	RT_{PTS} (°F)	RT_{PTS} (°F) Acceptance Criteria
Upper Shell B4711-1	C4194-1	0.11	0.55	73.5	0.0341	17.39	60	17.39	95	270
Upper Shell B4711-2	C4194-2	0.14	0.56	98.2	0.0341	23.23	60	23.23	106	270
Upper Shell B4711-3	C4171-1	0.12	0.58	82.6	0.0341	19.54	101	19.54	140	270
Intermediate Shell B4712-1	C4173-1	0.13	0.56	89.8	1.95	106.19	0	34	140	270
Intermediate Shell B4712-2	C4186-2	0.12	0.61	102.2	1.95	120.85	12	17	150	270
Intermediate Shell B4712-3	C4194-2	0.11	0.57	73.7	1.95	87.15	10	34	131	270
Lower Shell B4713-1	C4182-1	0.12	0.60	83.0	1.96	98.26	8	34	140	270
Lower Shell B4713-2	C4182-2	0.12	0.57	82.4	1.96	97.55	8	34	140	270
Lower Shell B4713-3	B-8343-1	0.12	0.58	82.6	1.96	97.78	10	34	142	270
Intermediate to Upper Shell Circumferential Weld Seam 8-442	20291/1P2809 Linde 1092, Lot 3854	0.27	0.735	205.6	0.0341	48.63	-56	59.34	52	300
Intermediate to Lower Shell Circumferential Weld Seam 9-442	90099 Linde 0091, Lot 3977	0.197	0.060	91.4	1.96	108.20	-56	65.51	118	300
Upper Shell Longitudinal Weld Seam 1-442 A & C	13253/12008, Linde 1092, Lot 3833	0.21	0.873	208.7	0.0248	40.94	-56	53.22	38	270
Upper Shell Longitudinal Weld Seam 1-442 B	13253/12008, Linde 1092, Lot 3833	0.21	0.873	208.7	0.0126	26.72	-56	43.24	14	270
Intermediate Shell Longitudinal Weld Seams 2-442 A	13253/20291, Linde 1092, Lot 3833	0.221	0.732	189.1	0.722	171.82	-56	65.51	181	270

Table 4.2.3-2 Calculation of RT_{PTS} Values for 50 EFPY at the Clad/Base Metal Interface for Salem Unit 2

Reactor Vessel Beltline Region Location	Heat	Cu (%)	Ni (%)	Chem Factor (°F)	Surface Fluence (E19 n/cm²)	ΔRT_{PTS} (°F)	$RT_{NDT(U)}$ (°F)	Margin (°F)	RT_{PTS} (°F)	RT_{PTS} (°F) Acceptance Criteria
Intermediate Shell Longitudinal Weld Seam 2-442 B & C	13253/20291, Linde 1092, Lot 3833	0.221	0.732	189.1	1.41	207.13	-56	65.51	217	270
Lower Shell Longitudinal Weld Seams 3-442 A & C	21935/12008, Linde 1092, Lot 3889	0.213	0.867	208.6	1.43	229.30	-56	65.51	239	270
Lower Shell Longitudinal Weld Seam 3-442 B	21935/12008, Linde 1092, Lot 3889	0.213	0.867	208.6	0.727	189.94	-56	65.51	199	270

Disposition: Revision, 10 CFR 54.21(c)(1)(ii) – The RT_{PTS} analyses have been satisfactorily projected to the end of the period of extended operation.

4.2.4 REACTOR VESSEL PRESSURE–TEMPERATURE LIMITS, INCLUDING LOW TEMPERATURE OVERPRESSURE PROTECTION LIMITS

Summary Description

Appendix G of 10 CFR 50 requires that the reactor pressure vessel be maintained within established pressure-temperature (P-T) limits, including heatup and cooldown operations. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor pressure vessel is exposed to increased neutron irradiation, its fracture toughness is reduced. The P-T limits must account for the anticipated reactor vessel fluence. The current Low Temperature Overpressure Protection (LTOP) setpoint for Salem Units 1 and 2 is 375 psig.

The current Salem Units 1 and 2 P-T and LTOP limit calculations are effective through 32 EFPY. These calculations are associated with the 40-year P-T limit curves that satisfy the criteria of 10 CFR 54.3(a). They are also based upon 32 EFPY fluence values associated with 40 years of operation. Therefore, they are TLAAs requiring evaluation for 60 years.

Analysis

Updated P-T limit calculations were prepared using fluence values valid for 50 EFPY for Salem reactor vessel beltline region materials, inlet and outlet nozzles, and closure head flange locations for normal heatup, normal cooldown, and in-service leak and hydrostatic test conditions. In addition, minimum bolt-up temperatures, minimum temperature of core criticality, and LTOP system limits were determined. These P-T limits are expressed in the form of a curve of allowable pressure versus temperature (P-T limit curves).

Heatup and cooldown P-T limit curves for 50 EFPY were prepared using the most limiting value of RT_{NDT} (reference nil ductility transition temperature) corresponding to the limiting material in the beltline region of the reactor vessel. This is determined by using the unirradiated reactor vessel material fracture toughness properties adjusted to account for the estimated irradiation-induced shift (ΔRT_{NDT}).

RT_{NDT} increases as the material is exposed to fast-neutron flux. Therefore, to find the most limiting RT_{NDT} at any time period in the reactor's life, ΔRT_{NDT} due to the radiation exposure associated with that time period must be added to the original unirradiated RT_{NDT}. Using the adjusted reference temperature (ART) values, pressure-temperature limit curves are determined in accordance with the requirements of 10 CFR Part 50, Appendix G, as augmented by Appendix G to Section XI of the ASME Boiler and Pressure Vessel (B&PV) Code.

The 1/4 and 3/4 thickness (1/4T and 3/4T) fluences and material properties were used to determine the limiting material and calculate its pressure-temperature limits at 50 EFPY, which is bounding for the end of the period of extended operation. The limiting materials were determined from the values of ART at the 1/4T and 3/4T locations and are summarized in Tables 4.2.4-1 and 4.2.4-2 for Salem Units 1 and 2, respectively.

Table 4.2.4-1 Summary of the Limiting ART Values used in Generation of the Salem Unit 1 Reactor Vessel Heatup and Cooldown Curves

EFPY	1/4T Limiting ART	3/4T Limiting ART
	Lower Shell Longitudinal Weld Seam 3-042 C	Intermediate Shell B2402-1
50	228°F	177°F

Table 4.2.4-2 Summary of the Limiting ART Values used in Generation of the Salem Unit 2 Reactor Vessel Heatup and Cooldown Curves

EFPY	1/4T Limiting ART	3/4T Limiting ART
	Lower Shell Longitudinal Weld Seams 3-442 A&C	
50	209°F	150°F

Salem P-T limit curves for normal heatup and cooldown of the primary reactor coolant system were developed utilizing the 1998 Edition through the 2000 Summer Addenda of the ASME Code Section XI, Appendix G methodology and ASME Code Case N-641. This edition of the ASME Code Section XI, Appendix G allows use of the K_{IC} stress intensity factors and also allows the use of the "Circ-Flaw" methodology (formerly defined in ASME Code Cases N-640 and N-588, respectively).

Code Case N-641 provides alternative procedures for calculating the allowable pressure-temperature relationships and Low Temperature Overpressure Protection (LTOP) effective temperatures. Code Case N-641 divided Section 2215 of the 1998 through the 2000 Summer Addenda Edition of Section XI, Appendix G into Sections 2215.1 and 2215.2 for allowable pressures and the LTOP System, respectively. Section 2215.1 of Code Case N-641 replaced all K_{IA} designations with K_{IC}, thus removing the option to use the more restrictive K_{IA} stress intensity factor. Section 2215.2 provided the methodology to determine the LTOP System effective temperature.

The LTOP system provides Reactor Coolant System (RCS) pressure relief capability when system temperature is below 350°F. Two (2) pressurizer power operated relief valves (PORVs) provide the automatic relief capability during the design basis Mass Injection (MI) and the design basis Heat Injection (HI) transients and automatically prevent RCS pressure from exceeding the P-T limits of 10 CFR 50, Appendix G. Using the NRC-approved methodology provided in WCAP-14040-A, Rev. 4, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves" (Reference 4.8.1), the analysis determines the LTOP system single setpoint for Salem Units 1 and 2 with MI as the limiting transient. The HI transients were analyzed at selected RCS temperature to verify that the MI transient remained as the limiting transient.

At the lowest RCS temperature of 60°F (bolt-up temperature), the corresponding Appendix G limit is 620 psig. The Appendix G pressure limit was adjusted using instrumentation uncertainties and the delta pressure between the vessel and the pressure transmitter, resulting in values of 522 psig and 488 psig, corresponding to two and four reactor coolant pumps in operation, respectively. When plotted against the MI overpressure line, the resulting PORV setpoints are presented in Table 4.2.4-3. The calculated LTOP arming temperatures for Salem Units 1 and 2 are 327°F and 308°F, respectively, therefore, a bounding value of 327°F will be used for both Units.

Table 4.2.4-3 LTOP Single Setpoints and Arming/Enable Temperature for Salem Units 1 and 2

Setpoint	Restrictions
LTOP Single Setpoint = 397 psig	Without reactor coolant pump operating restriction – any number of reactor coolant pumps in operation at any reactor coolant system temperature.
LTOP Single Setpoint = 434 psig	With reactor coolant pump operating restriction – no more than two reactor coolant pumps in operation for reactor coolant system temperatures below 198°F or any number of reactor coolant pumps in operation above 198°F.
LTOP Arming/Enable Temperature = 327°F	None

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii) – The P-T and LTOP limit analyses have been projected to the end of the period of extended operation, however, will not be submitted at this time. The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The Reactor Vessel Surveillance Program (B.2.1.19) monitors reactor vessel embrittlement. This program provides data to update the P-T limits and, therefore, permits Salem Units 1 and 2 to manage the P-T limits going forward in accordance with 10 CFR 54(c)(1)(iii). Salem Units 1 and 2 will submit updates to the P-T and LTOP limits to the NRC at the appropriate time to comply with 10 CFR 50 Appendix G.

4.3 METAL FATIGUE OF PIPING AND COMPONENTS

Metal fatigue was evaluated in the design process for Salem pressure boundary components, including the reactor vessel, reactor coolant pumps, steam generators, pressurizer, piping, valves, and components of primary, secondary, auxiliary, steam, and other systems. The current design analyses for these components have been determined to be Time-Limited Aging Analyses (TLAAs) requiring evaluation for the period of extended operation. Fatigue TLAAs for Salem pressure boundary components are characterized by determining the applicable design code and design specifications that specify the fatigue design requirements. These design codes are listed in Table 4.3.1-1 in the following section.

NUREG-1801 provides a listing of components that are likely to have TLAAs in place that require evaluation for License Renewal. Each of these has been reviewed and the applicable TLAAs are evaluated in the following sections, as appropriate.

This section is divided into seven subsections that each addresses a specific grouping of components that were analyzed in accordance with the same design requirements. These groupings are as follows:

- Nuclear Steam Supply System (NSSS) Pressure Vessel and Component Fatigue Analyses
- Pressurizer Safety Valve and Pilot-Operated Relief Valve Fatigue Analyses
- ASA / USAS B31.1 Piping Fatigue Analysis
- Supplementary ASME Section III, Class 1 Piping and Component Fatigue Analyses
- Reactor Vessel Internals Fatigue Analyses
- Spent Fuel Pool Bottom Plates Fatigue Analyses
- Environmentally-Assisted Fatigue Analyses

The evaluations referenced in these sections fall into the following categories:

- Explicit fatigue analyses for NSSS pressure vessels and components prepared in accordance with ASME Section III, Class A or Class 1 rules developed as part of the original design;
- Implicit fatigue evaluations specified by USAS B31.1 rules developed as part of the original design;
- Supplemental explicit fatigue analyses for piping and components that were prepared in accordance with ASME Section III rules to evaluate transients that were identified after the original design analyses were completed, such as pressurizer surge line thermal stratification; and
- Reactor vessel internal component fatigue analyses

New fatigue analyses were prepared for license renewal to evaluate the effects of the reactor water environment on the sample of high-fatigue locations applicable to older-vintage Westinghouse Plants, as identified in Section 5.5 of NUREG/CR-6260. The environmental fatigue methodology and results of these analyses are presented in Section 4.3.7. Since several of these components are located within systems currently analyzed to ASA/USAS B31.1 rules, new explicit analyses were prepared in accordance with ASME Section III, Class 1 rules for each of these components. For these locations environmental fatigue correction factors were computed and applied to the CUF values developed in the Class 1 fatigue analyses.

4.3.1 NUCLEAR STEAM SUPPLY SYSTEM (NSSS) PRESSURE VESSEL AND COMPONENT FATIGUE ANALYSES

Summary Description

Nuclear Steam Supply System (NSSS) pressure vessels and major components for Salem were designed in accordance with ASME Section III, Class A or Class 1 requirements and were required to have explicit analyses of cumulative fatigue usage. Table 4.3.1-1 identifies the applicable design codes for these components.

Table 4.3.1-1 Original Design Codes for NSSS Components at Salem Units 1 and 2

Component	Codes	Edition/Addendum
Reactor Vessel	ASME Section III, Class A ASME Section III, Class 1	1965 and all addenda through Winter 1965 (Unit 1) 1965 and all addenda through Winter 1966 (Unit 2)
Reactor Vessel Closure Head	ASME Section III, Class 1	1998 and all addenda through 2000
Pressurizer	ASME Section III, Class A ASME Section III, Class 1	1965 and all addenda through Winter 1966 1989 Edition (Lower Head)
Steam Generators	ASME Section III, Class A ASME Section III, Class 1	1971 and all addenda through Summer 1973 (Unit 1) 1995 and all addenda through 1996 (Unit 2)
Reactor Coolant Pump Casings	ASME Section III, Class A ASME Section III, Class 1	1965 and all addenda through Summer 1966 (Unit 1) 1971 and all addenda through Summer 1973 (Unit 2)

ASME Section III, Class A and Class 1 fatigue analyses determine the Cumulative Usage Factor (CUF) value that results from the component being exposed to the list of postulated transients during the expected life of the component. This analysis is performed using the appropriate s-N (stress amplitude / Number of cycles) fatigue curve from ASME Section III for the component material type. The curve shows the number of cycles the component can withstand without cracking for a given amplitude of applied alternating stress. The resulting CUF of less than 1.0 indicates the cumulative effects from the postulated transients will not result in the initiation of fatigue cracking.

These ASME Section III, Class A and Class 1 fatigue analyses are based upon explicit numbers and amplitudes of thermal and pressure transients described in the design specifications. The intent of the design basis transient definitions is to bound not just specific operations but a wide range of possible events with varying ranges of severity in temperature, pressure, and flow. The most limiting numbers of transients used in these NSSS component analyses are shown in Table 4.3.1-2, and are considered to be design limits.

Table 4.3.1-2 Design Transient Cycles for NSSS Class A and Class 1 Components at Salem Units 1 and 2

Transient Description	**Limiting Design Basis Number of Occurrences for 40 Years**
Normal Condition Transients:	
Plant Heat Up @ ≤ 100 °F/hr	200
Plant Cooldown @ ≤ 100 °F/hr	200
Unit Loading @ 5%/min	13,200(1)
Unit Unloading @ 5%/min	13,200(1)
Step Load Increase of 10% of Full Power	2,000
Step Load Decrease of 10% of Full Power	2,000
Large Step Load Decrease (50%) with Steam Dump	200
Hot Standby Operations	2,000
Upset Condition Transients:	
Loss of Load	80
Loss of Power	40
Loss of Flow	80
Reactor Trip from Full Power	400
Inadvertent Auxiliary Spray to Pressurizer	10
Inadvertent Safety Injection	50
Test Condition Transients:	
Turbine Roll Test	10
Primary Side Hydrostatic Test	5
Secondary Hydrostatic Test	5
Primary Side Leak Test	50

(1) For the design transient of Unit Loading and Unit Unloading @ 5%/min., the Steam Generators are designed for 13,200 cycles, where the Reactor Vessel was designed for 14,500 cycles, the Pressurizer was designed for 18,300 cycles, and the Reactor Coolant Pumps were designed for 29,000 cycles. The most limiting value of these major components is used as a monitoring limit in the Metal Fatigue of Reactor Coolant Pressure Boundary Program (B.3.1.1).

Each Salem Unit 1 and 2 component designed in accordance with ASME Section III, Class A and Class 1 rules was analyzed and shown to have a CUF less than the design limit of 1.0. Since each Class A and Class 1 fatigue analysis is based upon a number of cycles postulated to bound 40 years of service, they have been identified as TLAAs that require evaluation for 60 years.

Analysis

In order to determine if the ASME Section III, Class A and Class 1 fatigue analyses will remain valid for 60 years of service, a review of fatigue monitoring data was performed to determine the number of cumulative cycles of each transient type that have occurred during past plant operations. Then the average rate of occurrence was determined, and predictions of future transient occurrences were made. For each transient type, the 60-year projected number of occurrences was determined by adding the number of past occurrences to the number of predicted future occurrences. These 60-year projections were then compared to the numbers of design cycles used in the fatigue analyses to see if the design cycles remain bounding for 60 years of operations. If the 60-year projected numbers of cycles is less than the numbers of cycles used in the design fatigue analyses, then the fatigue analyses based upon the design transients will remain valid for 60 years of operation if the design transient severity is also bounding of the actual transient severity.

Therefore, an evaluation was performed to determine if the severity of the actual plant transients that have occurred during past operations remains bounded by the transient severity provided for each transient definition in the design specification. This was to assure that the past cycles were appropriately characterized during fatigue monitoring activities in the past. The administrative and operating procedures were also reviewed in order to assess the effectiveness of the design transient cycle counting program and to validate the cyclic assumptions. This evaluation determined that the actual transient severity was bounded by the design transient severity for each transient type. The cycle counting procedure was also determined to have been effective in properly characterizing actual plant transients.

The overall conclusion of these evaluations is that the existing design transients bound transients projected for 60 years of plant operations.

<u>60-Year Transient Projection Methodology</u>

1. Projection Methodology

   For Salem Unit 1, the baseline period started on 8/13/1976 and ended on 12/31/2007, a total of 31.4 calendar years. However, since Unit 1 was non-operational for 2.9 years during this period, the non-operational years were subtracted from the past calendar years of operation to determine actual years of plant operation to-date, resulting in 28.5 actual years of past operation. This method shortens the baseline period, which increases the rate of transient occurrence compared with results only using calendar years. For each transient type, the average rate of occurrence was determined by dividing the cumulative number of occurrences as of 12/31/2007 by 28.5 years of past operation. For each transient type, future cycles were predicted by multiplying the average rate of past occurrence by the number of calendar years remaining between 12/31/2007 and 8/13/2036. The 60-year projection was determined by adding the cumulative number of occurrences as of 12/31/2007 to the number of cycles predicted to occur in the 31.5 years of future operation.

For Salem Unit 2, the baseline period started on 4/18/1980 and ended on 12/31/2007, a total of 27.8 years. Unit 2 was non-operational for 2.2 years during this period resulting in 25.6 total years of past operation. For each transient type, the average rate of occurrence was determined by dividing the cumulative number of occurrences as of 12/31/2007 by 25.6 years of past operation. For each transient type, future cycles were predicted by multiplying the average rate of past occurrence by the number of calendar years remaining between 12/31/2007 and 4/18/2040. The 60-year projection was determined by adding the cumulative number of occurrences as of 12/31/2007 to the number of cycles predicted to occur in the 34.4 years of future operation.

2. Heatups and Cooldowns

A review of data from the transient cycle counting program and data from WESTEMS fatigue monitoring software for the pressurizer bottom head determined that there were 63 heatups and 63 cooldowns for Salem Unit 1 as of 12/31/2007. An average rate regression technique was used for the 60-year projections to yield 133 heatups and 133 cooldowns for Salem Unit 1.

A review of data from the transient cycle counting program and data from WESTEMS fatigue monitoring software for the pressurizer bottom head determined that there were 67 heatups and 66 cooldowns for Salem Unit 2 as of 12/31/2007. An average rate regression technique was used for the 60-year projections to yield 157 heatups and 155 cooldowns for Salem Unit 2.

3. Unit Loading and Unloading

Salem Unit 1 plant records indicated 764 Unit Loadings up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 764 / 28.5 years = 26.8 cycles/per year. Therefore, the projected Salem Unit 1 Loading transients are 764 + (26.8 * 31.5) = 1608. Salem Unit 1 Unit Unloading cycles are assumed to equal the Unit Loadings, or equal to 1608.

Salem Unit 2 plant records indicated 472 Unit Loadings up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 472 / 25.6 years = 18.4 cycles/per year. Therefore, the projected Salem Unit 2 Loading transients are 472 + (18.4 * 34.4) = 1106. Salem Unit 2 Unit Unloading cycles are assumed to equal the Unit Loadings, or equal to 1106.

4. 10% Step Load Change Projections

   Salem Unit 1 plant records indicated 41 10% Step Load Changes up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 41 / 28.5 years = 1.44 cycles/per year. Therefore, the projected Salem Unit 1 10% Step Load Change transients are 41 + (1.44 * 31.5) = 86.

   Salem Unit 2 plant records indicated 18 10% Step Load Changes up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 18 / 25.6 years = 0.70 cycles/per year. Therefore, the projected Salem Unit 2 10% Step Load Change transients are 18 + (0.70 * 34.4) = 42.

5. Large Step Load Change Projections

   Salem Unit 1 plant records indicated 17 Large Step Load Changes up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 17 / 28.5 years = 0.60 cycles/per year. Therefore, the projected Salem Unit 1 Large Step Load Change transients are 17 + (0.60 * 31.5) = 36.

   Salem Unit 2 plant records indicated 4 Large Step Load Changes up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 4 / 25.6 years = 0.16 cycles/per year. Therefore, the projected Salem Unit 2 Large Step Load Change transients are 4 + (0.16 * 34.4) = 10.

6. Loss of Power Projections

   Salem Unit 1 plant records indicated 19 Losses of Power up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 19 / 28.5 years = 0.66 cycles/per year. Therefore, the projected Salem Unit 1 Loss of Power transients are 19 + (0.66 * 31.5) = 40.

   Salem Unit 2 plant records indicated 10 Losses of Power up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 10 / 25.6 years = 0.40 cycles/per year. Therefore, the projected Salem Unit 2 Loss of Power transients are 10 + (0.40 * 34.4) = 24.

7. Loss of Load Projections

   Salem Unit 1 plant records indicated 2 Losses of Load up to 12/31/2007. Due to the low number of transients, an average rate method was used to project to 60 years, or 2 / 28.5 years = 0.07 cycles/per year. Therefore, the projected Salem Unit 1 Loss of Load transients are 2 + (0.07 * 31.5) = 4.

   Salem Unit 2 plant records indicated 0 Losses of Load up to 12/31/2007. Therefore, the projected Salem Unit 2 Loss of Load transients are 1.

8. Loss of Flow Projections

   Salem Unit 1 plant records indicated 5 Losses of Flow up to 12/31/2007. Due to the low number of transients, an average rate method was used to project to 60 years, or 5 / 28.5 years = 0.18 cycles/per year. Therefore, the projected Salem Unit 1 Loss of Flow transients are 2 + (0.18 * 31.5) = 11.

   Salem Unit 2 plant records indicated 2 Losses of Flow up to 12/31/2007. Due to the low number of transients, an average rate method was used to project to 60 years, or 2 / 25.6 years = 0.08 cycles/per year. Therefore, the projected Salem Unit 2 Loss of Flow transients are 2 + (0.08 * 34.4) = 5.

9. Reactor Trip Projections

   Salem Unit 1 plant records indicated 190 Reactor Trips up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 190 / 28.5 years = 6.67 cycles/per year. Therefore, the projected Salem Unit 1 Reactor Trip transients are 190 + (6.67 * 31.5) = 400.

   Salem Unit 2 plant records indicated 139 Reactor Trips up to 12/31/2007. Since there is a declining trend since 1976, an average rate method was used to project to 60 years, or 139 / 25.6 years = 5.43 cycles/per year. Therefore, the projected Salem Unit 2 Reactor Trip transients are 139 + (5.43 * 34.4) = 326.

10. Inadvertent Auxiliary Spray Projections

    There was one transient found in Salem Unit 1 plant records up to 12/31/2007. Due to the low number of transients, an average rate method was used to project to 60 years, or 1 / 28.5 years = 0.035 cycles/per year. Therefore, the projected Salem Unit 1 Inadvertent Auxiliary Spray transients are 1 + (0.035 * 31.5) = 2.

    There was one transient found in Salem Unit 2 plant records up to 12/31/2007. Due to the low number of transients, an average rate method was used to project to 60 years, or 1 / 25.6 years = 0.040 cycles/per year. Therefore, the projected Salem Unit 2 Inadvertent Auxiliary Spray transients are 1 + (0.04 * 34.4) = 3.

11. Safety Injection Projections

    Salem Unit 1 plant records indicated 21 Safety Injections up to 12/31/2007. An average rate method was used to project to 60 years, or 21 / 28.5 years = 0.72

cycles/per year. Therefore, the projected Salem Unit 1 Safety Injection transients are 21 + (0.72 * 31.5) = 44.

Salem Unit 2 plant records indicated 12 Safety Injections up to 12/31/2007. An average rate method was used to project to 60 years, or 12 / 25.6 years = 0.48 cycles/per year. Therefore, the projected Salem Unit 2 Safety Injection transients are 12 + (0.48 * 34.4) = 30.

12. Other Design Transients (Salem Units 1 and 2)

    Primary Side Hydrostatic Tests; 1 event for each Unit up to 12/31/2007, therefore, 60-year projections are 2 and 3 for Salem Unit 1 and Unit 2, respectively. Salem Unit 2 has more projected transients due to its later vintage.

    Secondary Side Hydrostatic Tests; 1 and 0 events for Units 1 and 2, respectively, up to 12/31/2007, therefore, 60-year projections are 2 and 3 for Salem Unit 1 and Unit 2, respectively. Salem Unit 2 has more projected transients due to its later vintage.

    Primary Side Leak Tests; 1 event up to 12/31/2007, therefore, 60-year projections are 2 and 3 for Salem Unit 1 and Unit 2, respectively. Salem Unit 2 has more projected transients due to its later vintage.

    Turbine Roll Tests; 0 events up to 12/31/2007, therefore, 60-year projections are 2 and 3 for Salem Unit 1 and Unit 2, respectively. Salem Unit 2 has more projected transients due to its later vintage.

    Operating Basis Earthquake; 0 events each up to 12/31/2007, therefore, 60-year projections are 2 and 3 for Salem Unit 1 and Unit 2, respectively. Salem Unit 2 has more projected transients due to its later vintage.

Tables 4.3.1-3 and Table 4.3.1-4 list the 60-year projections of transients applicable to Salem Units 1 and 2, respectively.

Table 4.3.1-3 Design Transients and 60-Year Projections for NSSS Class A and Class 1 Components at Salem Unit 1

Design Transient	Current Cycles	60-Year Projected Cycles	NSSS Design Limit
Normal Condition Transients:			
Plant Heat Up @ ≤ 100 °F/hr	63	133	200
Plant Cooldown @ ≤ 100 °F/hr	63	133	200
Unit Loading @ 5%/min	764	1608	13,200
Unit Unloading @ 5%/min	764	1608	13,200
Step Load Increase of 10% of Full Power	41	86	2,000
Step Load Decrease of 10% of Full Power	41	86	2,000
Large Step Load Decrease (50%) with Steam Dump	17	36	200
Hot Standby Operations	737	737[1]	2,000
Upset Condition Transients:			
Loss of Load	2	4	80
Loss of Power	19	40	40
Loss of Flow	5	11	80
Reactor Trip from Full Power	190	400	400
Inadvertent Auxiliary Spray to Pressurizer	1	2	10
Inadvertent Safety Injection	21	44	50
Test Condition Transients:			
Turbine Roll Test	0	2	10
Primary Side Hydrostatic Test	1	2	5
Secondary Hydrostatic Test	1	2	5
Primary Side Leak Test	1	2	50
Total Cycles:	2,731	4,936	N/A

[1]Hot Standby Operations remain constant following implementation of digital feedwater control.

Table 4.3.1-4 Design Transients and 60-Year Projections for NSSS Class A and Class 1 Components at Salem Unit 2

Design Transient	Current Cycles	60-Year Projected Cycles	NSSS Design Limit
Normal Condition Transients:			
Plant Heat Up @ ≤ 100 °F/hr	67	157	200
Plant Cooldown @ ≤ 100 °F/hr	66	155	200
Unit Loading @ 5%/min	472	1106	13,200
Unit Unloading @ 5%/min	472	1106	13,200
Step Load Increase of 10% of Full Power	18	42	2,000
Step Load Decrease of 10% of Full Power	18	42	2,000
Large Step Load Decrease (50%) with Steam Dump	4	10	200
Hot Standby Operations	1245	1245[(1)]	2,000
Upset Condition Transients:			
Loss of Load	0	1	80
Loss of Power	10	24	40
Loss of Flow	2	5	80
Reactor Trip from Full Power	139	326	400
Inadvertent Auxiliary Spray to Pressurizer	1	3	10
Inadvertent Safety Injection	12	30	50
Test Condition Transients:			
Turbine Roll Test	0	3	10
Primary Side Hydrostatic Test	1	3	5
Secondary Hydrostatic Test	0	3	5
Primary Side Leak Test	1	3	50
Total Cycles:	2,528	4,264	N/A

[(1)]Hot Standby Operations remain constant following implementation of digital feedwater control.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The 40-year design transients bound the numbers of cycles projected to occur during 60 years of plant operations at Salem Units 1 and 2. Therefore, the NSSS Class A and Class 1 fatigue analyses that are based upon the 40-year design transients remain valid for the period of extended operation.

4.3.2 PRESSURIZER SAFETY VALVE AND PILOT-OPERATED RELIEF VALVE FATIGUE ANALYSES

4.3.2.1 PRESSURIZER SAFETY VALVE FATIGUE ANALYSES

Summary Description

There are three (3) 6-inch safety valves installed on the pressurizer. Each of the valves has a design specification of 50 cycles. The fatigue analyses for these valves are a TLAA that requires evaluation for 60 years of operation.

Analysis

The pressurizer side of the safety relief valves experience the primary side transients while the downstream side experience pressure and thermal cycles when the valve lifts, i.e., when the pressurizer pressure exceeds the setpoint of 2485 psig.

Table 4.3.2-1 provides a summary of these pressurization cycles for Salem Units 1 and 2. There has been zero Feedwater Line Break, Reactor Coolant Pump (RCP) Locked Rotor, and Control Rod Ejection transients up to 12/31/2007, however, there is one transient projected for 60 years for each of these three transient types.

Table 4.3.2-1 Salem 60-Year Projections of Transients Applicable to the Pressurizer Safety Valve Fatigue Analyses

Transient Description	Salem Unit 1		Salem Unit 2	
	Current Cycles	60-Year Projected Cycles	Current Cycles	60-Year Projected Cycles
Loss of Load	2	4	0	1
Feedwater Line Break	0	1	0	1
RCP Locked Rotor	0	1	0	1
Control Rod Ejection	0	1	0	1
TOTALS	2	7	0	4

The number of cycles projected to occur in 60 years is well below 50 cycles analyzed for the pressurizer safety valves.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The pressurizer safety valve fatigue analyses remain valid for the period of extended operation.

4.3.2.2 PRESSURIZER PILOT-OPERATED RELIEF VALVE FATIGUE ANALYSES

Summary Description

There are two (2) 3-inch Pilot-Operated Relief Valves (PORVs) installed on the pressurizer. Each of the PORVs has a design specification of 500 cycles per year for the design operating life of 40 years, equivalent to 20,000 cycles. The fatigue analyses for these valves are a TLAA requiring evaluation for 60 years of operation.

Analysis

The pressurizer side of the PORVs experiences the primary side transients while the downstream side experience pressure and thermal cycles when the valve opens and the pressurizer is pressurized.

Table 4.3.2-2 provides a summary of these pressurization cycles.

Table 4.3.2-2 Salem 60-Year Projections of Transients Applicable to the Pressurizer Pilot-Operated Relief Valve Fatigue Analyses

Transient Description	Salem Unit 1		Salem Unit 2	
	Current Cycles	60-Year Projected Cycles	Current Cycles	60-Year Projected Cycles
Large Step Load w/ Steam Dump	17	36	4	10
Loss of Flow	5	11	2	5
Loss of Load	2	4	0	1
Loss of Power	19	40	10	24
TOTALS	43	91	16	40

The number of cycles projected to occur in 60 years is well below 20,000 cycles analyzed for the PORVs.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The pressurizer PORV fatigue analyses remain valid for the period of extended operation.

4.3.3 ASA / USAS B31.1 PIPING FATIGUE ANALYSES

This section describes fatigue-related TLAAs arising within design analyses of the piping and components designed in accordance with ASA / USAS B31.1 requirements.

Summary Description

Piping designed in accordance with ASA / USAS B31.1 Piping Code is not required to have an analysis of cumulative fatigue usage, but cyclic loading is considered in a simplified manner in the design process. When the Salem components were designed to ASA / USAS B31.1 requirements, the overall number of thermal and pressure cycles expected during the 40-year lifetime of these components was determined. The total number of cycles was compared to cycle ranges specified in ASA / USAS B31.1 for consideration of allowable stress reduction. If the total number of cycles exceeded 7,000 cycles, a stress range reduction factor had to be applied to the allowable stress range for secondary stresses (expansion and displacement) to account for thermal cycling. This is considered to be an implicit fatigue analysis since it is based upon a total number of cycles projected to occur in 40 years, but does not have an explicit Cumulative Usage Factor (CUF) value associated with it. Since the overall number of cycles could potentially increase during the period of extended operation, which could potentially result in further reduction of the allowable stress, these implicit fatigue analyses are also considered to be TLAAs requiring evaluation for the period of extended operation.

The following Salem systems that are in scope for license renewal were designed in accordance with ASA/USAS B31.1 requirements: Reactor Coolant System (including primary loop piping and pressurizer surge line piping), Chemical and Volume Control System, Safety Injection System, Component Cooling System, Sampling System, Residual Heat Removal System, Main Steam System, Main Condensate and Feedwater, Auxiliary Feedwater System and the Steam Generator Blowdown System.

Note that after originally being designed in accordance with ASA/USAS B31.1 requirements, portions of some components of these systems were reevaluated to ASME Section III, Class 1 requirements, as described in Section 4.3.4. The remaining components within those systems that were not reanalyzed are included within the evaluation provided within this section.

Analysis

In order to evaluate these TLAAs for 60 years, the numbers of cycles expected to occur within the 60-year operational period should be compared to the numbers of cycles that were originally considered in the design of these components. If this number does not exceed 7,000 cycles, the minimum number of cycles required that would result in application of an allowable stress reduction factor, then there is no impact from the added years of service and the original analyses remain valid. If the total number of cycles exceeds 7,000 cycles, then additional evaluation is required.

The 60-year transient projection results shown in Tables 4.3.1-3 and 4.3.1-4 for Salem

Units 1 and 2, respectively, show that even if all of the projected operational transients are added together, the total number of cycles projected for 60 years will not exceed 7,000 cycles. Therefore, there is no impact upon the implicit fatigue analyses used in the component design for the systems designed to ASA / USAS B31.1 requirements.

The Sampling System thermal cycles do not trend along with operational cycles since sampling is required on a periodic basis, as opposed to an operational basis. However, only the portion of the sampling lines that constitutes piping need be considered here. In this case that portion turns out to be a very short section of piping directly connected to the RCS loop piping. Since this section of piping has no isolation valve and no bends, it is assumed to always be exposed to primary loop temperature and pressure condition. Similarly since there are no other external piping connections (only the tubing connection exits) the line will not experience any other externally applied loads. Therefore, that section of the sampling line that constitutes B31.1 piping will only experience the RCS loop transients which have already been shown to be less than 7,000 cycles and the line is, therefore, acceptable.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for 60 years of operation.

4.3.4 SUPPLEMENTARY ASME SECTION III, CLASS 1 PIPING AND COMPONENT FATIGUE ANALYSES

Summary Description

In addition to the original design assumptions, the Salem Pressurizer Fatigue evaluations were updated to include the added thermal stratification effects of insurge and outsurge events on the pressurizer lower head and surge nozzle. These new conditions did not change the number of original design cycles, but rather incorporated the effects as new (added) sub-events within the original design transients. Hence, reporting of transient cycles remains with respect to the original design set.

Each of the Salem Unit 1 piping systems, including the Reactor Coolant System main loop piping, were originally designed in accordance with ASA B31.1-1955 design requirements. Piping systems for Unit 2 were designed in accordance with USAS B31.1-1967 requirements. Since then, a number of updated fatigue analyses have been prepared for piping systems and components to address transients that have been identified in the industry that were not originally considered. These analyses have been performed in accordance with ASME Section III, Class 1 rules to enable these transients to be thoroughly evaluated. These transients include those associated with potential valve leakage transients identified in Generic Letter 88-08 for the auxiliary spray line, charging lines, and safety injection lines, and thermal stratification of the pressurizer surge line, as described in Generic Letter 88-11.

As part of the Salem Unit 1 Steam Generator replacement, a new Feedwater nozzle transition piece forging was designed as an ASME III, Class 1 component. The design basis for the Unit 1 steam generator manway studs was also updated to include fatigue considerations.

Each of these analyses resulted in a Cumulative Usage Factor (CUF) value less than 1.0 based upon a number of transients postulated to bound 40 years of plant operations. Therefore, each of these analyses has been identified as a TLAA requiring evaluation for 60 years.

These analyses are separated from those evaluated in the previous sections because the transient definitions have been modified, or additional transients have been postulated for these components, in addition to those previously described. Therefore, the cycle projections for these components must address these revised transients or additional transient types to determine if they also remain bounded for 60 years of service. Each of these analyses is dispositioned separately within this section for clarity.

The ASA/USAS B31.1 systems that include components reevaluated to ASME Section III, Class 1 design requirements are listed in Table 4.3.4-1, along with the effective Code Edition and Addenda.

Table 4.3.4-1 Updated Design Codes for Select Salem Units 1 and 2 Piping Systems

Component	Codes	Edition/Addendum
Charging System Piping	ASME Section III, Class 1	1986
Pressurizer Auxiliary Spray Lines	ASME Section III, Class 1	1986
Pressurizer Surge Line Piping	ASME Section III, Class 1	1986
Feedwater Nozzle Transition Piece	ASME Section III, Class 1	1989

4.3.4.1 NRC Bulletin 88-08, Thermal Stresses in Piping Connected to Reactor Coolant Systems

Summary Description

NRC Bulletin 88-08 was issued June 22, 1988 with supplements in 1988 and 1989 because of observed pipe cracking due to valve leakage in unisolable lines. The Bulletin required that licensees identify potential locations that might be subject to high stresses due to leaking valves, inspect the potential locations, and to assure that susceptible locations will not fail for the remaining life of the unit.

The NRC Safety Evaluation Report (SER) approved Salem's response to NRC Bulletin 88-08, which included the evaluation of the fatigue analyses of the Normal and Alternate Charging Lines and the Auxiliary Spray Lines. The analyses were based on the requirements of ASME Section III, 1986 edition, Subsection NB-3653 and the fatigue curves of I-9.2.1 and I-9.2.2 and concluded that the cumulative usage factor would remain less than 1.0 for the Normal and Alternate Charging Lines. The Auxiliary Spray Line results for the same transients would remain less than 1.0 for twenty-four (24) calendar years since initial plant start-up.

In 1999, Salem performed a revised fatigue evaluation of the Auxiliary Spray Lines for a life of forty (40) calendar years. The analysis showed that the Inadvertent Auxiliary

Spray transient controlled the calculated fatigue usage. The original design basis was ten (10) Inadvertent Auxiliary Spray transients over the life of the plant. The 1999 analysis reduced the number of transients from ten (10) to five (5). The resulting fatigue usage was calculated to be less than 1.0 for forty (40) calendar years.

In 1994, Salem committed to perform leakage testing on a quarterly basis to ensure that the leakage rate was less than 0.05 gpm to preclude the potential for fatigue in Safety Injection piping downstream of the connection to the RCS piping, thus a fatigue analysis was not required to be performed in response to Bulletin 88-08. In 2001, Salem installed double valve isolation to eliminate the leakage path concern.

Analysis

Normal and Alternate Charging Lines

The fatigue evaluation of the charging lines to address potential thermal cycling transients included typical charging line transients from similar Westinghouse plants designed to ASME Section III, plus additional transients assumed to be induced by valve leakage over a 40 year period, based on operation of either charging line for 60% of the 40-year period, or an equivalent 24-year total leakage period. For the analyses to remain valid for the 60-year period, the cycles of the design transients and those due to leakage must be shown to be less than analyzed. For the design cycles, Metal Fatigue of Reactor Coolant Pressure Boundary program (B.3.1.1) will be used to ensure that the charging transient cycles in either the normal or alternate charging line remain less than those analyzed.

A re-evaluation, including consideration of reactor coolant environment (see Section 4.3.6), has been performed for the charging nozzles to account for the 60-year projected charging transient cycles, and the resulting fatigue usage is less than 1.0. Although the charging nozzles are not subject to thermal stratification and thermal cycling transients, these results of their re-evaluation demonstrate the relative impact of the 60-year projected charging design transients, and the ability of the design to accommodate these cycles.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) will be adequately managed for the period of extended operation by the Metal Fatigue of Reactor Coolant Pressure Boundary program (B.3.1.1), which monitors transient cycles to assure they do not exceed their design limits, validating the assumptions used in these evaluations.

Auxiliary Spray Line

The Pressurizer Auxiliary Spray line was reanalyzed to ASME Section III, Class 1 design rules in order to evaluate postulated thermal events described in Generic Letter 88-08. The potential thermal events would result from cold water leaking past a closed valve seat into the hot Pressurizer Auxiliary Spray line, leading to thermal cycling along the bottom of the pipe. Subsequent valve maintenance and monitoring has minimized the likelihood of this type of thermal cycling, but the analysis remains in effect, and was identified as a TLAA requiring evaluation for 60 years.

The 1999 analysis for 40 years of operation concluded that the cumulative usage factor was less than 1.0 for the limiting location of the Auxiliary Spray Line. The basis was five (5) Inadvertent Auxiliary Spray transients. The analysis also stated that the fatigue usage for thermal cycling and striping due to valve leakage was negligible. The 60-yr projected Inadvertent Auxiliary Spray to Pressurizer events are 2 and 3, respectively for Salem Units 1 and 2.

Therefore, the number of projected transients is bounded by the basis for the ASME III fatigue analysis.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.3.4.2 NRC Bulletin 88-11, Pressurizer Surge Line Thermal Stratification

Summary Description

NRC Bulletin 88-11, issued in December 1988, requested utilities to establish and implement a program to confirm the integrity of the pressurizer surge line. The program required both visual inspection of the surge line and demonstration that the design requirements of the surge line are satisfied, including the consideration of stratification effects.

The Pressurizer Surge Line piping and nozzles were previously evaluated for the effects of thermal stratification and plant-specific transients. The controlling fatigue location was the surge line weld to the pressurizer surge nozzle. In a later evaluation, a plant-specific WESTEMS™ model was developed for the pressurizer and surge line to evaluate the effects of pressurizer insurge and outsurge transients and surge line stratification on the pressurizer surge nozzle safe end to pipe weld and the surge line hot leg nozzle. This evaluation was part of an evaluation of reactor water environmental effects on the surge line. This is the current design analysis of record. The models from that analysis were also used to evaluate the design cycles for the NSSS transients and projected 60-year cycles of surge line stratification and insurge and outsurge transients, to calculate CUF at the pressurizer surge nozzle safe end to pipe weld and at the surge line hot leg nozzle, without environmental effects. Since the analysis envelops the 60-year cycles, it remains valid for 60 years. The evaluation incorporating these models in the evaluation of environmentally assisted fatigue is described further in the section on environmental fatigue.

Analysis

The Pressurizer Surge Line hot leg nozzle and pressurizer nozzle to safe end weld have been recently evaluated using an ASME Section III, Class 1 fatigue analysis. This analysis was part of the evaluation of the environmental effects of reactor coolant. The results of the 60-yr projected CUF evaluation, including the environmental factors, are less than 1.0.

In addition, models from that analysis were also used to evaluate CUF without environmental effects. The analyses performed to demonstrate compliance with design requirements considered ASME Code requirements and utilized the design set of NSSS transients. Pressurizer surge line stratification sub-transients were developed based on plant operating procedures, surge line monitoring data from similar units and historical records for each Salem unit, and projected 60-year cycles of surge line stratification and insurge and outsurge transients where these were greater than previously evaluated design cycles. These evaluations resulted in CUF less than 1.0 at the pressurizer surge nozzle safe end to pipe weld and at the surge line hot leg nozzle.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii) – The analyses have been projected to the end of the period of extended operation.

4.3.4.3 Salem Unit 1 Steam Generator Feedwater Nozzle Transition Piece

As part of the Salem Unit 1 Steam Generators replacement, a new feedwater nozzle transition piece forging was designed as an ASME III, Class 1 component. The specific requirements were ASME III, Subsection NB, 1989. Additionally, the requirements for cyclic operation of Article NB-3200 were incorporated into the design of the transition piece. The remainder of the feedwater piping was designed in accordance with ANSI B31.1.0. All transients considered in the original design of the feedwater nozzles remain the same, except that the hot standby case was replaced with thermal stratification loadings. This portion of the design assumed 800 hours of auxiliary feedwater flow per cycle, over the course of the fifteen (15) remaining cycles (22 years of balance of life of the plant), resulting in 12,000 hours of auxiliary feedwater operation.

Analysis

The thermal stratification loads are managed by the Metal Fatigue of Reactor Coolant Pressure Boundary program (B.3.1.1), where the number of Auxiliary Feedwater Flow operational hours will be tracked and compared to the design limit of 12,000 hours. Additionally, the 60-year projected numbers of applicable transients for the transition piece design analysis are within the individual transient design values. The Metal Fatigue of Reactor Coolant Pressure Boundary program monitors the transients to compare them to the design values.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) will be adequately managed for the period of extended operation by the Metal Fatigue of Reactor Coolant Pressure Boundary program (B.3.1.1), which monitors transient cycles to assure they do not exceed their design limits, validating the assumptions used in these evaluations.

4.3.4.4 Salem Unit 1 Steam Generator Primary Manway Studs

Summary Description

The Salem Unit 1 Steam Generator primary manway studs were originally planned for replacement every five (5) years. However, Westinghouse conducted a series of tests to qualify their life for forty (40) years. The analysis conducted for Salem Unit 1 compared the studs installed in the Model F Salem to those studs qualified for extended fatigue life at another Model F plant. The qualification tests were performed in accordance with ASME Code, Section III, Appendix II.

Analysis

Plant transients (cycles) were inputs to the fatigue analyses of the studs. The 60-year projected cycles applicable to the Unit 1 Model F Steam Generator primary manway studs are bounded by the cycles used in the Westinghouse fatigue analysis for the primary manway studs.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.3.5 REACTOR VESSEL INTERNALS FATIGUE ANALYSES

Summary Description

The Salem Reactor Vessel Internals were designed and constructed prior to the development of ASME Code requirements for core support structures, but the reactor coolant system functional design requirements were considered in the design. The Reactor Vessel Internals were implicitly designed for low cycle fatigue based upon the reactor coolant system design transient projections for 40 years, which has been identified as a TLAA.

Post-design analyses consist of two Westinghouse analyses; (1) a lower core plate evaluation based on the 1.4% uprate and (2) qualification of the Salem domed lower core support plate, also part of the 1.4% uprate project at Salem.

Analysis

Design cyclic loadings and thermal conditions for the Salem RCS pressure boundary components are listed in Tables 4.3.1-3 and 4.3.1-4 for Units 1 and 2, respectively, in Section 4.3.1.

The two post-design Westinghouse analyses were evaluations that analyzed the 1.4% uprate in terms of the effect of changes in significant thermal design transients, which were deemed negligible. Therefore, the cumulative fatigue usage attributable to the significant thermal design transients did not change.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.3.6 SPENT FUEL POOL BOTTOM PLATES FATIGUE ANALYSES

Summary Description

Salem responded to the NRC request for additional information (RAI) dated 2/26/96 where the NRC requested an analysis to show that the spent fuel pool (SFP) liner and anchors will not experience significant deformations as a result of thermal loadings. In their RAI, the NRC provided acceptance criteria contained in Tables CC-3720-1 and CC-3730-1 of ASME Section III, Div. 2, 1995. Using a conservative fatigue strength reduction factor of five (5), the Salem analysis determined the maximum alternating stresses and compared them to the austenitic stainless steel curves in the ASME code. The resulting number of allowable cycles for the bottom liner plates is 1,638 cycles.

A separate analysis evaluated the SFP liner bottom plate and anchors for the fuel rack pedestal loads under upset conditions; specifically operating basis earthquake (OBE) loadings. The cumulative usage factor was determined to be 0.00063 for one (1) design basis earthquake (DBE) and twenty (20) operating basis earthquake (OBE) cycles. Since this fatigue usage factor is based upon 40-year estimated cycles, it is a TLAA that must be evaluated for 60 years of operation.

Analysis

The events that would cause full temperature thermal cycles in the SFP are refueling outages, which can be estimated by correlating with plant heatups and cooldowns. The 60-year projected number of plant heatups and cooldowns for the Salem Units 1 and 2 are listed in Table 4.3.6-1, which provides a bounding estimate for plant refueling outages that cause cycles in the SFP.

Table 4.3.6-1 Salem 60-Year Projections of Transients Applicable to the Spent Fuel Pool Bottom Plates Fatigue Analyses

Transient Description	Unit 1		Unit 2	
	Current Cycles	**60-Year Projected Cycles**	**Current Cycles**	**60-Year Projected Cycles**
Plant Heatups	63	133	67	157
Plant Cooldowns	63	133	66	155
TOTALS	126	266	133	312

Therefore, since the number of cycles projected to occur in 60 years is well below 1,638 cycles analyzed for the SFP bottom liner, this design analysis remains valid for the period of extended operation.

For the DBE/OBE analysis, the following related transients are projected for the Salem Units 1 and 2 are listed in Table 4.3.6-2.

Table 4.3.6-2 Salem Units 1 and 2 60-Year Projections of Transients Applicable to the Spent Fuel Pool Bottom Plates Fuel Rack Pedestal Fatigue Analysis				
Transient Description	**Unit 1**		**Unit 2**	
	Current Cycles	**60-Yr Projected Cycles**	**Current Cycles**	**60-Yr Projected Cycles**
Design Basis Earthquake	0	1	0	1
Operating Basis Earthquake	0	2	0	3
TOTALS	0	3	0	4

Therefore, since the number of DBEs and OBEs projected to occur in 60 years are below the combination of 1 DBE and 20 OBE cycles analyzed for the SFP bottom plate considering the fuel rack pedestal, this design analysis remains valid for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.3.7 ENVIRONMENTALLY-ASSISTED FATIGUE ANALYSES

Summary Description

NUREG-1801, Revision 1, Generic Aging Lessons Learned, contains recommendations on specific areas for which existing programs should be augmented for license renewal. The program description for Aging Management Program X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary Program, provides guidance for addressing environmental fatigue for license renewal. It states that an acceptable program addresses the effects of the reactor coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant. Examples of critical components are identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components".

This sample of components can be evaluated by applying environmental life correction factors to the existing ASME Code fatigue analyses using formulae contained in NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low Alloy Steels", and in NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels". Demonstrating that these components have an environmentally adjusted cumulative usage factor less than or equal to the design limit of 1.0 is an acceptable option for managing metal fatigue for the reactor coolant pressure boundary.

NUREG/CR-6260 provided environmental fatigue calculations for an older vintage Westinghouse plant using the interim fatigue curves from NUREG/CR-5999 for the locations of highest design CUF for the components listed below:

1. Reactor Vessel Shell and Lower Head
2. Reactor Vessel Inlet and Outlet Nozzles
3. Pressurizer Surge Line (including hot leg and pressurizer nozzles)
4. RCS Piping Charging System Nozzles
5. RCS Piping System Safety Injection Nozzles
6. RHR System Class 1 Piping

Analysis

For the NUREG/CR-6260 locations identified above, the plant-specific components were identified, ASME fatigue usage factors were calculated, and the environmental fatigue multipliers (Fen) penalties were applied to obtain the updated fatigue results. The reactor vessel was designed to the requirements of the ASME Code, Section III, explicit fatigue usage factors were available from the design evaluations. The plant specific design fatigue results were used to determine the specific locations to be evaluated and apply the applicable Fen penalties to determine updated fatigue usage with environmentally assisted fatigue (EAF).

Salem piping was designed to ASA / USAS B31.1 Code and there is no original explicit fatigue design. To identify Salem specific piping components to be evaluated, design fatigue calculations for similar components were reviewed to determine limiting component locations with respect to the factors influencing fatigue and considering reactor water environmental effects. For the pressurizer surge line, an ASME III, Class 1 fatigue evaluation had been previously performed in response to NRC Bulletin 88-11. However, more detailed evaluations were required to accommodate the Fen penalty factors.

Since there was no explicit fatigue design for Salem, no design or transient specifications to the piping exist. Standard transient descriptions for a 4-loop Westinghouse plant were used as the starting point for the fatigue evaluation. Where Salem specific transient information was available, it was incorporated when applicable.

For the components identified, 60-year fatigue calculations, including environmental effects, were performed. Applicable Fen multipliers for the selected locations were determined in accordance with NUREG/CR-5704 for austenitic stainless steel components and NUREG/CR-6583 for carbon/low alloy steel components to obtain the adjusted cumulative fatigue usage, which included the effects of reactor water environment.

Tables 4.3.7-1 and 4.3.7-2 summarize the locations where EAF results were calculated as well as the results for Salem Units 1 and 2, respectively. The evaluations showed that no cumulative usage factors with environmental penalties exceed 1.0 for 60 years of service.

Table 4.3.7-1 Salem Unit 1 60-Year Environmentally-Assisted Fatigue Results

Component	60-Year Design CUF	Fen Multiplier	60-Year EAF-Adjusted CUF
1. Reactor Vessel Shell and Lower Head(1)			
1. Core Support Guide Welds(2)	0.0120	2.532	0.0304
2. Reactor Vessel Inlet and Outlet Nozzles(1)			
2a. Reactor Vessel Inlet Nozzles(2)	0.1510	2.532	0.3823
2b. Reactor Vessel Outlet Nozzles(2)	0.0475	2.532	0.1202
3. Pressurizer Surge Line (including hot leg and pressurizer nozzles)(1)			
3a. Surge Line Hot Leg Nozzle Safe End-to-Pipe Weld(2)	0.0701	6.47	0.4536
3b. Pressurizer Surge Nozzle Safe End-to-Pipe Weld(2)	0.0693	6.44	0.4462
4. RCS Piping Charging System Nozzles(1)			
4. Charging Nozzle-to-Pipe Weld(2)	0.0770	2.83	0.2175
5. RCS Piping System Safety Injection Nozzles(1)			
5. BIT Nozzle Pipe at Socket Weld(2)	0.0779	6.04	0.4703
6. RHR System Class 1 Piping(1)			
6. Accumulator Nozzle-to-Pipe Weld(2)	0.0574	2.56	0.1468

(1) NUREG/CR-6260 component location for an older vintage Westinghouse Plant

(2) Plant-specific, limiting location within the boundary of the applicable NUREG/CR-6260 component location

Table 4.3.7-2 Salem Unit 2 60-Year Environmentally-Assisted Fatigue Results

Component	60-Year Design CUF	Fen Multiplier	60-Year EAF-Adjusted CUF
1. Reactor Vessel Shell and Lower Head(1)			
1. Core Support Guide Welds(2)	0.0120	2.532	0.0304
2. Reactor Vessel Inlet and Outlet Nozzles(1)			
2a. Reactor Vessel Inlet Nozzles(2)	0.1510	2.532	0.3823
2b. Reactor Vessel Outlet Nozzles(2)	0.0475	2.532	0.1202
3. Pressurizer Surge Line (including hot leg and pressurizer nozzles(1)			
3a. Surge Line Hot Leg Nozzle Safe End-to-Pipe Weld(2)	0.1118	6.31	0.7055
3b. Pressurizer Surge Nozzle Safe End-to-Pipe Weld(2)	0.1121	7.71	0.8647
4. RCS Piping Charging System Nozzles(1)			
4. Charging Nozzle to Pipe Weld(2)	0.0852	2.62	0.2230
5. RCS Piping System Safety Injection Nozzles(1)			
5. BIT Nozzle Pipe at Socket Weld(2)	0.1717	5.76	0.9891
6. RHR System Class 1 Piping(1)			
6. Accumulator Nozzle to Pipe Weld(2)	0.0900	2.63	0.2367

(1) NUREG/CR-6260 component location for an older vintage Westinghouse Plant

(2) Plant-specific, limiting location within the boundary of the applicable NUREG/CR-6260 component location

Disposition: Revision, 10 CFR 54.21(c)(1)(ii) – The analyses have been projected to the end of the period of extended operation.

4.4 OTHER PLANT-SPECIFIC ANALYSES

Underclad cracking associated with stainless steel linings of major reactor coolant system (RCS) components has occurred within the industry in the late 1960's, and was addressed by analysis at that time. Since the cracking mechanism is fatigue-driven, and is based upon 40-year assumptions, the analysis is a TLAA requiring evaluation for 60 years. This TLAA is evaluated in Section 4.4.1

Westinghouse report WCAP-14535-A, "Topical Report On Reactor Coolant Pump Flywheel Inspection Elimination", includes a fatigue crack growth analysis that is associated with 40-year assumptions and has been identified as a TLAA requiring evaluation for 60 years. This TLAA is evaluated in Section 4.4.2.

A Leak-Before-Break analysis was prepared for the primary piping system at Salem Units 1 and 2. This TLAA is evaluated in Section 4.4.3.

An evaluation of the applicability of ASME Code Case N-481 to the Salem Units 1 and 2 Reactor Coolant Pump Casings was performed. This TLAA is evaluated in Section 4.4.4.

An existing flaw growth analysis for the Salem Unit 1 Volume Control Tank (VCT) is a TLAA. This TLAA is evaluated in Section 4.4.5.

4.4.1 REACTOR VESSEL UNDERCLAD CRACKING ANALYSES

Summary Description

Intergranular separations in low alloy steel heat-affected zones under austenitic stainless steel weld claddings (underclad cracking) was first detected in SA-508, Class 2, reactor vessel forgings in 1970 during examination of the Atucha reactor vessel. They have been reported to exist in SA-508, Class 2, reactor vessel forgings manufactured to a coarse grain practice and clad by high-heat-input submerged arc processes. The regulatory position regarding this issue is found Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components." Regulatory Guide 1.43 states that detection of underclad cracks normally requires destructively removing the cladding to the weld fusion line and examining the exposed base metal either by metallographic techniques or with liquid penetrant or magnetic particle testing methods.

A detailed analysis of underclad cracks is provided in a topical report (Reference 4.8.2) in which Westinghouse presented a fracture mechanics analysis to justify the continue operation of all Westinghouse Units for 32 EFPY with underclad cracks in the reactor pressure vessels. The Westinghouse Owners' Group and the NRC identified this topical report as a TLAA that required evaluation for License Renewal.

Analysis

By letter dated March 1, 2001, as supplemented by letters dated June 15 and July 31, 2001, the Westinghouse Owners' Group submitted another analysis (Ref. 4.8.3) for NRC review. It evaluated the impact of cracks in SA-508 Class 2 and SA-508 Class 3 forgings beneath austenitic stainless steel weld cladding on reactor pressure vessel integrity. The initial NRC SER issued on October 15, 2001 applied only to 3-loop plants. The Westinghouse Owners' Group provided clarification to the NRC in a letter dated June 19, 2002, to include all Westinghouse plants. The NRC issued a revised SER in September 2002 to include all Westinghouse plants and the evaluation was reissued (Ref. 4.8.4).

The reissued evaluation may be used to demonstrate that fatigue growth of the subject flaw is insignificant over 60 years and the presence of the underclad cracks is of no concern relative to the structural integrity of the vessels. In order to reference the reissued evaluation, the License Renewal applicant must complete the following action items:

1. The License Renewal applicant is to verify that its plant is bounded by the report. Specifically, the renewal applicant is to indicate whether the number of design cycles and transients assumed in the analysis bounds the number of cycles for 60 years of operation of its reactor pressure vessel.

2. 10 CFR 54.21(d) requires that the FSAR supplement for the facility contain a summary description of the programs and activities for managing the effects of aging and the evaluation of TLAAs for the period of extended operation. Those applicants for license renewal referencing the report for the reactor pressure vessel components shall ensure that the evaluation of the TLAAs is summarily described in the FSAR supplement.

The design cycles and transients for Salem Units 1 and 2 are reported in Tables 4.3.1-3 and 4.3.1-4, respectively. The numbers of design cycles and transients assumed in the analysis bound the numbers of design cycles and transients projected for 60 years of operation presented in Tables 4.3.1-3 and 4.3.1-4. Therefore, action item 1 above is complete.

A summary of this TLAA evaluation is provided in the FSAR supplement for license renewal. Therefore, action item 2 above is also complete.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The underclad cracking analyses remain valid for the period of extended operation.

4.4.2 REACTOR COOLANT PUMP FLYWHEEL FATIGUE CRACK GROWTH ANALYSES

Summary Description

A Westinghouse report (Ref. 4.8.5) includes a fatigue crack growth analysis that has been identified as a TLAA. The report was submitted for NRC review and the NRC issued a Safety Evaluation Report in September 1996. The purpose of the report was to provide an engineering basis for elimination of reactor coolant pump (RCP) flywheel in-service inspection requirements for all operating Westinghouse plants and certain Babcock and Wilcox plants. The number of cycles (pump starts and stops) used in this report was 6,000 for a 60-year plant life. Crack growth was shown to be negligible from exposure to these 6,000 cycles.

Analysis

The number of cycles (pump starts and stops) for a 60-year plant life was assumed to be 6,000 for this analysis. Crack growth was shown to be negligible from exposure to these 6,000 cycles.

Tables 4.4.2-1 and 4.4.2-2 provide the current and 60-yr projected number of RCP start/stop cycles for the Salem Units 1 and 2.

Table 4.4.2-1 Salem Unit 1 60-Year Projected Reactor Coolant Pump Start/Stop Cycles

RCP Identification	Current RCP Start-Stop Cycle Count[1]	60-Year RCP Start-Stop Cycle Projection[2]
11	244	514
12	238	501
13	276	581
14	314	661

(1) Data obtained from Salem Cycle Counting records.

(2) Using effective years of operations of 28.5 (Refer to Section 4.3.1). Calculation is as follows: Current No. of RCP Start/Stop Cycles + (No. of Current RCP Cycles / 28.5) * (31.5 years)

Table 4.4.2-2 Salem Unit 2 60-Year Projected Reactor Coolant Pump Start/Stop Cycles

RCP Identification	Current RCP Start-Stop Cycle Count(1)	60-Year RCP Start-Stop Cycle Projection(2)
21	300	703
22	264	619
23	238	558
24	240	563

(1) Data obtained from Salem Cycle Counting records.

(2) Using effective years of operations of 25.6 (Refer to Section 4.3.1). Calculation is as follows: Current No. of RCP Start/Stop Cycles + (No. of Current RCP Cycles / 25.6) * (34.4 years)

From Tables 4.4.2-1 and 4.4.2-2, the projected number of RCP start/stop cycles for the Salem Units 1 and 2 RCP flywheels are much less than the analyzed 6,000 cycles.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – Since the number of analyzed start/stop cycles exceeds the 60-year cycle projections, the reactor coolant pump flywheel analysis remains valid for the period of extended operation.

4.4.3 LEAK-BEFORE-BREAK ANALYSES

Summary Description

Appendix A, Criterion 4, of 10 CFR 50 allows for the use of leak-before-break (LBB) methodology for excluding the dynamic effects of postulated ruptures in reactor coolant system piping. The fundamental premise of the LBB methodology is that the materials used in nuclear power plant piping are sufficiently tough that even a large through-wall crack would remain stable and would not result in a double-ended pipe rupture. Application of the LBB methodology is limited to those high-energy fluid systems not considered to be overly susceptible to failure from such mechanisms as corrosion, water hammer, fatigue, thermal aging or indirectly from such causes as missile damage or the failure of nearby components. The analyses involved with LBB are considered TLAAs.

Analysis

A LBB analysis was initially performed for Salem primary loop piping in 1993. The initial analysis was updated to demonstrate compliance with LBB technology for the Salem.

The 60-year LBB analysis used input from steam generator snubber elimination program, steam generator replacement design change packages, 1.4% power uprate evaluation, the Tavg operating window, and the Mechanical Stress Improvement Process (MSIP) application at the reactor vessel primary nozzle locations. In addition, plant specific geometry, operating parameters, loading, and material properties were used in the fracture mechanics evaluation. The mechanical properties were determined at operating temperatures. Since the piping systems also include cast austenitic stainless steel (CASS) piping components, fracture toughness considering thermal aging was determined for each affected component's heat of material for the fully aged condition (applicable for the period of extended operation).

Based on loading, pipe geometry, and fracture toughness considerations, enveloping critical (governing) locations were determined at which LBB crack stability evaluations were made. Through-wall flaw sizes were found which would cause a leak at a rate of ten (10) times the leakage detection system capability of the plant. Large margins for such flaw sizes were demonstrated against flaw instability. Finally, fatigue crack growth was shown not to be an issue for the reactor coolant system primary loop piping. The thermal transients used in the fatigue crack growth analysis were the Salem Units 1 and 2 design transients and projected cycles, which are reported in Tables 4.3.1-3 and 4.3.1-4, respectively. The corresponding 60-year projected cycles, also shown in Tables 4.3.1-3 and 4.3.1-4, respectively, are lower than the 40-year design values. Therefore, the numbers of design cycles assumed in the analysis bound the numbers of design cycles projected for 60 years of operation.

The recent LBB analysis demonstrates that the previous LBB conclusions still remain valid, and the dynamic effects of the pipe rupture resulting from postulated breaks in the reactor coolant primary loop piping need not be considered in the Salem structural design basis for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.4.4 APPLICABILITY OF ASME CODE CASE N-481 TO THE SALEM UNITS 1 AND 2 REACTOR COOLANT PUMP CASINGS

Summary Description

Periodic volumetric inspections of the welds of the primary loop pump casings of commercial nuclear power plants are required by Section XI of the ASME Boiler and Pressure Vessel Code. These inspections require a large amount of time and resources to complete. They also result in large radiation exposure (man-rem). Since the pump casings are inspected prior to being placed in service, and no significant mechanisms exist for crack initiation and propagation, it has been concluded that the in-service volumetric inspection can be replaced with an acceptable alternate inspection. In recognition of this, ASME Code Case N-481, Alternative Examination Requirements for Cast Austenitic Pump Casings, provides an alternative to the volumetric inspection requirement. The code case allows the replacement of volumetric examinations of primary loop pump casings with fracture mechanics-based integrity evaluation (Item (d) of the code case) supplemented by specific visual examinations. Westinghouse demonstrated compliance with ASME Code Case N-481 on a generic basis that is documented in WCAP-13045 (Reference 4.8.6). In this evaluation, stress analyses were performed to support fracture mechanics analyses for postulated flaws. Salem applied WCAP-13045 to the Salem reactor coolant pump casings for their 40-year plant life.

Analysis

The TLAA related to Code Case N-481 is thermal aging of cast austenitic stainless steel and its consequence on fatigue crack growth. The 60-year analysis provided a comparison of the Salem pump casing nozzle loadings with the screening loads reported in WCAP-13045. The screening loads in WCAP-13045 bounded the Salem loads anticipated for 60 years of operation. The stability of the flaws postulated in the reactor coolant pump casings has been established by evaluating the necessary materials properties against the saturated (fully aged) fracture toughness values. The results of the 60-year analysis show that Code Case N-481 is satisfied for the license renewal period when supplemented with the visual inspections specified in the code case (Items a, b, and c).

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.4.5 SALEM UNIT 1 VOLUME CONTROL TANK FLAW GROWTH ANALYSIS

Summary Description

Flaws were identified in the shell to lower head weld of the Salem Unit 1 Volume Control Tank (VCT) during 1RF13 (1999). The flaws found during the inspection were subsurface and not in contact with the environment, therefore, only fatigue would be the contributing mechanism to flaw growth. The analyses concluded that an initial flaw would grow an insignificant amount of only $1.1 \times 10^{(-5)}$ inches, based on 1,000 pressurization cycles.

An examination was performed in 1R15 (2002) and found no further flaw growth. There have been no recordable indications on the Unit 2 VCT.

Analysis

The VCT is an operating surge volume compensating in part for reactor coolant releases from the reactor coolant system as a result of level changes. The major pressurization cycles (transients) experienced by the VCT would be Inadvertent Safety Injection events and Operating Basis Earthquake cycles, and to a lesser extent, Plant Heatups and Cooldowns. Table 4.4.5-1 provides a summary of these pressurization cycles.

Table 4.4.5-1 Salem Unit 1 60-Year Projection of Transients Applicable to the Volume Control Tank Flaw Growth Analysis

Transient Description	Current Cycles	60-Year Projected Cycles
Inadvertent Safety Injection	21	44
OBE	0	2
Heatup	63	133
Cooldown	63	133
TOTALS	147	312

Therefore, since the number of cycles projected to occur in 60 years for Inadvertent Safety Injection events and Operating Basis Earthquake cycles, Plant Heatups, and Plant Cooldowns is well below 1,000 pressurization cycles analyzed for the Unit 1 VCT flaw, this design analysis remains valid for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.5 FUEL TRANSFER TUBE BELLOWS DESIGN CYCLES

Summary Description

The fuel transfer tube connects the fuel transfer canal (inside the containment structure) to the transfer pool (inside the fuel handling building). The fuel transfer tube passes through the containment wall and through the exterior wall of the fuel handling building.

The fuel handling building fuel transfer tube is comprised of a 24-inch diameter penetration sleeve penetrating through the containment and fuel handling building walls and three (3) sets of expansion joints (bellows). The penetration sleeve and the three bellows perform a water retaining intended function, and are within the scope of license renewal.

Each of these three bellows was designed for a minimum of 50 cycles of seismic movement, therefore, this design analysis is a TLAA requiring evaluation for the period of extended operation.

Analysis

In order to determine if the design analyses remain valid for 60 years of operation, the number of seismic cycles for 60 years has been conservatively projected. As of January 2009, the Salem transfer tube bellows will have been exposed to zero (0) Operating Basis Earthquake (OBE) cycles. It is projected that 2 and 3 OBEs would occur for Salem Units 1 and 2, respectively, in 60 years of operation.

Therefore, since the number of cycles in 60 years is well below the 50 seismic movement cycles analyzed for these bellows, these design analyses remain valid for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.6 CRANE LOAD CYCLE LIMITS

4.6.1 POLAR GANTRY CRANE

Summary Description

The purchasing specification for the 230/35-ton Polar Crane in the containment structure at Salem required the crane conform to the design requirements of EOCI-61, "Specifications for Electric Overhead Traveling Cranes – 1961. Issuance of the Crane Manufacturers Association of America (CMAA) Specification 70 was meant to supersede EOCI-61. An engineering study reviewed the design of this crane and determined that it complied with CMAA 70, Rev. 75. As such, the design of this crane corresponds to the cyclic loading requirements of CMAA 70, Class A. This evaluation of cycles over the 40-year life is the basis of a safety determination and is, therefore, a TLAA Analysis.

Analysis

The Polar Crane was designed for a minimum of 20,000 load cycles, corresponding to the criteria of CMAA Specification 70 for service Class A.

The Salem responses for Control of Heavy Loads (NUREG-0612) provided estimates of the expected frequency of lifts for the Polar Crane. Based on the response to the NUREG-0612 requirements, the estimated number of lifts for Salem Unit 1 to date is 900, and is projected to be 1,620 for 60 years. Additionally, the Polar Crane was used during original construction, steam generator replacement, and integrated reactor vessel head replacement, where the estimated number of lifts for these combined major modifications is 100. Therefore, the total number of lifts for Salem Unit 1 is estimated to be 1,720 through the period of extended operation. These values are also representative of the Unit 2 Polar Crane lifts. Since the total number of lifts is considerably less than the minimum allowable design value of 20,000 cycles, the Polar Crane load cycle fatigue analyses for Unit 1 and Unit 2 remain valid for 60 years of plant operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.6.2 FUEL HANDLING CRANE

Summary Description

The purchasing specification for the 5-ton Fuel Handling Crane in the Fuel Handling Building at Salem required the crane conform to the design requirements of EOCI-61, "Specifications for Electric Overhead Traveling Cranes – 1961". Issuance of the Crane Manufacturers Association of America (CMAA) Specification 70 was meant to supersede EOCI-61. An engineering study reviewed the design of this crane and determined that it complied with CMAA 70, Rev. 75. As such, the design of this crane corresponds to the cyclic loading requirements of CMAA 70, Class A, equal to a minimum allowable design value of 20,000 load cycles. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

Analysis

The Fuel Handling Crane was designed for a minimum of 20,000 load cycles, corresponding to the criteria of CMAA Specification 70 for service Class A.

The Salem responses for Control of Heavy Loads (NUREG-0612) provided estimates of the expected frequency of lifts for the Fuel Handling Crane. Based on the Salem response to the NRC regarding implementation of the NUREG-0612 requirements, the estimated number of lifts for Salem Unit 1 to date is 6,600. The total number of lifts for Salem Unit 1 is estimated at 12,000 through the period of extended operation. This number of lift cycles is also representative for the Unit 2 Fuel Handling Crane. Since this total number of lifts is less than the minimum allowable design value of 20,000 cycles, the Fuel Handling Crane load cycle fatigue analyses for Unit 1 and Unit 2 remain valid for 60 years of plant operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.6.3 CASK HANDLING CRANE

Summary Description

The existing Salem Cask Handling Cranes were replaced in 2009 by single failure-proof Cask Handling Cranes rated for 115 tons (main hoist) and 10 tons (auxiliary hoist). Each of these cranes was designed in accordance with ASME NOG-1-2004, NUREG-0554, and NUREG-0612 criteria in order to be certified as an NRC-approved single failure-proof design. The cranes were also designed to CMAA 70-04 (2004) standards for Class A service. This evaluation of cycles over the projected 40-year life is the basis of a safety determination and has been identified as a TLAA requiring evaluation for the period of extended operation.

Analysis

These new cranes became operational in 2009. The period of extended operation expires in 2036 for Salem Unit 1 and expires in 2040 for Salem Unit 2, resulting in 27 and 32 years of operation, respectively. The projected numbers of lifts for the Cask Handling Cranes are 1,560 each. This estimate is based upon the expected number of casks that must be handled during each cask loading campaign and the projected number of campaigns, starting in 2010 and continuing through the period of extended operation. Since the estimated number of lifts for the Cask Handling Crane is much less than the minimum allowable design value of 20,000 cycles, the Cask Handling Crane load cycle fatigue analyses remain valid for 60 years of plant operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i) – The analyses remain valid for the period of extended operation.

4.7 ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT

Summary Description

Thermal, radiation, and cyclical aging analyses of plant electrical and I&C components, developed to meet 10 CFR 50.49 requirements, have been identified as time-limited aging analyses (TLAAs) for Salem. The NRC has established nuclear station environmental qualification (EQ) requirements in 10 CFR 50.49 and 10 CFR 50, Appendix A, Criterion 4. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments are qualified to perform their safety function in those harsh environments after the effects of in-service aging. Harsh environments are defined as those areas of the plant that could be subject to the harsh environmental effects of a loss-of-coolant accident (LOCA), high energy line break (HELB), or post-LOCA radiation. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification.

Environmental Qualification Program Background

The Salem Environmental Qualification (EQ) of Electric Components program (B.3.1.2) meets the requirements of 10 CFR 50.49 for the applicable electrical components important to safety. 10 CFR 50.49 defines the scope of components to be included, 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 the environmental conditions to which the components could be subjected.

Aging evaluations for electrical components in the Salem Environmental Qualification (EQ) of Electrical Components program that specify a qualification of at least 40 years are TLAAs for license renewal because the criteria contained in 10 CFR 54.3 are met.

Analysis

Under 10 CFR 54.21(c)(1)(iii), the Salem Environmental Qualification (EQ) of Electric Components program, which implements the requirements of 10 CFR 50.49 (as further defined and clarified by NUREG-0588, and RG 1.89, Rev. 1), is viewed as an aging management program for License Renewal.

Additionally, reanalysis of an aging evaluation to extend the qualifications of components is performed on a routine basis as part of the Salem Environmental Qualification (EQ) of Electric Components program. Important attributes for the reanalysis of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). TLAA demonstration to option 10 CFR 54.21(c)(1)(iii), which states that the effects of aging will be adequately managed for the period of extended operation, is chosen and the Salem Environmental Qualification (EQ) of Electric Components program will manage the aging effects of the components associated with the environmental qualification TLAA.

NUREG-1800 states that the staff evaluated the EQ program (10 CFR 50.49) and determined that it is an acceptable aging management program to address environmental qualification according to 10 CFR 54.21(c)(1)(iii). The evaluation referred to in the Standard Review Plan for License Renewal contains sections on "EQ Component Reanalysis Attributes, Evaluation, and Technical Basis" that is the basis of the description provided below.

Component Reanalysis Attributes

The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism, or applying more accurate location specific conditions, that were not incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of a component is performed on a routine basis pursuant to 10 CFR 50.49(e) as part of the Salem Environmental Qualification (EQ) of Electric Components program. While a component life-limiting condition may be due to thermal, radiation or cyclical aging, the vast majority of component aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the design ambient versus measured ambient temperature, unrealistically low activation energy, or in the application of a component (de-energized versus energized). The reanalysis of an aging evaluation is documented according to Salem quality assurance program requirements, which require the verification of assumptions and conclusions. As already noted, important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria and corrective actions (if acceptance criteria are not met). These attributes are discussed below.

Analytical Methods

The Salem Environmental Qualification (EQ) of Electric Components program uses the same analytical models in the reanalysis of an aging evaluation as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable thermal model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose, which is the normal radiation dose for the projected installed life plus accident radiation dose. For license renewal, one acceptable method of establishing the 60-year normal radiation dose is to multiply the 40-year normal radiation dose by 1.5 (that is, 60 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For cyclical aging, a similar approach may be used. Other models may be justified on a case-by-case basis.

Data Collection & Reduction Methods

The chief method used for a reanalysis per the Salem Environmental Qualification (EQ) of Electric Components program is reduction of excess conservatism in the component service conditions used in the prior aging evaluation, including temperature, radiation, and cycles. Temperature data used in an aging evaluation should be based on plant design temperatures or on actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance, other installed monitors, measurements made by plant operators during rounds, and temperature sensors on large motors. A representative number of temperature measurements are evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as: (a) directly applying the plant temperature data in the evaluation or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. Any changes to material activation energy values as part of a reanalysis must be justified. Similar methods of reducing excess conservatism in the component service conditions used in prior aging evaluations can be used for radiation and cyclical aging. Operating Experience can also provide additional basis to justify changes in the qualification of the equipment.

Underlying Assumptions

The Salem Environmental Qualification (EQ) of Electric Components program component aging evaluations contain sufficient conservatism. Additionally, plant modifications that have potential impact to the Salem Environmental Qualification (EQ) of Electric Components program are evaluated during the modification process to determine the impact of the plant modification on the Salem Environmental Qualification (EQ) of Electrical Components Program. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

Acceptance Criteria and Corrective Action

Under the Salem Environmental Qualification (EQ) of Electric Components program, the reanalysis of an aging evaluation could extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component must be refurbished, replaced, or requalified prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner such that sufficient time is available to refurbish, replace, or requalify the component if the reanalysis is unsuccessful.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The Salem Environmental Qualification (EQ) of Electric Components program has been demonstrated to be capable of programmatically managing the qualified lives of the components falling within the scope of the program for License Renewal.

4.8 REFERENCES

4.8.1 WCAP-14040-A, Rev. 4, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves"

4.8.2 WCAP-7733-A, Rev. 0, "Reactor Vessels Weld Cladding – Base Metal Interaction"

4.8.3 WCAP-15338, Rev. 0, "A Review of Cracking Associated with Weld Deposited Cladding in Operating PWR Plants"

4.8.4 WCAP-15338-A, Rev. 0, "A Review of Cracking Associated with Weld Deposited Cladding in Operating PWR Plants"

4.8.5 WCAP-14535-A, Rev. 0, "Topical Report On Reactor Coolant Pump Flywheel Inspection Elimination"

4.8.6 WCAP-13045, Rev. 0, "Compliance to ASME Code Case N-481 of the Primary Loop Pump Casings of Westinghouse Type Nuclear Steam Supply Systems"

APPENDIX A FINAL SAFETY ANALYSIS REPORT SUPPLEMENT
TABLE OF CONTENTS

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A.1 Introduction

The application for a renewed operating license is required by 10 CFR 54.21(d) to include a FSAR Supplement. This appendix, which includes the following sections, comprises the FSAR supplement:

- Section A.1.1 contains a listing of the aging management programs that correspond to NUREG-1801 Chapter XI programs, including the status of the program at the time the License Renewal Application was submitted.
- Section A.1.2 contains a listing of the plant-specific aging management programs, including the status of the program at the time the License Renewal Application was submitted.
- Section A.1.3 contains a listing of aging management programs that correspond to NUREG-1801 Chapter X programs associated with Time-Limited Aging Analyses, including the status of the program at the time the License Renewal Application was submitted.
- Section A.1.4 contains a listing of the Time-Limited Aging Analyses (TLAA).
- Section A.1.5 contains a discussion of the Quality Assurance Program and Administrative Controls.
- Section A.2 contains a summarized description of the aging management programs.
- Section A.2.1 contains a summarized description of the NUREG-1801 Chapter XI programs for managing the effects of aging.
- Section A.2.2 contains a summarized description of the plant-specific programs for managing the effects of aging.
- Section A.3 contains a summarized description of the NUREG-1801 Chapter X programs that support the TLAAs.
- Section A.4 contains a summarized description of the TLAAs applicable to the period of extended operation.
- Section A.5 contains the License Renewal Commitment List.

The integrated plant assessment for license renewal identified new and existing aging management programs necessary to provide reasonable assurance that systems, structures, and components within the scope of license renewal will continue to perform their intended functions consistent with the Current Licensing Basis (CLB) for the period of extended operation. The period of extended operation is defined as 20 years from the units current operating license expiration date.

A.1.1 NUREG-1801 Chapter XI Aging Management Programs

The NUREG-1801 Chapter XI Aging Management Programs (AMPs) are described in the following sections. The AMPs are either consistent with generally accepted industry methods as discussed in NUREG-1801 or require enhancements.

The following list reflects the status of these programs at the time of the License Renewal Application (LRA) submittal. Commitments for program additions and enhancements are identified in the Appendix A.5 License Renewal Commitment List.

1. ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section A.2.1.1) [Existing]
2. Water Chemistry (Section A.2.1.2) [Existing]
3. Reactor Head Closure Studs (Section A.2.1.3) [Existing]
4. Boric Acid Corrosion (Section A.2.1.4) [Existing]
5. Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (Section A.2.1.5) [Existing]
6. Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section A.2.1.6) [New]
7. PWR Vessel Internals (Section A.2.1.7) [New]
8. Flow-Accelerated Corrosion (Section A.2.1.8) [Existing]
9. Bolting Integrity (Section A.2.1.9) [Existing – Requires Enhancement]
10. Steam Generator Tube Integrity (Section A.2.1.10) [Existing]
11. Open-Cycle Cooling Water System (Section A.2.1.11) [Existing]
12. Closed-Cycle Cooling Water System (Section A.2.1.12) [Existing – Requires Enhancement]
13. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section A.2.1.13) [Existing – Requires Enhancement]
14. Compressed Air Monitoring (Section A.2.1.14) [Existing]
15. Fire Protection (Section A.2.1.15) [Existing – Requires Enhancement]
16. Fire Water System (Section A.2.1.16) [Existing – Requires Enhancement]
17. Aboveground Steel Tanks (Section A.2.1.17) [Existing – Requires Enhancement]
18. Fuel Oil Chemistry (Section A.2.1.18) [Existing – Requires Enhancement]

19. Reactor Vessel Surveillance (Section A.2.1.19) [Existing – Requires Enhancement]

20. One-Time Inspection (Section A.2.1.20) [New]

21. Selective Leaching of Materials (Section A.2.1.21) [New]

22. Buried Piping Inspection (Section A.2.1.22) [Existing – Requires Enhancement]

23. One-Time Inspection of ASME Code Class 1 Small Bore-Piping (Section A.2.1.23) [New]

24. External Surfaces Monitoring (Section A.2.1.24) [New]

25. Flux Thimble Tube Inspection (Section A.2.1.25) [New]

26. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section A.2.1.26) [New]

27. Lubricating Oil Analysis (Section A.2.1.27) [Existing]

28. ASME Section XI, Subsection IWE (Section A.2.1.28) [Existing – Requires Enhancement]

29. ASME Section XI, Subsection IWL (Section A.2.1.29) [Existing]

30. ASME Section XI, Subsection IWF (Section A.2.1.30) [Existing]

31. 10 CFR Part 50, Appendix J (Section A.2.1.31) [Existing]

32. Masonry Wall Program (Section A.2.1.32) [Existing – Requires Enhancement]

33. Structures Monitoring Program (Section A.2.1.33) [Existing – Requires Enhancement]

34. RG 1.127 Inspection of Water-Control Structures (Section A.2.1.34) [Existing – Requires Enhancement]

35. Protective Coating Monitoring and Maintenance Program (Section A.2.1.35) [Existing]

36. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.36) [New]

37. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section A.2.1.37) [New]

38. Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.38) [New]

39. Metal Enclosed Bus (Section A.2.1.39) [New]

40. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.40) [New]

A.1.2 Plant-Specific Aging Management Programs

The plant-specific programs are described in the following sections. The following list reflects the status of these programs at the time of the License Renewal Application (LRA) submittal. Commitments for program additions and enhancements are identified in the Appendix A.5 License Renewal Commitment List.

1. High Voltage Insulators (Section A.2.2.1) [New]

2. Periodic Inspection (Section A.2.2.2) [New]

3. Aboveground Non-Steel Tanks (Section A.2.2.3) [New]

4. Buried Non-Steel Piping Inspection (Section A.2.2.4) [Existing – Requires Enhancement]

5. Boral Monitoring Program (Section A.2.2.5) [Existing – Requires Enhancement]

6. Nickel Alloy Aging Management Program (Section A.2.2.6) [Existing]

A.1.3 NUREG-1801 Chapter X Aging Management Programs

The NUREG-1801 Chapter X Aging Management Programs associated with Time-Limited Aging Analyses are described in the following sections. The AMPs are either consistent with generally accepted industry methods as discussed in NUREG-1801 Chapter X or require enhancements. The following list reflects the status of these programs at the time of the License Renewal Application (LRA) submittal. Commitments for program additions and enhancements are identified in the Appendix A.5 License Renewal Commitment List.

1. Metal Fatigue of Reactor Coolant Pressure Boundary (Section A.3.1.1) [Existing – Requires Enhancement]

2. Environmental Qualification (EQ) of Electric Components (Section A.3.1.2) [Existing]

A.1.4 Time-Limited Aging Analyses

Summaries of the Time-Limited Aging Analyses applicable to the period of extended operation are included in the following sections.

1. Reactor Vessel Neutron Embrittlement (Section A.4.2)

2. Metal Fatigue of Piping and Components (Section A.4.3)

3. Other Plant-Specific Analyses (Section A.4.4)
4. Fuel Transfer Tube Bellows Design Cycles (Section A.4.5)
5. Crane Load Cycle Limits (Section A.4.6)
6. Environmental Qualification of Electric Equipment (Section A.4.7)

A.1.5 Quality Assurance Program and Administrative Controls

The Quality Assurance Program implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2, "Quality Assurance For Aging Management Programs (Branch Technical Position IQMB-1)" of NUREG-1800. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls, and these elements are applicable to the safety-related and non-safety related systems, structures, and components (SSCs) that are subject to Aging Management Review (AMR). In many cases, existing activities were found adequate for managing aging effects during the period of extended operation.

A.2 Aging Management Programs

A.2.1 NUREG-1801 Chapter XI Aging Management Programs

This section provides summaries of the NUREG-1801 programs credited for managing the effects of aging.

A.2.1.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is an existing program that consists of periodic volumetric and visual examinations of components for assessment, identification of signs of degradation, and establishment of corrective actions. The program includes inspections performed to manage cracking, loss of fracture toughness and loss of material in Class 1, 2, and 3 piping and components exposed to reactor coolant, steam, treated water and treated borated water environments. The inspections will be implemented in accordance with 10 CFR 50.55(a). These activities include inspections, and monitoring and trending of results to confirm that aging effects are managed.

A.2.1.2 Water Chemistry

The Salem Water Chemistry aging management program is an existing program that provides activities for monitoring and controlling the chemical environments of the Salem primary cycle and secondary cycle systems such that aging effects of system components are minimized. Aging effects include cracking, loss of material, reduction of neutron-absorbing capacity and reduction of heat transfer. The primary cycle scope of this program consists of the reactor coolant system and related auxiliary systems containing treated water, reactor coolant, treated borated water and steam, including the primary side of the steam generators that contain treated water and steam. The secondary cycle portion of the program consists of the various secondary side systems and the secondary side of the steam generators. Major component types include reactor vessel, reactor internals, piping, piping elements and piping components, heat exchangers and tanks. The Water Chemistry aging management program is consistent with EPRI, Pressurized Water Reactor Primary Chemistry Guidelines, and Plant UFSAR limits for fluorides, chlorides, and dissolved oxygen. The Water Chemistry program is consistent with EPRI, Pressurized Water Secondary Water Chemistry Guidelines.

A.2.1.3 Reactor Head Closure Studs

The Reactor Head Closure Studs program is an existing program that provides for condition monitoring and preventive activities to manage reactor head closure stud cracking caused by stress corrosion cracking. The program is implemented through station procedures based on the examination and inspection requirements specified in ASME Section XI, Table IWB-2500-1 and preventive measures described in NRC Regulatory Guide 1.65, “Materials and Inspection for Reactor Vessel Closure Studs.”

A.2.1.4 Boric Acid Corrosion

The Boric Acid Corrosion aging management program is an existing program that manages loss of; material on piping, piping elements, heat exchangers, bolting, panels, racks, cabinets and enclosures, insulation jacketing, cable trays, concrete anchors, concrete embedments, manhole covers, conduit, miscellaneous steel, and other structural components, component supports, cracking, blistering, flaking, peeling, and delamination of coatings, and corrosion of electrical connector contact surfaces. The program includes provisions to identify, inspect, examine and evaluate leakage, and initiate corrective action. The program relies in part on implementation of recommendations contained in NRC Generic Letter 88-05, “Boric Acid Corrosion of Carbon Steel Reactor Components in PWR plants”.

A.2.1.5 Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors

The Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program is an existing program that consists of a combination of periodic bare metal visual inspections of the outer surface of the upper reactor vessel closure head (closure head) and periodic non-destructive examinations (surface and volumetric) of the upper vessel head penetration (VHP) nozzles and associated J-groove welds, for assessment, identification of signs of degradation, and establishment of corrective actions. The program monitors the condition of nickel-alloy components and J-groove welds for the effects of cracking in a reactor coolant environment. The inspections will be implemented in accordance with 10 CFR 50.55(a), which endorses ASME Code Case N-729-1. The program ensures the structural integrity of the closure head, VHP nozzles, and associated J-groove welds, and the detection of cracking and any loss of material/wastage prior to a loss of intended function. These activities include examinations, and monitoring and trending of results to confirm that aging effects are managed.

A.2.1.6 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel aging management program is a new program that includes condition monitoring activities to provide assurance that reactor coolant system CASS components susceptible to thermal aging embrittlement meet the intended functions. The reactor coolant system CASS components are maintained by inspecting and evaluating the extent of thermal aging embrittlement in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1998 Edition, 2000 Addenda. The Salem ASME Section XI Inservice Inspection program is augmented by the implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program which monitors the aging effect of loss of fracture toughness due to thermal aging embrittlement of CASS components.

The Thermal Aging Embrittlement of CASS program will include a screening for components susceptible to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For "potentially susceptible" components, thermal aging embrittlement management will be accomplished through either a component-specific flaw tolerance evaluation or enhanced volumetric examinations. Inspections or evaluations are not required for components that are determined not to be susceptible to thermal aging embrittlement. Screening for CASS components susceptible to thermal aging embrittlement is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481, Alternate Examination Requirements for Cast Austenitic Pump Casings, are adequate for all pump casings and valve bodies. This new program will be implemented prior to the period of extended operation.

A.2.1.7 PWR Vessel Internals

Salem Units 1 and 2 commit to the following activities for the new PWR Vessel Internals program:

1. Participate in the industry programs for investigating and managing aging effects on reactor internals.
2. Evaluate and implement the results of the industry programs as applicable to the reactor internals.
3. Upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.8 Flow-Accelerated Corrosion

The Flow-Accelerated Corrosion (FAC) aging management program at Salem is an existing program based on EPRI guidelines in NSAC-202L, "Recommendations for an Effective Flow Accelerated Corrosion Program." The program provides for predicting, detecting, and monitoring wall thinning in piping, fittings, valve bodies, and heat exchangers due to FAC. Analytical evaluations and periodic examinations of locations that are most susceptible to wall thinning due to FAC are used to predict the amount of wall thinning in pipes, fittings, and feedwater heater shells. Program activities include analyses to determine critical locations, baseline inspections to determine the extent of thinning at these critical locations, and follow-up inspections to confirm the predictions. Repairs and replacements are performed as necessary.

A.2.1.9 Bolting Integrity

The Bolting Integrity aging management program is an existing program that provides for condition monitoring of pressure retaining bolted joints within the scope of license renewal. The Bolting Integrity program incorporates NRC and industry recommendations delineated in NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," EPRI TR-104213, "Bolted Joint Maintenance & Applications Guide," and EPRI NP 5769, "Degradation and Failure of Bolting in Nuclear Power Plants," as part of the comprehensive corporate component pressure retaining bolting program. The program provides for managing cracking, loss of material and loss of preload by performing visual inspections for pressure retaining bolted joint leakage in the following environments: air, groundwater/soil, raw water and soil.

The Bolting Integrity aging management program will be enhanced to include:

1. In the following cases, bolting material should not be reused:
   a. Galvanized bolts and nuts,

b. ASTM A490 bolts; and

c. Any bolt and nut tightened by the turn of nut method.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.10 Steam Generator Tube Integrity

The Steam Generator Tube Integrity aging management program is an existing program that establishes the operation, maintenance, testing, inspection and repair of the steam generators to ensure that Technical Specification surveillance requirements, ASME Code requirements and the Maintenance Rule performance criteria are met, thereby adequately managing the aging effects of the steam generator tubes, plugs, and tube support plates. Aging effects include cracking, loss of material, loss of preload, reduction of heat transfer and wall thinning. The program identifies and maintains the steam generator design and licensing bases and implements NEI 97-06. NEI 97-06 establishes a framework for prevention, inspection, evaluation, repair and leakage monitoring measures.

A.2.1.11 Open-Cycle Cooling Water System

The Salem Open-Cycle Cooling Water System aging management program is an existing program that includes mitigative, performance-monitoring, and condition-monitoring activities to manage the internal corrosion of piping to minimize susceptibility of corrosion and to verify that corrosion has not exceeded acceptance limits. More than one type of aging management program is necessary to ultimately ensure that the aging effects are adequately managed and the intended function(s) are maintained for the extended period of operation. These activities provide assurance that cracking, material loss, and heat transfer reduction aging effects are maintained at acceptable levels for systems and components within the scope of license renewal. The GL 89-13 activities provide for management of aging effects in raw water cooling systems through tests and inspections per the guidelines of NRC Generic Letter 89-13. System and component testing, visual inspections, non-destructive examination (e.g., RT-Radiographic Testing, UT-Ultrasonic Testing, and/or ECT-Eddy Current Testing), and sodium hypochlorite injection are conducted to ensure that aging effects are managed such that system and component intended functions and integrity are maintained. Major component types include pumps, piping, piping elements, piping components, heat exchangers and tanks.

The Salem Open-Cycle Cooling Water System (OCCWS) aging management program primarily consists of station GL 89-13 activities that include sodium hypochlorite injection, system testing, periodic inspections and non-destructive examination. The program includes surveillance and control techniques to manage aging effects caused by bio-fouling, corrosion, erosion, protective coating failures, and silting in the Service Water System components and on the systems, structures, and components supported by the Service Water System. Other activities include station maintenance inspections, component preventive maintenance, plant surveillance testing, and inspections. These activities provide for management of loss of material (without credit for protective coatings) and heat transfer reduction (including fouling from biological, corrosion product, and external sources) aging effects where applicable in system components exposed to a raw water environment.

A.2.1.12 Closed-Cycle Cooling Water System

The Closed-Cycle Cooling Water System aging management program is an existing program that manages aging of piping, piping components, piping elements, tanks, and heat exchangers that are included in the scope of license renewal for loss of material, stress corrosion cracking, and reduction of heat transfer and are exposed to a closed cooling water environment at Salem. The Closed-Cycle Cooling Water System aging management program relies on mitigation measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive examinations based on industry-recognized guidelines of EPRI 1007820 for closed-cycle cooling water systems. Station maintenance inspections and nondestructive examinations provide condition monitoring of heat exchangers exposed to closed-cycle cooling water environments.

The following enhancements will be incorporated to the Closed-Cycle Cooling Water System Program.

1. The Component Cooling System is not currently analyzed for sulfates, which is not consistent with the EPRI standard. The program will be enhanced to include monitoring this parameter as part of the Closed-Cycle Cooling Water program.

2. The emergency diesel generator jacket water system is not currently analyzed for azole or ammonia, chlorides, fluorides, and microbiologically-influenced corrosion in accordance with the current EPRI standard. The program will be enhanced to include monitoring these parameters as part of the Closed-Cycle Cooling Water program.

3. The Closed-Cycle Cooling Water program for the Chilled Water System will have a program or hardware change to bring the system chemistry parameters into compliance with EPRI 1007820, prior to the period of extended operation.

4. New recurring tasks will be established to enhance the performance monitoring of selected heat exchangers cooled by the Component Cooling System.

5. New recurring tasks will be established for enhancing the performance monitoring of selected Chilled Water System components.

6. A one-time inspection of selected components will be established for Chilled Water System piping to confirm the effectiveness of the Closed-Cycle Cooling Water program.

7. A one-time inspection of selected closed-cycle cooling water components in stagnant flow areas will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program.

8. A one-time inspection of selected closed-cycle cooling water chemical mixing tanks and associated piping will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program on the interior surfaces of the tanks and associated piping.

9. The program will be enhanced such that the Heating Water and Heating Steam System will have a pure water control program instituted, in accordance with EPRI 1007820, prior to the period of extended operation.

10. New recurring tasks will be established for enhancing the performance monitoring of selected Heating Water and Heating Steam System components.

11. A one-time inspection of selected Heating Water and Heating Steam System piping will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program.

These enhancements will be implemented prior to entering the period of extended operation. In addition, the one-time inspections will be performed prior to the period of extended operation.

A.2.1.13 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is an existing program that is credited for managing aging effects of cranes and hoists in the scope of license renewal. Administrative controls ensure that only allowable loads are handled. Cranes and hoists structural components, including the bridge, the trolley, bolting, lifting devices, and the rail system are visually inspected periodically for loss of material. Bolting is also monitored for loss of preload by inspecting for missing, detached, or loosened bolts. The program relies on procurement controls and installation practices, defined in plant procedures, to ensure that only approved lubricants and proper torque are applied to bolting.

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program will be enhanced to include:

1. The program will be enhanced to include visual inspection of structural components and structural bolts for loss of material due to general, pitting, and crevice corrosion and structural bolting for loss of preload due to self-loosening.

2. The program will be enhanced to require visual inspection of the rails in the rail system for loss of material due to wear.

3. The acceptance criteria will be enhanced to require evaluation of significant loss of material due to corrosion for structural components and structural bolts, and significant loss of material due to wear of rail in the rail system.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.14 Compressed Air Monitoring

The Compressed Air Monitoring aging management program is an existing program that manages piping, piping components, and piping elements, compressor housings, and tanks for loss of material due to general, pitting, and crevice corrosion in the Compressed Air System. The Compressed Air Monitoring aging management activities consist of preventive maintenance and condition monitoring measures to manage the aging effects.

A.2.1.15 Fire Protection

The Fire Protection aging management program is an existing program that includes a fire barrier inspection, diesel-driven fire pump inspection and Halon and Carbon Dioxide systems inspections and functional tests. These inspections and functional tests provide assurance that the fire protection components within the scope of license renewal are maintained operational. The fire protection components are comprised of piping, piping elements, piping components, doors, dampers and fire barriers. The Fire Protection program provides for visual inspections of fire barriers and penetration seals for signs of degradation such as cracking, loss of material and hardening, through periodic inspection and functional testing. These components within the scope of license renewal are maintained in accordance to the guidance contained within NFPA Codes and Standards. The fire barrier inspections require periodic visual inspections of fire barrier penetration seals, fire barrier walls, ceilings, and floors, and periodic visual inspection. Functional testing and inspections of the fire rated doors and dampers is performed to ensure that their operability is maintained. The program includes surveillance tests of fuel oil systems for the diesel-driven fire pumps to ensure that the fuel supply lines can perform their intended functions. The program also includes visual inspections and periodic operability tests of Halon and Carbon Dioxide fire suppression systems using NFPA Codes and Standards for guidance.

The Fire Protection aging management program will be enhanced to include:

1. The Salem routine inspection procedures will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors for aging effects such as cracking, spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.
2. The Salem fire pump supply line functional tests will be enhanced to provide specific guidance for examining exposed external surfaces of the fire pump diesel fuel oil supply line for corrosion during pump tests.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.16 Fire Water System

The Fire Water System aging management program is an existing program that provides for system pressure monitoring, fire system header flushing and flow testing, pump performance testing, hydrant flushing, and visual inspection activities. Testing, inspection and flushing activates are performed periodically assure that the aging effect of loss of material due to corrosion, microbiologically influenced corrosion (MIC), or biofouling are managed such that the system intended functions are maintained. System flow tests measure hydraulic resistance and compare results with previous testing, as a means of evaluating the internal piping conditions. Major component types include piping and fittings, heat exchangers, tanks and pumps. Monitoring system piping flow characteristics ensures that signs of loss of material will be detected in a timely manner. Pump performance tests, hydrant flushing and system inspections are based on guidance from the applicable NFPA standards.

The Fire Water System program will be enhanced as follows:

1. The Fire Water System aging management program will be enhanced to inspect selected portions of the water based fire protection system piping located aboveground and exposed to the fire water internal environment by non-intrusive volumetric examinations. These inspections shall be performed prior to the period of extended operation and will be performed every 10 years thereafter.
2. The Fire Water System aging management program will be enhanced to replace or perform 50-year sprinkler head inspections and testing using the guidance of NFPA-25 "Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems" (2002 Edition), Section 5-3.1.1. These inspections will be performed by the 50-year in-service date and every 10-years thereafter.

These enhancements will be implemented prior to the period of extended operation, with the inspections and testing performed in accordance with the schedule described above.

A.2.1.17 Aboveground Steel Tanks

The Aboveground Steel Tanks aging management program is an existing program that will manage loss of material aging effects of outdoor carbon steel tanks (Fire Protection Water Storage Tanks). Paint is a corrosion preventive measure, and periodic visual inspections will monitor degradation of the paint and any resulting metal degradation of carbon steel tanks. Inspection of the grout or sealant at the tank-foundation interface is included for tanks that are located on a sand bed on top of concrete foundations.

The Aboveground Steel Tanks program will be enhanced as follows:

1. The program will be enhanced to include UT measurements of the bottom of the tanks that are supported on concrete foundations (Fire Protection Water Storage Tanks). Measured wall thickness will be monitored and trended if significant material loss is detected. These thickness measurements of the tank bottom will be taken and evaluated against design thickness and corrosion allowance to ensure that significant degradation is not occurring and the component intended function would be maintained during the extended period of operation.
2. The program will be enhanced to provide routine visual inspections of the Fire Protection Water Storage Tanks external surfaces. The visual inspection activities will include inspection of the grout or sealant between the tank bottom and the concrete foundation for signs of degradation.

These enhancements will be implemented prior to the period of extended operation. Tank bottom UT inspections will also be performed prior to the period of extended operation.

A.2.1.18 Fuel Oil Chemistry

The Fuel Oil Chemistry aging management program is an existing program that includes preventive activities to provide assurance that contaminants are maintained at acceptable levels in fuel oil for systems and components within the scope of License Renewal. The fuel oil tanks within the scope of License Renewal are maintained by monitoring and controlling fuel oil contaminants in accordance with the guidelines of the American Society for Testing and Materials (ASTM). Fuel oil sampling and analysis is performed in accordance with approved procedures for new fuel oil and stored fuel oil. Fuel oil tanks are periodically drained of accumulated water and sediment, cleaned, and internally inspected. These activities effectively manage the effects of aging by providing reasonable assurance that potentially harmful contaminants are maintained at low concentrations.

The Fuel Oil Chemistry aging management program will be enhanced to include:

1. Equivalent requirements for fuel oil purity and fuel oil testing as described by the Standard Technical Specifications.
2. Analysis for particulate contamination in new and stored fuel oil.
3. Addition of biocides, stabilizers and inhibitors as determined by fuel oil sampling or inspection activities.
4. Quarterly analysis for bacteria in new and stored fuel oil.
5. Internal inspection of 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23) using visual inspections and ultrasonic thickness examination of tank bottoms.
6. Sampling of new fuel oil deliveries for API gravity and flash point prior to off load.

7. Internal inspection of the 30,000-gallon Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2) using visual inspections and ultrasonic thickness examination of tank bottoms.

8. To confirm the absence of any significant aging effects, a one-time inspection of each of the 550-gallon Diesel Fuel Oil Day Tanks will be performed.

These enhancements will be implemented prior to the period of extended operation. In addition, the one-time inspections will be performed prior to the period of extended operation.

A.2.1.19 Reactor Vessel Surveillance

The Reactor Vessel Surveillance Program is an existing program that manages the loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline materials. The program fulfills the intent and scope of 10 CFR 50, Appendix H. This program evaluates neutron embrittlement by projecting Upper Shelf Energy (USE) for all reactor materials with projected neutron exposure greater than 10^{17} n/cm2 (E > 1.0 MeV) after 60 years of operation and with the development of pressure-temperature limit curves. Embrittlement information is obtained in accordance with Regulatory Guide 1.99, Rev. 2. In accordance with 10 CFR Part 50, Appendix H, Salem Units 1 and 2 will submit their proposed capsule withdrawal schedules for approval prior to implementation.

The Reactor Vessel Surveillance program will be enhanced as follows:

1. The Reactor Vessel Surveillance program will be enhanced to state the bounding vessel inlet temperature (cold leg) limits and fluence projections, and to provide instructions for changes.

   a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max)

   b. Fluence Limitation (max.): 1.00 x 10^{20} n/cm^2 (E > 1.0 MeV)

2. The Reactor Vessel Surveillance program will be enhanced to describe the capsule storage requirements and the need to retain future pulled capsules.

3. The Reactor Vessel Surveillance program will be enhanced to specify a scheduled date for withdrawal of capsules, including pulling one of the remaining four capsules during the period of extended operation to monitor the effects of long-term exposure to neutron embrittlement for each Salem Unit. Those dates shall be approved by the NRC prior to withdrawal of the capsules, in accordance with 10 CFR Part 50, Appendix H.

4. The Reactor Vessel Surveillance Program will be enhanced to incorporate the requirements for (1) withdrawing the remaining capsules when the monitor capsule is withdrawn during the period of extended operation and placing them in storage for the purpose

of reinstituting the Reactor Vessel Surveillance Program if required, i.e. if the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, and subsequently the basis for the projection to 60 years warrant the reinstitution, and (2) changes to the reactor vessel exposure conditions and the potential need to re-institute a vessel surveillance program will be discussed with the NRC staff prior to changing the plant's licensing basis.

5. Enhancements to the current Reactor Vessel Surveillance Program will be made to require that if future plant operations exceed the limitations or bounds specified for cold leg temperatures (vessel inlet) or higher fluence projections, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC shall be notified.

    a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max)

    b. Fluence Limitation (max.): 1.00×10^{20} n/cm^2 (E > 1.0 MeV)

These enhancements will be implemented prior to the period of extended operation.

A.2.1.20 One-Time Inspection

The One-Time Inspection aging management program is a new program that will provide reasonable assurance that an aging effect is not occurring, or that the aging effect is occurring slowly enough to not affect a component intended function during the period of extended operation, and therefore will not require additional aging management. The program will be credited for cases where either (a) an aging effect is not expected to occur but there is insufficient data to completely rule it out, (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected, or (c) the characteristics of the aging effect include a long incubation period. Major component types covered by the program include, piping, piping elements and piping components, steam generators, heat exchangers and tanks.

The One-Time Inspection aging management program will be used for the following:

1. To confirm the effectiveness of the Water Chemistry program to manage the loss of material, cracking, and the reduction of heat transfer aging effects for aluminum, copper alloy, nickel alloy, steel, stainless steel, and cast austenitic stainless steel in treated water, treated borated water, steam, and reactor coolant environments.
2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for aluminum, copper alloy, gray cast iron, steel and stainless steel in a fuel oil environment.
3. To confirm the effectiveness of the Lubricating Oil Analysis program to manage the loss of material and the reduction of heat transfer aging effects for aluminum, copper alloy, ductile cast iron, gray cast iron, steel, stainless

steel, cast austenitic stainless steel and titanium alloy in a lubricating oil environment.

Inspection methods will include visual examination or volumetric examinations. Acceptance criteria are in accordance with industry guidelines, codes, and standards, including the applicable edition of ASME Boiler and Pressure Vessel Code, Section XI. The One-Time Inspection program provides for the evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the period of extended operation. Should aging effects be detected, the program triggers actions to characterize the nature and extent of the aging effect and determines what subsequent monitoring is needed to ensure intended functions are maintained during the period of extended operation.

The new program, including performance of physical inspections and evaluation of results, will be implemented prior to the period of extended operation.

A.2.1.21 Selective Leaching of Materials

The Selective Leaching of Materials aging program is a new program that will include inspections of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring. Components include valve bodies, filter housing, heat exchanger components, pump casings, strainer bodies, piping and fittings, drain traps, and tanks. One-time inspections will include visual examinations, supplemented by hardness tests, and other examinations, as required. If selective leaching is found, the condition will be evaluated to determine the need to expand inspection scope.

These one-time inspections will be performed in the last 10 years of the current term, prior to entering the period of extended operation

A.2.1.22 Buried Piping Inspection

The Buried Piping Inspection aging management program is an existing program that manages the external surface aging effects of loss of material for piping and components in a soil or groundwater (external) environment. The Salem buried component activities consist of preventive and condition-monitoring measures to manage, detect and monitor the loss of material due to external corrosion for piping and components in the scope of license renewal that are in a soil environment.

External inspections of buried components will occur opportunistically when they are excavated during maintenance.

The Buried Piping Inspection aging management program will be enhanced to include:

1. At least one opportunistic or focused excavation and inspection of carbon steel, ductile cast iron and gray cast iron piping and components within ten years prior to entering the period of extended operation. Also, upon entering the period of extended operation, a focused excavation and inspection of each of the above materials shall be performed within the first ten years, unless an opportunistic inspection occurs within this ten-year period.

This enhancement will be implemented prior to the period of extended operation, with the inspections performed in accordance with the schedule described above.

A.2.1.23 One-Time Inspection of ASME Code Class 1 Small Bore-Piping

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program that will manage the aging effect of cracking in stainless steel small-bore, less than nominal pipe size (NPS) 4 inches and greater than or equal to NPS 1 Class 1 piping through the use of a combination of volumetric examinations and visual inspections. The components include piping, piping elements and piping components. This program is a part of the Salem Risk Informed Inservice Inspection program.

The program will manage the aging effect through the identification and evaluation of cracking in small-bore Class 1 piping. The program will include one-time volumetric examination of a sample of class 1 butt welds for pipe size less than 4 inches NPS and greater than or equal to NPS 1. In lieu of performing one-time volumetric inspections of socket welds for pipe size less than 4 inches NPS and greater than or equal to NPS 1, the examination method and frequency will be VT-2, as allowed per the code, each refueling outage as defined in Code Case N-578-1, Table 1. Any cracking identified in small-bore Class 1 piping resulting from stress corrosion or thermal and mechanical loading will result in periodic inspections. The program will effectively manage the aging effect by identifying and evaluating cracking in small-bore Class 1 piping prior to loss of intended function.

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program will be implemented and one-time inspections completed and evaluated prior to the period of extended operation.

A.2.1.24 External Surfaces Monitoring

The External Surfaces Monitoring aging management program is a new program that directs visual inspections that are performed during system walkdowns. The program consists of periodic visual inspection of components such as piping, piping components, ducting, and other components within the scope of license renewal. The program manages aging effects through visual inspection of external surfaces for evidence of loss of material. Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion program. The external surfaces of components that are buried are inspected via the Buried Piping Inspection and Buried Non-Steel Piping Inspection programs. The external surfaces of above ground tanks are inspected via the Aboveground Steel Tanks and Aboveground Non-Steel Tanks programs.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.25 Flux Thimble Tube Inspection

The Flux Thimble Tube Inspection Program is a new program that manages the loss of material of the flux thimble tube materials by use of inspection methods such as eddy current testing. The reason it is a new program is that in Salem's response and supplements to NRC Bulletin 88-09, Salem implemented a flux thimble tube inspection program in 1988, then discontinued the program in 1993 after replacement of the flux thimble tubes with those of an improved design and satisfactory follow-up inspections of the improved materials for Unit 1. This new program implements the recommendations of NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors". Acceptance criteria were established from industry guidance.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.26 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is a new program that manages the aging of the internal surfaces of steel piping, piping components and piping elements, ducting components, tanks and heat exchanger components. This program will manage the aging effect of loss of material. The program includes provisions for visual inspections of the internal surfaces of components not managed under other aging management programs. Identified deficiencies due to age related degradation are evaluated under the Corrective Action Program.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.27 Lubricating Oil Analysis

The Lubricating Oil Analysis aging management program is an existing program that provides oil condition monitoring activities to manage the loss of material and the reduction of heat transfer in piping, piping components, piping elements, heat exchangers, and tanks within the scope of license renewal exposed to a lubricating oil environment. Sampling, analysis, and condition monitoring activities identify specific wear products and contamination and determine the physical properties of lubricating oil within operating machinery. These activities are used to verify that the wear product and contamination levels and the physical properties of the lubricating oil are maintained within acceptable limits to ensure that intended functions are maintained.

A.2.1.28 ASME Section XI, Subsection IWE

The ASME Section XI, Subsection IWE aging management program is an existing program based on ASME Code and complies with the provisions of 10 CFR 50.55a. The program consists of periodic inspection of the containment structure liner plate, including its integral attachments, penetration sleeves, pressure retaining bolting, personnel airlock and equipment hatches, moisture barrier, and other pressure retaining components for loss of material, loss of preload, and loss of sealing (of the moisture barrier). The moisture barrier is a sealant installed at the junction of the Containment concrete floor and the carbon steel Containment liner.

Examination methods include visual and volumetric testing as required by ASME Section XI, Subsection IWE. Observed conditions that have the potential for impacting an intended function are evaluated for acceptability in accordance with ASME requirements or corrected in accordance with corrective action process.

The ASME Section XI, Subsection IWE aging management program will be enhanced to include:

1. Inspection of a sample of the inaccessible liner covered by insulation and lagging prior to the period of extended operation and every 10 years thereafter. Should unacceptable degradation be found additional insulation will be removed as necessary to determine extent of condition in accordance with the corrective action process.
2. Visual inspection of 100 % of the moisture barrier, at the junction between the containment concrete floor and the containment liner, will be performed in accordance with ASME Section XI, Subsection IWE program requirements, to the extent practical within the limitation of design, geometry, and materials of construction of the components. The bottom edge of the stainless steel insulation lagging will be trimmed, if necessary, to perform the moisture barrier inspections. This inspection will be performed prior to the period of extended operation, and on a frequency consistent with IWE inspection requirements thereafter. Should unacceptable degradation be found, corrective actions, including extent of condition, will be addressed in accordance with the corrective action process.

These enhancements will be implemented prior to the period of extended operation, with the inspections performed in accordance with the schedule described above.

A.2.1.29 ASME Section XI, Subsection IWL

The ASME Section XI, Subsection IWL aging management program is an existing program based on ASME Code and complies with the provisions of 10 CFR 50.55a. The program requires periodic inspection of Containment Structure concrete surfaces to identify areas of deterioration and distress such as defined in ACI 201.1, including loss of material, cracks and distortion, and loss of bond.

Inspection methods, inspected parameters, and acceptance criteria are in accordance with ASME Section XI, Subsection IWL as approved by 10 CFR 50.55a. Observed conditions that have the potential for impacting an intended function are evaluated for acceptability in accordance with ASME Section XI, Subsection IWL requirements or corrected in accordance with the corrective action process.

A.2.1.30 ASME Section XI, Subsection IWF

The ASME Section XI, Subsection IWF aging management program is an existing program that consists of periodic visual examinations of ASME Class 1, 2, and 3 piping and component supports for identification of signs of degradation such as loss of material, loss of mechanical function and loss of pre-load. The inspections are in accordance with American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section XI, Subsection IWF as approved in 10 CFR 50.55(a). The program activities are relied upon to detect and confirm that aging effects of ASME Class 1, 2, and 3 piping and component supports are adequately managed.

A.2.1.31 10 CFR 50, Appendix J

The 10 CFR 50, Appendix J aging management program is an existing program that monitors leakage rates through the containment pressure boundary, including penetrations, fittings and other access openings, in order to detect age related degradation of the containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. The Primary Containment Leakage Rate Testing Program (LRT) provides for aging management of pressure boundary degradation due to aging effects from the loss of leakage tightness, loss of sealing, loss of material, or loss of preload in various systems penetrating containment. The 10 CFR 50 Appendix J program also detects age related degradation in material properties of gaskets, o-rings and packing materials for the containment pressure boundary access points. Consistent with the current licensing basis, the containment leakage rate tests are performed in accordance with the regulations and guidance provided in 10 CFR 50 Appendix J Option B, Regulatory Guide 1.163, "Performance-Based Containment Leak-Testing Program," NEI 94-01 "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50 Appendix J", and ANSI/ANS 56.8, "Containment System Leakage Testing Requirements."

A.2.1.32 Masonry Wall Program

The Masonry Wall Program is an existing program implemented as part of the Structures Monitoring Program. The Masonry wall condition monitoring is based on guidance provided in IE Bulletin 80-11, "Masonry Wall Design", and IN 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11". The Masonry Wall aging management program addresses loss of material, and cracking due to age-related degradation of concrete for masonry walls during the period of extended operation. The program relies on periodic visual inspections to monitor and maintain the condition of masonry walls within the scope of license renewal.

The Masonry Wall Program will be enhanced to include:

1. Add buildings, and masonry walls that have been determined to be in the scope of License Renewal.
    a. Fire Pump House
    b. Masonry Wall Fire Barriers
    c. Office Buildings (The clean and controlled facilities buildings)
    d. SBO Compressor Building
    e. Service Building
    f. Turbine Building
2. Add an Examination Checklist for masonry wall inspection requirements.
3. Specify an inspection frequency of not greater than 5 years for masonry walls.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.33 Structures Monitoring Program

The Structures Monitoring Program is an existing program that was developed to implement the requirements of 10 CFR 50.65 and is based on NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,". The program includes the Masonry Wall Program and the RG 1.127, Inspection of *Water-Control Structures Associated With Nuclear Power Plants aging* management program.

The program relies on periodic visual inspections to monitor the condition of structures and structural components, structural bolting, component supports, masonry block walls, and water control structures. The inspections are conducted on a frequency not greater than 5 years.

The Structures Monitoring Program will be enhanced to include:

1. The scope of the program will be enhanced to include the following structures and components:
    a. Fire Pump House
    b. Office Buildings (The clean and controlled facilities buildings)
    c. SBO Compressor Building
    d. Service Building
    e. Switchyard
    f. Turbine Building

   g. Transmission towers
   h. Yard Structures (Foundations for fire water and demineralized water tanks, the plant vent radiation monitoring enclosures, the turbine crane runway extensions, and manholes)
   i. Building penetrations and pipe encapsulations that perform flood barrier, pressure boundary, shelter and protection intended functions
   j. Pipe whip restraints and jet impingement/spray shields
   k. Trench covers and sump liners
   l. Masonry walls, including Fire Barriers
   m. Miscellaneous steel (catwalks, vents, louvers, platforms, etc.)
   n. Vortex Suppressor, Ice Barrier, Marine Dock Bumper (Service Water Intake Structure)
   o. Panels, Racks, Cabinets, and Other Enclosures
   p. Metal-enclosed Bus
   q. Components supports including, electrical cable trays, electrical conduit, tubing, HVAC ducts, instrument racks, battery racks, and supports for piping and components that are not within the scope of ASME Section XI, Subsection IWF
   r. Duct banks that contain safety-related cables, and cables credited for SBO or ATWS

2. Concrete structures will be observed for a reduction in equipment anchor capacity due to local concrete degradation. This will be accomplished by visual inspection of concrete surfaces around anchors for cracking and spalling.
3. Clarify that inspections are performed for loss of material due to corrosion and pitting of additional steel components, such as embedments, panels and enclosures, doors, siding, metal deck, and anchors.
4. Require inspection of penetration seals, structural seals, and elastomers, for degradations that will lead to a loss of sealing by visual inspection of the seal for hardening, shrinkage and loss of strength.
5. Require the following actions related to the spent fuel pool liner:
   a. Perform periodic structural examination of the Fuel Handling Building per ACI 349.3R to ensure structural condition is in agreement with the analysis.
   b. Monitor telltale leakage and inspect the leak chase system to

ensure no blockage.

c. Test water drained from the seismic gap for boron concentration.

6. Require monitoring of vibration isolators, associated with component supports other than those covered by ASME XI, Subsection IWF.
7. Add an Examination Checklist for masonry wall inspection requirements.
8. Parameters monitored for wooden components will be enhanced to include: Change in Material Properties, Loss of Material due to Insect Damage and Moisture Damage.
9. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the service water intake structure.
10. Require individuals responsible for inspections and assessments for structures to have a B.S. Engineering degree and/or Professional Engineer license, and a minimum of four years experience working on building structures.
11. Perform periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates on a frequency of 5 years. Groundwater samples in the areas adjacent to Unit 1 containment structure and Unit 1 auxiliary building will also be tested for boron concentration.
12. Require supplemental inspections of the affected in scope structures within 30 days following extreme environmental or natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes).
13. Perform a chemical analysis of ground or surface water in-leakage when there is significant in-leakage or there is reason to believe that the in-leakage may be damaging concrete elements or reinforcing steel.
14. Implementing procedures will be enhanced to include additional acceptance criteria details specified in ACI 349.3R-96.

These enhancements will be implemented prior to entering the period of extended operation.

A.2.1.34 RG 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants

The RG 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants is implemented through the Structures Monitoring Program. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program is an existing program that will be enhanced to require inspection of water control structures and components that are in scope for license renewal. These structures include the Service Water Intake structure and Shoreline Protection and Dike structures (including outer walls of the Circulating Water Intake Structure). The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants aging management program addresses age-related deterioration, degradation due to extreme environmental conditions, and the effects of natural phenomena that may affect the safety function of the water control structures. The program manages loss of material, cracking, and change in material properties for concrete components, loss of material and loss of preload for steel and metal components, loss of material and change in material properties for wooden components, hardening and loss of strength for elastomers, and loss of material and loss of form for earthen water control structures. Elements of the program are designed to detect degradations and take corrective actions to prevent a loss of an intended function.

The RG 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants Program will be enhanced to include:

1. Parameters monitored for wooden components will be enhanced to include change in material properties and loss of material due to insect damage and moisture damage.

2. Parameters monitored for elastomers will be enhanced to include hardening, shrinkage and loss of strength due to weathering and elastomer degradation.

3. The inspection requirement for submerged concrete structural components will be enhanced to require that inspections be performed by dewatering a pump bay or by a diver if the pump bay is not dewatered.

4. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the Service Water Intake Structure.

5. Require supplemental inspections of the in scope structures within 30 days following extreme environmental or natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes).

These enhancements will be implemented prior to the period of extended operation.

A.2.1.35 Protective Coating Monitoring and Maintenance Program

The Protective Coating Monitoring and Maintenance Program is an existing program that provides for aging management of Service Level I coatings inside the containment structure. Service Level I coatings are used in areas where coating failure could adversely affect the operation of post-accident fluid systems and thereby impair safe shutdown. The Protective Coating Monitoring and Maintenance Program provides for inspections, assessments, and repairs for any condition that adversely affects the ability of Service Level I coatings to function as intended.

A.2.1.36 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new program that will be used to manage aging of non-EQ cables and connections during the period of extended operation. A representative sample of accessible cables and connections located in adverse localized environments will be visually inspected at least once every 10 years for indications of accelerated insulation aging such as embrittlement, discoloration, cracking, swelling, or surface contamination. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cable or connection.

This new aging management program, including performance of initial inspections, will be implemented prior to the period of extended operation.

A.2.1.37 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program is a new program that will be implemented to manage the aging of the cable and connection insulation of the in scope portions of the Radiation Monitoring System and the Reactor Protection System (i.e., the nuclear instrumentation system). This program applies to sensitive instrumentation cable and connection circuits with low-level signals that are in scope for license renewal and are located in areas where the cables and connections could be exposed to adverse localized environments caused by heat, radiation, or moisture. These adverse localized environments can result in reduced insulation resistance causing increases in leakage currents.

Calibration results and findings of surveillance programs for the in-scope portions of the Radiation Monitoring System and the Reactor Protection System will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards.

This new program will be implemented prior to the period of extended operation.

A.2.1.38 Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new program that will be used to manage the aging effects and mechanisms of non-EQ, in scope inaccessible medium voltage cables. These cables may at times be exposed to significant moisture simultaneously with significant voltage. The Salem cables in the scope of this aging management program will be tested using a proven test for detecting deterioration of the insulation system due to wetting, that is state-of-the-art at the time the test is performed. The cables will be tested at least once every 10 years and the first tests will be completed prior to the period of the extended operation.

Manholes and cable vaults associated with the cables included in this aging management program will be inspected for water collection. The frequency of inspections for accumulated water and subsequent pumping will be adjusted based on inspection results. The objective of the inspections, as a preventive action, is to keep the cables infrequently submerged, thereby minimizing their exposure to significant moisture. This also recognizes that a recurring inspection, set at the optimum frequency, would result in the cables being submerged only as a result of event driven, rain and drain, type occurrences. As a limit on the amount of time between inspections, the maximum time between inspections will be no more than 2 years.

This new program will be implemented prior to the period of extended operation. In addition, the first tests and inspections will be completed prior to the period of extended operation.

A.2.1.39 Metal Enclosed Bus

The Metal Enclosed Bus aging management program is a new condition monitoring program that will manage the aging of in-scope metal enclosed busses at Salem.

The internal portions of the in-scope metal enclosed bus enclosures will be visually inspected for cracks, corrosion, foreign debris, excessive dust build-up and evidence of moisture intrusion. The bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The internal bus supports will be visually inspected for structural integrity and signs of cracks. Bolted connections are not accessible, but will be checked (sampled) for loose connection using thermography from outside the metal enclosed bus.

Metal enclosed busses are to be free from unacceptable visual indications of surface anomalies, which suggest that conductor insulation degradation exists. In addition no unacceptable indication of corrosion, cracks, foreign debris, excessive dust buildup or evidence of moisture intrusion is to exist. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of intended function. Thermography results will be confirmed to be within the acceptance criteria of administrative program procedures.

This new aging management program will be implemented prior to the period of extended operation. In addition, the first inspections will be completed prior to the period of extended operation and every 10-years thereafter.

A.2.1.40 Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new program that will be used to confirm the absence of an aging effect with respect to electrical cable connection stressors. A representative sample of non-EQ electrical cable connections will be selected for one-time testing considering application (medium and low voltage), circuit loading (high loading) and location, with respect to connection stressors. The technical basis for the sample selected will be documented. The specific type of test performed will be a proven test for detecting loose connections, such as thermography or contact resistance measurement, as appropriate to the application.

This new aging management program will be implemented and the one-time tests will be completed prior to the period of extended operation.

A.2.2 Plant-Specific Aging Management Programs

This section provides summaries of the plant-specific programs credited for managing the effects of aging.

A.2.2.1 High Voltage Insulators

The High Voltage Insulators program is a new program that manages the degradation of insulator quality due to the presence of salt deposits or surface contamination. This aging effect will be identified through visual inspections of the external surfaces of the high voltage insulators. The visual inspections will be performed on a twice per year frequency.

This new aging management program will be implemented prior to the period of extended operation.

A.2.2.2 Periodic Inspection

The Periodic Inspection aging management program is a new condition-monitoring program that manages the aging of piping, piping components, piping elements, ducting components, tanks and heat exchanger components. This program will manage the aging effects of loss of material, cracking, reduction of heat transfer, and hardening and loss of strength. The program includes provisions for visual inspections of stainless steel, aluminum, copper alloy, and elastomer components not managed under other aging management programs. The program also includes provisions for ultrasonic wall thickness measurements to detect loss of material. Identified deficiencies due to age related degradation are evaluated under the Corrective Action Program.

This new program will be implemented prior to the period of extended operation.

A.2.2.3 Aboveground Non-Steel Tanks

The Aboveground Non-Steel Tanks aging management program is a new program that will manage loss of material of outdoor non-steel tanks in the scope of license renewal. Periodic visual inspections will monitor for degradation of the non-steel tanks external surfaces. Periodic visual inspections will also monitor for degradation of the seal at the interface between the tank bottom and the concrete foundation. Tanks within the scope of this program are the Auxiliary Feedwater Storage Tanks, Primary Water Storage Tanks, Refueling Water Storage Tanks and Demineralized Water Storage Tanks.

The Aboveground Non-Steel Tanks program will include a UT wall thickness inspection of the bottom of the tanks. The UT measurements will be taken to ensure that significant degradation is not occurring and that the component intended function will be maintained during the extended period of operation.

This new program, including tank bottom UT inspections, will be implemented prior to the period of extended operation.

A.2.2.4 Buried Non-Steel Piping Inspection

The Salem Buried Non-Steel Piping Inspection program is an existing condition monitoring program that manages buried reinforced concrete piping and components in the Service Water System and Circulating Water System that are exposed to an external soil or groundwater environment for cracking, loss of bond, increase in porosity and permeability, and loss of material. The Salem Buried Non-Steel Piping Inspection aging management program also inspects the buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, for loss of material. These aging effects will be identified through visual inspections of the external surfaces of the buried piping and components.

The Buried Non-Steel Piping Inspection will be enhanced to include:

1. At least one opportunistic or focused excavation and inspection of buried reinforced concrete piping and components will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried reinforced concrete piping and components will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period.

2. At least one opportunistic or focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period.

3. Guidance for inspection of concrete aging effects.

These enhancements will be implemented prior to the period of extended operation, with the inspections performed in accordance with the schedule described above.

A.2.2.5 Boral Monitoring Program

The Boral Monitoring Program is an existing program that manages the aging effects of the Boral neutron-absorbing material used in the Exxon and Holtec spent fuel storage rack assemblies in the units 1 and 2 spent fuel pools at Salem. The aging affects that need managing for the Boral neutron-absorbing material during the period of extended operation are reduction of neutron-absorbing capacity and loss of material.

The Boral Monitoring Program performs inspections and/testing on Boral test specimens or coupons. The program monitors changes in physical properties of the Boral by performing measurements on representative Boral test coupons. The Boral test coupons simulate as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the Boral panels in the spent fuel storage rack assemblies. Monitoring of the Boral neutron-absorbing material is accomplished through periodic examination of the Boral test coupons, consisting of visual observations (which may include photography), and may consist of dimensional measurements (length, width, and thickness), weight and density determinations, and neutron attenuation measurements (for B-10 areal density). The results are evaluated against acceptance criteria for determination of any follow-up activities as appropriate (e.g., removal and examination of additional Boral test coupons, wet chemical analyses, radiography, etc.).

The Boral Monitoring Program will be enhanced to include:

1. The program will be enhanced to perform a neutron attenuation measurement on one each of the three (no vent holes, one vent holes and two vent holes) flat plate sandwich Boral test coupons during the first three two-year inspection frequency periods and every six years thereafter for the Exxon spent fuel storage rack assemblies.
2. The program will be enhanced to include acceptance criteria of the neutron attenuation measurement on the Boral test coupons for the Exxon spent fuel storage rack assemblies: A decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements. The benchmark Boron-10 content used for comparison will be based on the nominal B-10 areal density in the design basis specification.

These enhancements will be implemented prior to the period of extended operation.

A.2.2.6 Nickel Alloy Aging Management

The Salem Nickel Alloy Aging Management program is an existing program that manages cracking for nickel alloy components in the reactor vessel and steam generators. The Nickel Alloy Aging Management program implements mitigative and condition monitoring activities. Mitigative actions include replacement of components whose materials are susceptible to cracking with materials with improved susceptibility to cracking, and Mechanical Stress Improvement Process on the reactor vessel primary nozzle to safe end welds. The condition monitoring portion of the program uses a number of inspection techniques to detect cracking due, including surface examinations, volumetric examinations and bare metal visual examinations. The Nickel Alloy Aging Management program implements the inspection of components through an augmented Inservice Inspection program. The augmented program administers component evaluations, examination methods, scheduling, and site documentation as required to comply with regulatory, code, and industry commitments related to nickel alloy issues. The Nickel Alloy Aging Management program implements applicable NRC Bulletins, Generic Letters and staff-accepted industry guidelines.

A.3 NUREG-1801 Chapter X Aging Management Programs

A.3.1 Evaluation of Chapter X Aging Management Programs

Aging Management Programs evaluated in Chapter X of NUREG-1801 are associated with Time-Limited Aging Analyses for metal fatigue of the reactor coolant pressure boundary and environmental qualification (EQ) of electrical components. These programs are evaluated in this section.

A.3.1.1 Metal Fatigue of Reactor Coolant Pressure Boundary

The Metal Fatigue of Reactor Pressure Boundary program is an existing program that manages cumulative fatigue usage for the reactor vessel, the pressurizer, the steam generators, Class 1 and non-Class 1 piping, and Class 1 components subject to the reactor coolant, treated borated water, and treated water environments.

The Metal Fatigue of Reactor Pressure Boundary program is a preventive program that monitors and tracks the number of critical thermal and pressure transients to ensure that the cumulative usage factors for selected reactor coolant system (RCS) components remain less than 1.00 through the period of extended operation. The program determines the number of transients that occur and updates the 60-year projections as required on an annual basis. A software program, WESTEMS, computes cumulative usage factors for select locations.

The effect of the reactor coolant environment on fatigue usage, known as environmental fatigue, has been evaluated for the period of extended operation using the formulae contained in NUREG/CR-6583 for carbon and low-alloy steels and NUREG/CR-5704 for austenitic stainless steels. The fatigue usage associated with the effects of the reactor coolant environment will be included into the ongoing monitoring program.

The program requires the generation of a periodic fatigue monitoring report, including a listing of transient events, cycle summary event details, cumulative usage factors, a detailed fatigue analysis report, and a cycle projection report. If the fatigue usage for any location has had an unanticipated increase based on cycle accumulation trends or if the number of cycles is approaching their limit, the corrective action program is used to evaluate the condition and determine the corrective action. Acceptable corrective actions include repair of the component, replacement of the component, and a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded during the period of extended operation. Corrective actions include a review of additional affected reactor coolant pressure boundary locations.

There are several enhancements identified for this existing program as follows.

1. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to include additional transients beyond those defined in the Technical Specifications and the UFSAR, and expanding the fatigue monitoring program to encompass other components identified to have fatigue as an analyzed aging effect, which require monitoring.
2. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to use a software program to automatically count transients and calculate cumulative usage on select components.
3. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to address the effects of the reactor coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant identified in NUREG/CR-6260.
4. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to require a review of additional reactor coolant pressure boundary locations if the usage factor for one of the environmental fatigue sample locations approaches its design limit.

These enhancements will be implemented prior to the period of extended operation.

A.3.1.2 Environmental Qualification (EQ) of Electric Components

The Environmental Qualification (EQ) of Electric Components is an existing program that manages the aging of electrical equipment within the scope of 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants." The program establishes, demonstrates, and documents the level of qualification, qualified configurations, maintenance, surveillance and replacements necessary to meet 10 CFR 50.49. A qualified life is determined for components within the scope of the program and appropriate actions such as replacement or refurbishment, or reanalysis, are taken prior to or at the end of the qualified life of the components so that the aging limit is not exceeded. The aging effects are adequately managed so that the intended functions of components within the scope of 10 CFR 50.49 are maintained consistent with the current licensing basis during the period of extended operation.

A.4 Time-Limited Aging Analyses

A.4.1 Introduction

As part of the application for a renewed license, 10 CFR 54.21(c) requires that an evaluation of Time-Limited Aging Analyses (TLAAs) for the period of extended operation be provided. The following TLAAs have been identified and evaluated to meet this requirement.

A.4.2 Reactor Vessel Neutron Embrittlement

The reactor vessel embrittlement calculations for Salem that evaluated reduction of fracture toughness of the Salem reactor vessel beltline materials for 40 years are based upon a predicted End of License fluence of 32 Effective Full Power Years (EFPY). These analyses are considered Time-Limited Aging Analyses (TLAAs) as defined in 10 CFR 54.21(c) and they must be evaluated for the increased neutron fluence associated with 60 years of operation (50 EFPY).

A.4.2.1 Neutron Fluence Analyses

The current reactor vessel embrittlement calculations that evaluated reduction of fracture toughness of the Salem reactor vessel beltline materials for 40 years are based on predicted 40-year EOL fluence values (32 EFPY). These analyses also incorporate the effect of 1.4% power uprate. Therefore, they are Time-Limited Aging Analyses as defined by 10 CFR 54.21(c) and must be evaluated for the increased neutron fluence associated with 60 years of operation.

A value of 50 EFPY for both Salem units was selected to provide conservatism in the fluence projections.

The reactor vessel beltline neutron fluence values applicable to a postulated 20-year license renewal period were calculated for each reactor pressure vessel beltline materials on Salem. The analysis methods used to calculate the Salem vessel fluences satisfy the requirements set forth in Regulator Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence".

The analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.2 Upper Shelf Energy Analyses

The current Charpy Upper Shelf Energy (USE) calculations were prepared for each reactor vessel beltline material for Salem based upon projected neutron fluence values for 40 years of service (32 EFPY). These are TLAAs requiring evaluation using 60-year fluence values (50 EFPY).

Appendix G of 10 CFR 50 contains screening criteria that establish limits on how far the USE value for a reactor pressure vessel material may be allowed to decrease due to neutron irradiation exposure. The regulations requires the initial USE value to be greater than 75 ft-lbs in the non-irradiated condition and that the value be greater than 50 ft-lbs in the fully irradiated conditions as determined by Charpy V-notch specimen testing throughout the licensed life of the plant. USE values of less than 50 ft-lbs may be acceptable to the NRC if it can be demonstrated that these lower values will provide margins of safety against brittle fracture equivalent to those required by ASME Section XI, Appendix G.

Per Regulatory Guide 1.99, Revision 2, the Charpy USE should be assumed to decrease as a function of fluence according to Figure 2 of the Regulatory Guide when surveillance data is not used. If surveillance data is used, the decrease in USE may be obtained by plotting the reduced plant surveillance data on Figure 2 of the Regulatory Guide and fitting the data with a line drawn parallel to the existing lines as the upper bound of all of the data. Charpy USE for the beltline forgings and welds were determined using surveillance data (Position 2.2 of the Regulatory Guide), and the Charpy USE for the extended beltline materials was determined without the use of surveillance data (Position 1.2 of the Regulatory Guide).

Predictions of the Charpy USE for EOL (50 EFPY) for Salem have been made using the corresponding 1/4T fluence projection, the copper and nickel content of the beltline materials, and the results of the capsule specimens tested to date, where applicable, using Figure 2 in Regulatory Guide 1.99.

The USE values for the beltline and extended beltline materials are projected to remain above the 50 ft-lb requirement through the period of extended operation.

The analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.3 Pressurized Thermal Shock Analyses

10 CFR 50.61(b)(1) provides rules for the protection of pressurized water reactors against pressurized thermal shock. Licensees are required to assess the projected values of nil ductility reference temperature whenever a significant change occurs in the projected values of Reference Temperature Pressurized Thermal Shock (RT_{PTS}), or upon request for a change in the expiration date for the facility operating license. For the current 40-year period, the RT_{PTS} was analyzed for 32 EFPY, which is considered a TLAA.

Reactor vessel beltline fluence is one of the factors used in determining the margin of acceptability of the reactor vessel to pressurized thermal shock as a result of neutron embrittlement. The margin is the difference between the maximum nil ductility reference temperature in the limiting beltline material and the screening criteria established in accordance with 10 CFR 50.61(b)(2). The screening criteria for the limiting reactor vessel materials are 270°F for beltline plates, forgings, and axial weld materials, and 300°F for beltline circumferential weld materials.

The limiting RT_{PTS} value for the Salem Unit 1 axially oriented welds and plates is 258°F, which corresponds to the Lower Shell Longitudinal Weld Seam 3-042C. The limiting RT_{PTS} value for the Salem Unit 1 circumferentially oriented welds and plates is 229°F, which corresponds to the Intermediate-to-Lower Shell Circumferential Weld Seam 9-042.

The limiting RT_{PTS} value for the Salem Unit 2 axially oriented welds and plates is 239°F which corresponds to the Lower Shell Longitudinal Weld Seams 3-442 A&C. The limiting RT_{PTS} value for the Salem Unit 2 circumferentially oriented welds is 118°F, which corresponds to the Intermediate Shell-to-Lower Shell Circumferential Weld Seam 9-442.

Therefore, all of the Salem Units 1 and 2 reactor vessel materials that exceed a surface fluence of 1.0E+17 n/cm2 (E > 1.0 MeV) at 50 EFPY are below the RT_{PTS} screening criteria values of 270°F, for axially oriented welds and plates/forgings, and 300°F, for circumferentially oriented welds, at 50 EFPY.

The analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.4 Reactor Vessel Pressure–Temperature Limits, Including Low Temperature Overpressure Protection Limits

Appendix G of 10 CFR 50 requires that the reactor pressure vessel be maintained within established pressure-temperature (P-T) limits, including heatup and cooldown operations. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor pressure vessel is exposed to increased neutron irradiation, its fracture toughness is reduced. The P-T limits must account for the anticipated reactor vessel fluence.

The current Low temperature Overpressure Protection (LTOP) setpoint for Salem Units 1 and 2 is 375 psig, and is effective through 32 EFPY for both Units. These calculations are associated with the generation of the P-T limit curves that satisfy the criteria of 10 CFR 54.3(a) and are, therefore, TLAAs.

Updated P-T limits were calculated using fluence values valid for 50 EFPY for Salem reactor vessel beltline region, inlet and outlet nozzles, and closure head flange locations for normal heatup, normal cooldown, and in-service leak and hydrostatic test conditions. In addition, minimum bolt up temperatures, minimum temperature of core criticality, and LTOP system limits were determined. These P-T limits are expressed in the form of a curve of allowable pressure versus temperature.

Salem Units 1 and 2 will submit updates to the P-T and LTOP limits to the NRC at the appropriate time to comply with 10 CFR 50 Appendix G.

The P-T and LTOPs limit analyses will be managed through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3 Metal Fatigue of Piping and Components

Metal fatigue was evaluated in the design process for Salem pressure boundary components, including the reactor vessel, reactor coolant pumps, steam generators, pressurizer, piping, valves, and components of primary, secondary, auxiliary, steam, and other systems. The current design analyses for these components have been determined to be Time-Limited Aging Analyses (TLAAs) requiring evaluation for the period of extended operation. Fatigue TLAAs for Salem pressure boundary components are characterized by determining the applicable design code and design specifications that specify the fatigue design requirements.

NUREG-1801 provides a listing of components that are likely to have TLAAs in place that require evaluation for License Renewal. Each of these has been reviewed and the applicable TLAAs are evaluated in the following sections, as appropriate.

In addition, for license renewal, fatigue calculations have been prepared to evaluate the effects of the reactor water environment on the sample of high-fatigue locations applicable to Older-Vintage Westinghouse Plants, identified in Section 5.5 of NUREG/CR-6260. Since several of these components are located within systems currently analyzed to ASA/USAS B31.1 rules, new explicit analyses were prepared in accordance with ASME Section III, Class 1 rules for each of these components. For these locations environmental fatigue correction factors were computed and applied to the CUF values developed in the Class 1 fatigue analyses.

A.4.3.1 Nuclear Steam Supply System (NSSS) Pressure Vessel and Component Fatigue Analyses

Nuclear Steam Supply System (NSSS) pressure vessels and components for Salem were designed in accordance with ASME Section III, Class A or Class 1 requirements, and were required to have explicit analyses of cumulative fatigue usage.

ASME Section III, Class A and Class 1 fatigue analyses are based upon explicit numbers and amplitudes of thermal and pressure transients described in the design specifications. The intent of the design basis transient definitions is to bound not just specific operations but a wide range of possible events with varying ranges of severity in temperature, pressure, and flow. The most limiting numbers of transients used in these NSSS component analyses are considered design limits. Those that are significant contributors to fatigue usage are monitored to assure the limits are not exceeded.

Each Salem Unit 1 and 2 component designed in accordance with ASME Section III, Class A and Class 1 rules was analyzed and shown to have a CUF less than the design limit of 1.0. Since each of the Class A and Class 1 fatigue analyses described above are based upon a number of cycles postulated to bound 40 years of service, they have been identified as TLAAs that require evaluation for 60 years.

The evaluation method used to determine the adequacy of the existing design transients for 60 years operations for the Salem license renewal was as follows:

- An investigation of the actual number of cumulative cycles of each transient type was performed, along with predictions of future cycles, and the results were compared to the original design number of cycles for each transient type to demonstrate that the original design cycles were bounding.
- An investigation of the actual severity of the plant transients in comparison with the severity of the equivalent design basis transients was performed to demonstrate the original design transient severities are bounding.
- The administrative and operating procedures were reviewed in order to assess the effectiveness of the design transient cycle counting program and to validate the cyclic assumptions.

The overall conclusion of these investigations is that the existing design transients are sufficiently conservative for encompassing 60 years of plant operations.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.2 Pressurizer Safety Valve and Pilot-Operated Relief Valve Fatigue Analyses

A.4.3.2.1 Pressurizer Safety Valve Fatigue Analyses

There are three (3) 6-inch safety valves installed on the pressurizer. Each of the valves has a design specification of 50 cycles. The analysis associated with the safety valves is considered a TLAA to be evaluated for 60 years.

The pressurizer side of the safety relief valves experience the primary side transients while the downstream side experience pressure and thermal cycles when the valve lifts, i.e., when the pressurizer pressure exceeds the setpoint of 2485 psig.

The number of cycles projected to occur in 60 years is well below 50 cycles analyzed for the pressurizer safety valves.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.2.2 Pressurizer Pilot-Operated Relief Valve Fatigue Analyses

There are two (2) 3-inch pilot-operated relief valves (PORVs) installed on the pressurizer. Each of the PORVs has a design specification of 500 cycles per year for the design operating life of 40 years, equivalent to 20,000 cycles. The analysis associated with the PORVs is considered a TLAA to be evaluated for 60 years.

The pressurizer side of the PORVs experiences the primary side transients while the downstream side experience pressure and thermal cycles when the valve opens and the pressurizer is pressurized.

The number of cycles projected to occur in 60 years is well below 20,000 cycles analyzed for the PORVs.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.3 ASA / USAS B31.1 Piping Fatigue Analyses

Piping designed in accordance with USAS B31.1 Piping Code is not required to have an analysis of cumulative fatigue usage, but cyclic loading is considered in a simplified manner in the design process. When the Salem B31.1 components were designed, the overall number of thermal and pressure cycles expected during the 40-year lifetime of these components was determined. The total number of cycles was compared to cycle ranges specified in USAS B31.1 for consideration of allowable stress reduction. If the total number of cycles exceeded 7,000 cycles, a stress range reduction factor had to be applied to the allowable stress range for secondary stresses (expansion and displacement) to account for thermal cycling. This is considered to be an implicit fatigue analysis since it is based upon a total number of cycles projected to occur in 40 years, but does not have an explicit Cumulative Usage Factor (CUF) value associated with it. Since the overall number of cycles could potentially increase during the period of extended operation, which could potentially result in further reduction of the allowable stress, these implicit fatigue analyses are also considered to be TLAAs requiring evaluation for the period of extended operation.

Note that after originally being designed in accordance with USAS B31.1 requirements, portions of some components of these systems were reevaluated to ASME Section III, Class 1 requirements. The remaining components within those systems that were not reanalyzed are included within the evaluation provided within this section.

In order to evaluate these TLAAs for 60 years, the numbers of cycles expected to occur within the 60-year operational period should be compared to the numbers of cycles that were originally considered in the design of these components. If this number does not exceed 7,000 cycles, the minimum number of cycles required that would result in application of an allowable stress reduction factor, then there is no impact from the added years of service and the original analyses remain valid. If the total number of cycles exceeds 7,000 cycles, then additional evaluation is required.

The 60-year transient projections show that even if all of the projected operational transients are added together, the total number of cycles projected for 60 years will not exceed 7,000 cycles. Therefore, there is no impact upon the implicit fatigue analyses used in the component design for any system that is only affected by operational transients.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.4 Supplementary ASME Section III, Class 1 Piping and Component Fatigue Analyses

Each of the Salem piping systems, including the Reactor Coolant System main loop piping, were originally designed in accordance with ASA B31.1-1955 design requirements. Piping systems for Unit 2 were designed in accordance with USAS B31.1.0-1967 requirements. Since then, a number of updated fatigue analyses have been prepared for piping systems and components to address transients that have been identified in the industry that were not originally considered. These analyses have been performed in accordance with ASME Section III, Class 1, rules to enable these transients to be thoroughly evaluated.

Each of these analyses resulted in a Cumulative Usage Factor (CUF) value less than 1.0 based upon a number of transients postulated to bound 40 years of plant operations. Therefore, each of these analyses has been identified as a TLAA requiring evaluation for 60 years.

These analyses are separated from those evaluated in the previous sections because the transient definitions have been modified, or additional transients have been postulated for these components, in addition to those previously described. Therefore, the cycle projections for these components must address these revised transients or additional transient types to determine if they also remain bounded for 60 years of service. Each of these analyses is dispositioned separately within this section for clarity.

A.4.3.4.1 NRC Bulletin 88-08, Thermal Stresses in Piping Connected to Reactor Coolant Systems

NRC Bulletin 88-08 was issued June 22, 1988 with supplements in 1988 and 1989 because of observed pipe cracking due to valve leakage in unisolable lines. The Bulletin required that licensees identify potential locations that might be subject to high stresses due to leaking valves, inspect the potential locations, and to assure that susceptible locations will not fail for the remaining life of the unit.

The NRC Safety Evaluation Report (SER) approved Salem's response to NRC Bulletin 88-08, which included the evaluation of the fatigue analyses of the Normal and Alternate Charging Lines and the Auxiliary Spray Lines. The analyses were based on the requirements of ASME Section III, 1986 edition, Subsection NB-3653 and the fatigue curves of I-9.2.1 and I-9.2.2 and concluded that the cumulative usage factor would remain less than 1.0 for the Normal and Alternate Charging Lines. The Auxiliary Spray Line results for the same transients would remain less than 1.0 for twenty-four (24) calendar years since initial plant start-up. A follow-up analysis was performed and concluded that the fatigue usage for the Auxiliary Spray Line was calculated to be less than 1.0 for a life of 40 calendar years. These analyses are considered TLAAs for evaluation through the period of extended operation.

Normal and Alternate Charging Lines

The fatigue evaluation of the charging lines to address potential thermal cycling transients included typical charging line transients from similar Westinghouse plants designed to ASME Section III, plus additional transients assumed to be induced by valve leakage over a 40 year period, based on operation of either charging line for 60% of the 40-year period, or an equivalent 24-year total leakage period. For the analyses to remain valid for the 60-year period, the cycles of the design transients and those due to leakage must be shown to be less than analyzed. For the design cycles, the fatigue monitoring program can be used to show the charging transient cycles in either the normal or alternate charging line to be less than those analyzed.

A re-evaluation has been performed for the charging nozzles to account for the 60-year projected charging transient cycles, and the resulting fatigue usage is less than 1.0. Although the charging nozzles are not subject to thermal stratification and cycling transients, the results of the re-evaluation demonstrate the relative impact of the 60-year projected charging design transients, and the ability of the design to accommodate these cycles.

The Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue in accordance with 10 CFR 54.21(c)(1)(iii).

Auxiliary Spray Line

The Pressurizer Auxiliary Spray line was reanalyzed to ASME Section III, Class 1 design rules in order to evaluate postulated thermal events described in Generic Letter 88-08. The potential thermal events would result from cold water leaking past a closed valve seat into the hot Pressurizer Auxiliary Spray line, leading to thermal cycling along the bottom of the pipe. Subsequent valve maintenance and monitoring has minimized the likelihood of this type of thermal cycling, but the analysis remains in effect, and was identified as a TLAA requiring evaluation for 60 years.

The 1999 analysis for 40 years of operation concluded that the cumulative usage factor was less than 1.0 for the limiting location of the Auxiliary Spray Line. The basis was five (5) Inadvertent Auxiliary Spray transients. The analysis also stated that the fatigue usage for thermal cycling and striping due to valve leakage was negligible. The 60-yr projected Inadvertent Auxiliary Spray to Pressurizer events are 2 and 3, respectively for Salem Units 1 and 2.

Therefore, the number of projected transients is bounded by the basis for the ASME III fatigue analysis.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.4.2 NRC Bulletin 88-11, Pressurizer Surge Line Thermal Stratification

NRC Bulletin 88-11, issued in December 1988, requested utilities to establish and implement a program to confirm the integrity of the pressurizer surge line. The program required both visual inspection of the surge line and demonstration that the design requirements of the surge line are satisfied, including the consideration of stratification effects.

The Pressurizer Surge Line piping and nozzles were previously evaluated for the effects of thermal stratification and plant-specific transients. The controlling fatigue location was the surge line weld to the pressurizer surge nozzle. In a later evaluation, a plant-specific WESTEMS™ model was developed for the pressurizer and surge line to evaluate the effects of pressurizer insurge/outsurge transients and surge line stratification on the pressurizer surge nozzle safe end to pipe weld and the surge line hot leg nozzle, which is the analysis of record and needs to be evaluated as a TLAA for 60 years.

The 60-year analyses demonstrated compliance with design requirements considering ASME Code requirements and utilized the design set of NSSS transients. The Pressurizer Surge Line stratification sub-transients were developed based on plant operating procedures, surge line monitoring data from similar units and historical records for each Salem Unit, and projected 60-year cycles of surge line stratification and insurge/outsurge transients where these were greater than previously evaluated design cycles. These evaluations resulted in CUF less than 1.0 at the pressurizer surge nozzle safe end to pipe weld and at the surge line hot leg nozzle.

The analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.3.4.3 Salem Unit 1 Steam Generator Feedwater Nozzle Transition Piece

As part of the Salem Unit 1 Steam Generators replacement, a new feedwater nozzle transition piece forging was designed as an ASME III, Class 1 component. The specific requirements were ASME III, Subsection NB, 1989. Additionally, the requirements for cyclic operation of Article NB-3200 were incorporated into the design of the transition piece. The remainder of the feedwater piping was designed in accordance with ANSI B31.1.0.

All transients considered in the original design of the feedwater nozzles remain the same, except that the hot standby case was replaced with thermal stratification loadings. This portion of the design assumed 800 hours of auxiliary feedwater flow per cycle, over the course of the fifteen (15) remaining cycles (22 years of balance of life of the plant), resulting in 12,000 hours of auxiliary feedwater operation. This analysis is considered a TLAA for evaluation through the period of extended operation.

The thermal stratification loads will be managed by the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program, where the number of Auxiliary Feedwater Flow operational hours will be tracked and compared to the design limit of 12,000 hours. Additionally, the 60-year projected numbers of applicable transients for the transition piece design analysis are within the individual transient design values. The Metal Fatigue of Reactor Coolant Pressure Boundary program monitors the transients to compare them to the design values.

The Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.4.4 Salem Unit 1 Steam Generator Primary Manway Studs

The Salem Unit 1 Steam Generator primary manway studs were originally planned for replacement every five (5) years. However, Westinghouse conducted a series of tests to qualify their life for forty (40) years. The analysis conducted for Salem Unit 1 compared the studs installed in the Model F Salem to those studs qualified for extended fatigue life at another Model F plant. The qualification tests were performed in accordance with ASME Code, Section III, Appendix II. This analysis is considered a TLAA for evaluation through the period of extended operation.

Transients were inputs to the fatigue analyses of the studs. The 60-year projected cycles applicable to the Salem Unit 1 Model F Steam Generator primary manway studs are bounded by the cycles in the Westinghouse fatigue analysis.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.5 Reactor Vessel Internals Fatigue Analyses

The Salem Reactor Vessel Internals were designed and constructed prior to the development of ASME Code requirements for core support structures, but the reactor coolant system functional design requirements were considered in the design. The Reactor Vessel Internals were implicitly designed for low cycle fatigue based upon the reactor coolant system design transient projections for 40 years, which has been identified as a TLAA.

Post-design analyses consist of two Westinghouse calculation notes; (1) a lower core plate evaluation based on the 1.4% uprate and (2) qualification of the Salem domed lower core support plate, also part of the 1.4% uprate project at Salem.

The two post-design Westinghouse calculation notes are evaluations that analyzed the 1.4% uprate in terms of the effect of changes in significant thermal design transients, which were deemed negligible. Therefore, the cumulative fatigue usage attributable to the significant thermal design transients did not change.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.6 Spent Fuel Pool Bottom Plates Fatigue Analyses

Salem responded to the NRC request for additional information (RAI) dated 2/26/96 where the NRC requested an analysis to show that the spent fuel pool (SFP) liner and anchors will not experience significant deformations as a result of thermal loadings. In their RAI, the NRC provided acceptance criteria contained in Tables CC-3720-1 and CC-3730-1 of ASME Section III, Div. 2, 1995. Using a conservative fatigue strength reduction factor of five (5), the Salem analysis determined the maximum alternating stresses and compared them to the austenitic stainless steel curves in the ASME code. The resulting allowable cycles for the bottom liner plates were 1,638 cycles.

A separate analysis evaluated the liner bottom plate for the fuel rack pedestal loads under upset conditions, specifically operating basis earthquake (OBE) loadings. The cumulative usage factor was determined to be 0.00063 for one (1) design basis earthquake (DBE) and twenty (20) OBEs.

The events that would cause full temperature thermal cycles in the SFP are refueling outages which can conservatively be correlated to plant heatups and cooldowns. Since the number of cycles projected to occur in 60 years is well below 1,638 cycles analyzed for the SFP bottom liner, this design analysis remains valid for the period of extended operation.

Since the number of DBEs and OBEs projected to occur in 60 years are below the combination of 1 DBE and 20 OBE cycles analyzed for the SFP bottom liner, this design analysis remains valid for the period of extended operation.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.7 Environmentally-Assisted Fatigue Analyses

NUREG-1801, Revision 1, Generic Aging Lessons Learned, contains recommendations on specific areas for which existing programs should be augmented for license renewal. The program description for Aging Management Program X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary Program, provides guidance for addressing environmental fatigue for license renewal. It states that an acceptable program addresses the effects of the reactor coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant. Examples of critical components are identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components".

This sample of components can be evaluated by applying environmental life correction factors to the existing ASME Code fatigue analyses using formulae contained in NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low Alloy Steels", and in NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels". Demonstrating that these components have an environmentally adjusted cumulative usage factor less than or equal to the design limit of 1.0 is an acceptable option for managing metal fatigue for the reactor coolant pressure boundary.

NUREG/CR-6260 provided environmental fatigue calculations for an Older Vintage Westinghouse plant using the interim fatigue curves from NUREG/CR-5999 for the locations of highest design CUF for the components listed below:

1. Reactor Vessel Shell and Lower Head
2. Reactor Vessel Inlet and Outlet Nozzles
3. Pressurizer Surge Line (including hot leg and pressurizer nozzles)
4. RCS Piping Charging System Nozzles
5. RCS Piping System Safety Injection Nozzles
6. RHR System Class 1 Piping

For the NUREG/CR-6260 locations identified above, the plant-specific components were identified. ASME fatigue usage factors were calculated for each plant-specific component, and the environmental fatigue (Fen) penalties were applied to obtain the updated fatigue results. The reactor vessel was designed to the requirements of the ASME Code, Section III, explicit fatigue usage factors were available from the design evaluations. The plant specific design fatigue results were used to determine the specific locations to be evaluated and apply the applicable Fen penalties to determine updated fatigue usage with environmentally assisted fatigue (EAF).

Salem piping was designed to ANSI B31.1 Code and there is no original explicit fatigue design. To identify Salem specific piping components to be evaluated, design fatigue calculations for similar components were reviewed to determine limiting component locations with respect to the factors influencing fatigue and considering reactor water environmental effects. For the pressurizer surge line, an ASME fatigue evaluation had been previously performed in response to NRC Bulletin 88-11. However, more detailed evaluations were required to accommodate the Fen penalty factors.

Since there was no explicit fatigue design for Salem, no design or transient specifications to the piping exist. Standard transient descriptions for a 4-loop Westinghouse plant were used as the starting point for the fatigue evaluation. Where Salem specific transient information was available, this was incorporated when applicable.

The evaluations showed that no cumulative usage factors with environmental penalties exceeded 1.0 for 60 years of service for the identified plant-specific locations.

The analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.4 Other Plant-Specific Analyses

A.4.4.1 Reactor Vessel Underclad Cracking Analyses

Intergranular separations (underclad cracking) in low alloy steel heat-affected zones under austenitic stainless steel weld claddings were first detected in SA-508, Class 2, reactor vessel forgings in 1970. They have been reported to exist in SA-508, Class 2, reactor vessel forgings manufactured to a coarse grain practice and clad by high-heat-input submerged arc processes. The regulatory position regarding this issue is found in Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components."

A detailed analysis of underclad cracks is provided in a topical report in which Westinghouse presented a fracture mechanics analysis to justify the continue operation of all Westinghouse Units for 32 EFPY with underclad cracks in the reactor pressure vessels. The Westinghouse Owners' Group and the NRC identified this topical report as a TLAA that required evaluation for License Renewal.

By letter dated March 1, 2001, as supplemented by letters dated June 15 and July 31, 2001, the Westinghouse Owners' Group submitted another analysis for NRC review. It evaluated the impact of cracks in SA-508 Class 2 and SA-508 Class 3 forgings beneath austenitic stainless steel weld cladding on reactor pressure vessel integrity. The initial NRC SER issued on October 15, 2001 applied only to 3-loop plants. The Westinghouse Owners' Group provided clarification to the NRC in a letter dated June 19, 2002, to include all Westinghouse plants. The NRC issued a revised SER in September 2002 to include all Westinghouse plants and the evaluation was reissued.

The reissued evaluation was used to demonstrate that fatigue growth of the subject flaw is insignificant over 60 years and the presence of the underclad cracks is of no concern relative to the structural integrity of the vessels, since (1) Salem verified that it was bounded by the report, and (2) Salem provided a FSAR summary description of the programs and activities for managing the effects of aging and evaluation of TLAAs for the period of extended operation.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.4.2 Reactor Coolant Pump Flywheel Fatigue Crack Growth Analyses

A Westinghouse report includes a fatigue crack growth analysis that has been identified as a TLAA. The report was submitted for NRC review and the NRC issued a Safety Evaluation Report in September 1996. The purpose of the report was to provide an engineering basis for elimination of flywheel in-service inspection requirements for all operating Westinghouse plants and certain Babcock and Wilcox plants.

The analysis addresses crack growth of a postulated flaw and compares this growth to a critical flaw size to determine whether or not a failure would occur under maximum overspeed conditions. To estimate the magnitude of fatigue crack growth during plant life, an initial radial crack length of 10 percent of the through the flywheel was assumed. The maximum stress intensity range occurs during reactor coolant pump startup. The number of cycles on the flywheel corresponds to the number of reactor coolant pump starts and stops. The number of cycles (pump starts and stops) for a 60-year plant life was assumed to be 6,000 for this analysis. Crack growth was shown to be negligible from exposure to these 6,000 cycles.

The projected number of start/stop cycles for the Salem Units 1 and 2 RCP flywheels are much less than the analyzed 6,000 cycles.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.4.3 Leak-Before-Break Analyses

Appendix A, Criterion 4, of 10 CFR 50 allows for the use of leak-before-break (LBB) methodology for excluding the dynamic effects of postulated ruptures in reactor coolant system piping. The fundamental premise of the LBB methodology is that the materials used in nuclear power plant piping are sufficiently tough that even a large through-wall crack would remain stable and would not result in a double-ended pipe rupture. Application of the LBB methodology is limited to those high-energy fluid systems not considered to be overly susceptible to failure from such mechanisms as corrosion, water hammer, fatigue, thermal aging or indirectly from such causes as missile damage or the failure of nearby components. The analyses involved with LBB are considered TLAAs.

The 60-year LBB analysis demonstrates that the previous LBB conclusions still remain valid, and the dynamic effects of the pipe rupture resulting from postulated breaks in the reactor coolant primary loop piping need not be considered in the Salem structural design basis for the period of extended operation. This 60-year analysis used input from steam generator snubber elimination program, steam generator replacement design change packages, 1.4% power uprate evaluation, the Tavg operating window, and the Mechanical Stress Improvement Process (MSIP) application at the reactor vessel primary nozzle locations.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.4.4 Applicability of ASME Code Case N-481 to the Salem Units 1 and 2 Reactor Coolant Pump Casings

Periodic volumetric inspections of the welds of the primary loop pump casings of commercial nuclear power plants are require by Section XI of the ASME Boiler and Pressure Vessel Code. These inspections require a large amount of time and resources to complete. They also result in large radiation exposure (man-rem). Since the pump casings are inspected prior to being placed in service, and no significant mechanisms exist for crack initiation and propagation, it has been concluded that the in-service volumetric inspection can be replaced with an acceptable alternate inspection. In recognition of this, ASME Code Case N-481, Alternative Examination Requirements for Cast Austenitic Pump Casings, provides an alternative to the volumetric inspection requirement. The code case allows the replacement of volumetric examinations of primary loop pump casings with fracture mechanics-based integrity evaluation (Item (d) of the code case) supplemented by specific visual examinations. Westinghouse demonstrated compliance with ASME Code Case N-481 on a generic basis that is documented in WCAP-13045. In this evaluation, stress analyses were performed to support fracture mechanics analyses for postulated flaws. Salem applied WCAP-13045 to the Salem reactor coolant pump casings for their 40-year plant life.

The TLAA related to Code Case N-481 is thermal aging of cast austenitic stainless steel and its consequence on fatigue crack growth. The 60-year analysis provided a comparison of the Salem pump casing nozzle loadings with the screening loads reported in WCAP-13045. The screening loads in WCAP-13045 bounded the Salem loads anticipated for 60 years of operation. The stability of the flaws postulated in the primary loop pump casings has been established by evaluating the necessary materials properties against the saturated (fully aged) fracture toughness values. The results of the 60-year analysis show that Code Case N-481 is satisfied for the license renewal period when supplemented with the visual inspections specified in the code case (Items a, b, and c).

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.4.5 Salem Unit 1 Volume Control Tank Flaw Growth Analysis

Flaws were identified in the shell to lower head weld of the Salem Unit 1 Volume Control Tank (VCT) during 1RF13 (1999). The flaws found during the inspection were subsurface and not in contact with the environment, therefore, only fatigue would be the contributing mechanism to flaw growth. The analyses concluded that an initial flaw would grow an insignificant amount of only 1.1 x $10^{(-5)}$ inches, based on 1,000 pressurization cycles.

The VCT is an operating surge volume compensating in part for reactor coolant releases from the reactor coolant system as a result of level changes. The major pressurization cycles (transients) experienced by the VCT would be Inadvertent Safety Injection events and Operating Basis Earthquake cycles, and to a lesser extent, Plant Heatups and Cooldowns.

Therefore, since the number of cycles projected to occur in 60 years for Inadvertent Safety Injection events and Operating Basis Earthquake cycles, Plant Heatups, and Plant Cooldowns is well below 1,000 pressurization cycles analyzed for the Unit 1 VCT flaw, this design analysis remains valid for the period of extended operation.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.5 Fuel Transfer Tube Bellows Design Cycles

The fuel transfer tube connects the fuel transfer canal (inside the Containment Structure) to the transfer pool (inside the Fuel Handling Building). The fuel transfer tube passes through the containment wall and through the exterior wall of the Fuel Handling Building.

The fuel handling building fuel transfer tube is comprised of a 24-inch diameter penetration sleeve penetrating through the containment and fuel handling building walls and three (3) sets of expansion joints (bellows). The penetration sleeve and the three bellows perform a water retaining intended function, and are within the scope of license renewal.

Each of these three bellows was designed for a minimum of 50 cycles of seismic movement, therefore, this design analysis is a TLAA requiring evaluation for the period of extended operation.

In order to determine if the design analyses remain valid for 60 years of operation, the number of seismic cycles for 60 years has been conservatively projected. As of January 2009, the Salem transfer tube bellows have been exposed to zero (0) Operating Basis Earthquake cycles. It is anticipated that 2 and 3 Operating Basis Earthquake cycles would occur in 60 years of operation for Salem Units 1 and 2, respectively.

Therefore, since the number of cycles in 60 years is well below the 50 seismic movement cycles analyzed for these bellows, these design analyses remain valid for the period of extended operation.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.6 Crane Load Cycle Limits

A.4.6.1 Polar Gantry Crane

The purchasing specification for the 230/35-ton Polar Crane in the containment structure at Salem required the crane conform to the design requirements of EOCI-61, "Specifications for Electric Overhead Traveling Cranes – 1961. Issuance of the Crane Manufacturers Association of America (CMAA). Specification 70 was meant to supercede EOCI-61. An engineering study reviewed the design of this crane and determined that it complied with CMAA 70, Rev. 75. As such, the design of this crane corresponds to the cyclic loading requirements of CMAA 70, Class A. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

The Polar Crane was designed for a minimum of 20,000 load cycles, corresponding to the criteria of CMAA Specification 70 for service Class A. The number of anticipated lifts for the Polar Crane is estimated to be 1,720 through the period of extended operation, which is less than the minimum allowable design value of 20,000 cycles.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.6.2 Fuel Handling Crane

The purchasing specification for the 5-ton Fuel Handling Crane in the Fuel Handling Building at Salem required the crane conform to the design requirements of EOCI-61, "Specifications for Electric Overhead Traveling Cranes – 1961. Issuance of the Crane Manufacturers Association of America (CMAA) Specification 70 was meant to supercede EOCI-61. An engineering study reviewed the design of this crane and determined that it complied with CMAA 70, Rev. 75. As such, the design of this crane corresponds to the cyclic loading requirements of CMAA 70, Class A. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

The Fuel Handling Crane was designed for a minimum of 20,000 load cycles, corresponding to the criteria of CMAA Specification 70 for service Class A. The number of anticipated lifts for the Fuel Handling Crane is estimated at 12,000, which is less than the minimum allowable design value of 20,000 cycles.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.6.3 Cask Handling Crane

The existing Salem Cask Handling Cranes were replaced (Unit 1 in Fall 2008; Unit 2 in Fall 2009) by single failure proof Cask Handling Cranes rated for 115 tons (main hoist) and 10 tons (auxiliary hoist). Each of these two cranes was designed to ASME NOG-1-2004, NUREG-0554, and NUREG-0612 criteria in order to be certified as an NRC-approved single failure proof design. The cranes were also designed to CMAA 70-04 standards for Class A service. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

The Cask Handling Crane was designed for a minimum of 20,000 load cycles, corresponding to the criteria of CMAA Specification 70 for service Class A. The number of anticipated lifts for the Cask Handling Crane is estimated at 1,560, which is less than the minimum allowable design value of 20,000 cycles.

The analyses are valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7 Environmental Qualification of Electrical Equipment

Thermal, radiation, and cyclical aging analyses of plant electrical and I&C components, developed to meet 10 CFR 50.49 requirements, have been identified as time-limited aging analyses (TLAAs) for Salem. The NRC has established nuclear station environmental qualification (EQ) requirements in 10 CFR 50.49 and 10 CFR 50, Appendix A, Criterion 4. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments are qualified to perform their safety function in those harsh environments after the effects of in-service aging. Harsh environments are defined as those areas of the plant that could be subject to the harsh environmental effects of a loss-of-coolant accident (LOCA), high energy line break (HELB), or post-LOCA radiation. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification.

Under 10 CFR 54.21(c)(1)(iii), the Salem Environmental Qualification (EQ) of Electric Components program, which implements the requirements of 10 CFR 50.49 (as further defined and clarified by NUREG-0588, and RG 1.89, Rev. 1), is viewed as an aging management program for License Renewal.

Additionally, reanalysis of an aging evaluation to extend the qualifications of components is performed on a routine basis as part of the Salem Environmental Qualification (EQ) of Electric Components program. Important attributes for the reanalysis of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). TLAA demonstration option (iii), which states that the effects of aging will be adequately managed for the period of extended operation, is chosen and the Salem Environmental Qualification (EQ) of Electric Components program will manage the aging effects of the components associated with the environmental qualification TLAA.

NUREG-1800 states that the staff evaluated the industry's EQ program (10 CFR 50.49) and determined that it is an acceptable aging management program to address environmental qualification according to 10 CFR 54.21(c)(1)(iii).

The Environmental Qualification (EQ) of Electric Components program will manage the effects of aging in accordance with 10 CFR 54.21(c)(1)(iii).

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A.5 License Renewal Commitment List

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	Existing program is credited.	A.2.1.1	Ongoing	Section B.2.1.1
2	Water Chemistry	Existing program is credited.	A.2.1.2	Ongoing	Section B.2.1.2
3	Reactor Head Closure Studs	Existing program is credited.	A.2.1.3	Ongoing	Section B.2.1.3
4	Boric Acid Corrosion	Existing program is credited.	A.2.1.4	Ongoing	Section B.2.1.4
5	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Existing program is credited.	A.2.1.5	Ongoing	Section B.2.1.5
6	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) is a new program that will provide for aging management of the thermal embrittlement of CASS piping, piping elements and piping components in a reactor coolant environment. The program will include a screening for components susceptible to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For "potentially susceptible" components, thermal aging embrittlement will be managed through either an enhanced volumetric inspection or a component-specific flaw tolerance evaluation.	A.2.1.6	Program to be implemented prior to the period of extended operation.	Section B.2.1.6
7	PWR Vessel Internals	PWR Vessel Internals is a new program that will include the following activities: 1. Participate in the industry programs for investigating and managing aging effects on reactor internals. 2. Evaluate and implement the results of	A.2.1.7	Program to be implemented prior to the period of extended operation. Inspection plan to be submitted to NRC not less	Section B.2.1.7

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		the industry programs as applicable to the reactor internals. 3. Upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.		than 24 months prior to the period of extended operation.	
8	Flow-Accelerated Corrosion	Existing program is credited.	A.2.1.8	Ongoing	Section B.2.1.8
9	Bolting Integrity	Bolting Integrity Program is an existing program that will be enhanced to include: 1. In the following cases, bolting material should not be reused: a. Galvanized bolts and nuts, b. ASTM A490 bolts; and c. Any bolt and nut tightened by the turn of nut method.	A.2.1.9	Program to be enhanced prior to the period of extended operation.	Section B.2.1.9
10	Steam Generator Tube Integrity	Existing program is credited.	A.2.1.10	Ongoing	Section B.2.1.10
11	Open-Cycle Cooling Water System	Existing program is credited.	A.2.1.11	Ongoing	Section B.2.1.11
12	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System is an existing program that will be enhanced to include: 1. The Component Cooling System is not currently analyzed for sulfates, which is not consistent with the EPRI standard. The program will be enhanced to include monitoring this parameter as part of the Closed-Cycle Cooling Water program. 2. The emergency diesel generator jacket water system is not currently analyzed	A.2.1.12	Program to be enhanced and one-time inspections to be implemented prior to the period of extended operation.	Section B.2.1.12

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		for azole or ammonia, chlorides, fluorides, and microbiologically-influenced corrosion in accordance with the current EPRI standard. The program will be enhanced to include these parameters as part of the Closed-Cycle Cooling Water program. 3. The Closed-Cycle Cooling Water program for the Chilled Water System will have a program or hardware change to bring the system chemistry parameters into compliance with EPRI 1007820, prior to the period of extended operation. 4. New recurring tasks will be established to enhance the performance monitoring of selected heat exchangers cooled by Component Cooling System. 5. New recurring tasks will be established for enhancing the performance monitoring of selected Chilled Water System components. 6. A one-time inspection of selected components will be established for Chilled Water System piping to confirm the effectiveness of the Closed-Cycle Cooling Water program. 7. A one-time inspection of selected closed-cycle cooling water components in stagnant flow areas will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program. 8. A one-time inspection of selected closed-cycle cooling water chemical			

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		mixing tanks and associated piping will be conducted to confirm the effectiveness of the closed cycle cooling water program on the interior surfaces of the tanks and associated piping. 9. The program will be enhanced such that the Heating Water and Heating Steam System will have a pure water control program instituted, in accordance with EPRI 1007820, prior to the period of extended operation. 10. New recurring tasks will be established for enhancing the performance monitoring of selected Heating Water and Heating Steam System components. 11. A one-time inspection of selected Heating Water and Heating Steam System piping will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program.			
13	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems is an existing program that will be enhanced to include: 1. Visual inspection of structural components and structural bolts for loss of material due to general, pitting, and crevice corrosion and structural bolting for loss of preload due to self-loosening. 2. Visual inspection of the rails in the rail system for loss of material due to wear.	A.2.1.13	Program to be enhanced prior to the period of extended operation.	Section B.2.1.13

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		3. The acceptance criteria will be enhanced to require evaluation of significant loss of material due to corrosion for structural components and structural bolts, and significant loss of material due to wear of rail in the rail system.			
14	Compressed Air Monitoring	Existing program is credited.	A.2.1.14	Ongoing	Section B.2.1.14
15	Fire Protection	Fire Protection is an existing program that will be enhanced to include: 1. The routine inspection procedures will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors for aging effects such as cracking, spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. 2. The fire pump supply line functional tests will be enhanced to provide specific guidance for examining exposed external surfaces of the fire pump diesel fuel oil supply line for corrosion during pump tests.	A.2.1.15	Program to be enhanced prior to the period of extended operation.	Section B.2.1.15
16	Fire Water System	Fire Water System is an existing program that will be enhanced to include: 1. The Fire Water System aging management program will be enhanced to inspect selected portions of the water based fire protection system piping located aboveground	A.2.1.16	Program to be enhanced prior to the period of extended operation. Inspection schedule identified in Commitment	Section B.2.1.16

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		and exposed to the fire water internal environment by non-intrusive volumetric examinations. These inspections shall be performed prior to the period of extended operation and will be performed every 10 years thereafter. 2. The Fire Water System aging management program will be enhanced to replace or perform 50-year sprinkler head inspections and testing using the guidance of NFPA-25 "Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems" (2002 Edition), Section 5-3.1.1. These inspections will be performed by the 50-year in-service date and every 10-years thereafter.			
17	Aboveground Steel Tanks	Aboveground Steel Tanks is an existing program that will be enhanced to include: 1. The program will be enhanced to include UT measurements of the bottom of the tanks that are supported on concrete foundations (Fire Protection Water Storage Tanks). Measured wall thickness will be monitored and trended if significant material loss is detected. These thickness measurements of the tank bottom will be taken and evaluated against design thickness and corrosion allowance to ensure that significant degradation is not occurring and the component intended function would be	A.2.1.17	Program to be enhanced prior to the period of extended operation. Tank bottom UT inspections will also be performed prior to the period of extended operation	Section B.2.1.17

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		maintained during the extended period of operation. 2. The program will be enhanced to provide routine visual inspections of the Fire Protection Water Storage Tanks external surfaces. The visual inspection activities will include inspection of the grout or sealant between the tank bottom and the concrete foundation for signs of degradation.			
18	Fuel Oil Chemistry	Fuel Oil Chemistry is an existing program that will be enhanced to include: 1. Equivalent requirements for fuel oil purity and fuel oil testing as described by the Standard Technical Specifications. 2. Analysis for particulate contamination in new and stored fuel oil. 3. Addition of biocides, stabilizers and corrosion inhibitors as determined by fuel oil sampling or inspection activities. 4. Quarterly analysis for bacteria in new and stored fuel oil. 5. Internal inspection of 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23) using visual inspections and ultrasonic thickness examination of tank bottoms. 6. Sampling of new fuel oil deliveries for API gravity and flash point prior to off load. 7. Internal inspection of the 30,000-gallon	A.2.1.18	Program to be enhanced and one-time inspections to be implemented prior to the period of extended operation.	Section B.2.1.18

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2) using visual inspections and ultrasonic thickness examination of tank bottoms. 8. To confirm the absence of any significant aging effects, a one-time inspection of each of the 550-gallon Diesel Fuel Oil Day Tanks will be performed.			
19	Reactor Vessel Surveillance	Reactor Vessel Surveillance is an existing program that will be enhanced to include: 1. The Reactor Vessel Surveillance program will be enhanced to state the bounding vessel inlet temperature (cold leg) limits and fluence projections, and to provide instructions for changes. a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max) b. Fluence Limitation (max.): 1.00×10^{20} n/cm^2 (E > 1.0 MeV) 2. The Reactor Vessel Surveillance program will be enhanced to describe the capsule storage requirements and the need to retain future pulled capsules. 3. The Reactor Vessel Surveillance program will be enhanced to specify a scheduled date for withdrawal of capsules including pulling one of the remaining four capsules during the period of extended operation to	A.2.1.19	Program to be enhanced prior to the period of extended operation.	Section B.2.1.19

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		monitor the effects of long-term exposure to neutron embrittlement for each Salem Unit. Those dates shall be approved by the NRC prior to withdrawal of the capsules, in accordance with 10 CFR Part 50, Appendix H. 4. The Reactor Vessel Surveillance program will be enhanced to incorporate the requirements for (1) withdrawing the remaining capsules when the monitor capsule is withdrawn during the period of extended operation and placing them in storage for the purpose of reinstituting the Reactor Vessel Surveillance Program if required, i.e. if the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, and subsequently the basis for the projection to 60 years warrant the reinstitution, and (2) changes to the reactor vessel exposure conditions and the potential need to re-institute a vessel surveillance program will be discussed with the NRC staff prior to changing the plant's licensing basis. 5. Enhancements to the current Reactor Vessel Surveillance program will be made to require that if future plant operations exceed the limitations or bounds specified for cold leg temperatures (vessel inlet) or higher fluence projections, then the impact of plant operation changes on the extent			

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		of reactor vessel embrittlement will be evaluated and the NRC shall be notified. a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max) b. Fluence Limitation (max.): 1.00×10^{20} n/cm^2 (E > 1.0 MeV)			
20	One-Time Inspection	One-Time Inspection is a new program and will be used for the following: 1. To confirm the effectiveness of the Water Chemistry program to manage the loss of material, cracking, and the reduction of heat transfer aging effects for aluminum, copper alloy, nickel alloy, steel, stainless steel, and cast austenitic stainless steel in treated water, treated borated water, steam, and reactor coolant environments. 2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for aluminum, copper alloy, gray cast iron, steel and stainless steel in a fuel oil environment. 3. To confirm the effectiveness of the Lubricating Oil Analysis program to manage the loss of material and the reduction of heat transfer aging effects for aluminum, copper alloy, ductile cast iron, gray cast iron, steel, stainless steel, cast austenitic stainless steel and titanium alloy in a lubricating oil environment.	A.2.1.20	Program to be implemented prior to the period of extended operation. One-time inspections to be performed within the ten-year period prior to the period of extended operation.	Section B.2.1.20

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
21	Selective Leaching of Materials	Selective Leaching of Materials is a new program that will include inspections of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring.	A.2.1.21	Program to be implemented prior to the period of extended operation. One-time inspections to be performed within the ten-year period prior to the period of extended operation.	Section B.2.1.21
22	Buried Piping Inspection	Buried Piping Inspection is an existing program that will be enhanced to include: 1. At least one opportunistic or focused excavation and inspection of carbon steel, ductile cast iron and gray cast iron piping and components within ten years prior to entering the period of extended operation. Also, upon entering the period of extended operation, a focused excavation and inspection of each of the above materials shall be performed within the first ten years, unless an opportunistic inspection occurs within this ten-year period.	A.2.1.22	Program to be enhanced prior to the period of extended operation. Inspection Schedule identified in Commitment	Section B.2.1.22
23	One-Time Inspection of ASME Code Class 1 Small Bore-Piping	One-Time Inspection of ASME Code Class 1 Small-Bore Piping is a new program that will manage the aging effect of cracking in stainless steel small-bore, less than nominal pipe size (NPS) 4 inches and greater than or equal to NPS 1 Class 1 piping through the use of a combination of volumetric examinations and visual inspections.	A.2.1.23	Program to be implemented prior to the period of extended operation. One-time inspections to be performed within the ten-year period prior to the period of extended operation.	Section B.2.1.23

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
24	External Surfaces Monitoring	External Surfaces Monitoring is a new program that directs visual inspections of components such as piping, piping components, ducting and other components in the scope of license renewal, exposed to an air environment, to manage aging effects.	A.2.1.24	Program to be implemented prior to the period of extended operation.	Section B.2.1.24
25	Flux Thimble Tube Inspection	Flux Thimble Tube Inspection is a new program that manages the loss of material due to wear of the flux thimble tube materials using inspection methods such as eddy current testing.	A.2.1.25	Program to be implemented prior to the period of extended operation.	Section B.2.1.25
26	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components is a new program that manages the aging of the internal surfaces of piping, piping components, piping elements, ducting components, tanks and heat exchanger components.	A.2.1.26	Program to be implemented prior to the period of extended operation.	Section B.2.1.26
27	Lubricating Oil Analysis	Existing program is credited.	A.2.1.27	Ongoing	Section B.2.1.27
28	ASME Section XI, Subsection IWE	ASME Section XI, Subsection IWE is an existing program that will be enhanced to include: 1. Inspection of a sample of the inaccessible liner covered by insulation and lagging once prior to the period of extended operation and every 10 years thereafter. Should unacceptable degradation be found additional insulation will be removed as necessary to determine extent of condition in accordance with the corrective action process. 2. Visual inspection of 100 % of the moisture barrier, at the junction between the containment concrete floor and the containment liner, will be performed in accordance with ASME Section XI, Subsection IWE program	A.2.1.28	Program to be enhanced prior to the period of extended operation. Inspection Schedule identified in Commitment	Section B.2.1.28

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		requirements, to the extent practical within the limitation of design, geometry, and materials of construction of the components. The bottom edge of the stainless steel insulation lagging will be trimmed, if necessary, to perform the moisture barrier inspections. This inspection will be performed prior to the period of extended operation, and on a frequency consistent with IWE inspection requirements thereafter. Should unacceptable degradation be found, corrective actions, including extent of condition, will be addressed in accordance with the corrective action process.			
29	ASME Section XI, Subsection IWL	Existing program is credited.	A.2.1.29	Ongoing	Section B.2.1.29
30	ASME Section XI, Subsection IWF	Existing program is credited.	A.2.1.30	Ongoing	Section B.2.1.30
31	10 CFR Part 50, Appendix J	Existing program is credited.	A.2.1.31	Ongoing	Section B.2.1.31
32	Masonry Wall Program	Masonry Wall is an existing program that will be enhanced to include: 1. Additional buildings and masonry walls as described in A.2.1.32. 2. Add an Examination Checklist for masonry wall inspection requirements. 3. Specify an inspection frequency of not greater than 5 years for masonry walls.	A.2.1.32	Program to be enhanced prior to the period of extended operation.	Section B.2.1.32
33	Structures Monitoring Program	Structures Monitoring is an existing program that will be enhanced to include:	A.2.1.33	Program to be enhanced prior to the period of extended operation.	Section B.2.1.33

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		1. Additional structures and components as described in A.2.1.33. 2. Concrete structures will be observed for a reduction in equipment anchor capacity due to local concrete degradation. This will be accomplished by visual inspection of concrete surfaces around anchors for cracking, and spalling. 3. Clarify that inspections are performed for loss of material due to corrosion and pitting of additional steel components, such as embedments, panels and enclosures, doors, siding, metal deck, and anchors. 4. Require inspection of penetration seals, structural seals, and elastomers, for degradations that will lead to a loss of sealing by visual inspection of the seal for hardening, shrinkage and loss of strength. 5. Require the following actions related to the spent fuel pool liner: a. Perform periodic structural examination of the Fuel Handling Building per ACI 349.3R to ensure structural condition is in agreement with the analysis. b. Monitor telltale leakage and inspect the leak chase system to ensure no blockage. c. Test water drained from the seismic gap for boron concentration. 6. Require monitoring of vibration			

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		isolators, associated with component supports other than those covered by ASME XI, Subsection IWF. 7. Add an Examination Checklist for masonry wall inspection requirements. 8. Parameters monitored for wooden components will be enhanced to include: Change in Material Properties, Loss of Material due to Insect Damage and Moisture Damage. 9. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the service water intake structure. 10. Require individuals responsible for inspections and assessments for structures to have a B.S. Engineering degree and/or Professional Engineer license, and a minimum of four years experience working on building structures. 11. Perform periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates on a frequency of 5 years. Groundwater samples in the areas adjacent to Unit 1 containment structure and Unit 1 auxiliary building will also be tested for boron concentration. 12. Require supplemental inspections of the affected in scope structures within 30 days following extreme environmental or natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes). 13. Perform a chemical analysis of ground			

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		or surface water in-leakage when there is significant in-leakage or there is reason to believe that the in-leakage may be damaging concrete elements or reinforcing steel. 14. Implementing procedures will be enhanced to include additional acceptance criteria details specified in ACI 349.3R-96.			
34	RG 1.127, Inspection of Water-Control Structures	RG 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants is an existing program that will be enhanced to include: 1. Parameters monitored for wooden components will be enhanced to include change in material properties and loss of material due to insect damage and moisture damage. 2. Parameters monitored for elastomers will be enhanced to include hardening, shrinkage and loss of strength due to weathering and elastomer degradation. 3. The inspection requirement for submerged concrete structural components will be enhanced to require that inspections be performed by dewatering a pump bay or by a diver if the pump bay is not dewatered. 4. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the Service Water Intake Structure. 5. Require supplemental inspections of the in scope structures within 30 days following extreme environmental or	A.2.1.34	Program to be enhanced prior to the period of extended operation.	Section B.2.1.34

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes).			
35	Protective Coating Monitoring and Maintenance Program	Existing program is credited.	A.2.1.35	Ongoing	Section B.2.1.35
36	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements is a new program and will be used to manage aging of non-EQ cables and connections during the period of extended operation.	A.2.1.36	Program and initial inspections to be implemented prior to the period of extended operation.	Section B.2.1.36
37	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits is a new program that will be implemented to manage the aging of the cable and connection insulation of the in scope portions of the Radiation Monitoring System and the Reactor Protection System (i.e., the nuclear instrumentation system).	A.2.1.37	Program and initial assessment of testing and calibration results to be implemented prior to the period of extended operation.	Section B.2.1.37
38	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements is a new program that will be used to manage the aging effects and mechanisms of non-EQ, in scope inaccessible medium voltage cables. Manholes and cable vaults associated with the cables included in this aging management program will be inspected as described in A.2.1.38.	A.2.1.38	Program and initial cable tests and manhole inspections to be implemented prior to the period of extended operation.	Section B.2.1.38
39	Metal-Enclosed Bus	Metal Enclosed Bus is a new program that will manage the aging of in-scope metal enclosed busses.	A.2.1.39	Program and initial inspections to be implemented prior to the period of extended operation.	Section B.2.1.39

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
40	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements is a new program that will be used to confirm the slow progression or the absence of an aging effect with respect to electrical cable connection stressors. A representative sample of non-EQ electrical cable connections will be selected, for one-time testing considering application (medium and low voltage), circuit loading (high loading) and location, with respect to connection stressors.	A.2.1.40	Program and one-time testing to be implemented prior to the period of extended operation.	Section B.2.1.40
41	High Voltage Insulators	High Voltage Insulators is a new program that manages the degradation of insulator quality due to the presence of salt deposits or surface contamination.	A.2.2.1	Program to be implemented prior to the period of extended operation.	Section B.2.2.1
42	Periodic Inspection	Periodic Inspection is a new program that manages the aging of piping, piping components, piping elements, ducting components, tanks and heat exchanger components.	A.2.2.2	Program to be implemented prior to the period of extended operation.	Section B.2.2.2
43	Aboveground Non-Steel Tanks	Aboveground Non-Steel Tanks is a new program that will manage loss of material of outdoor non-steel tanks. The Aboveground Non-Steel Tanks program will include a UT wall thickness inspection of the bottom of the tanks. The UT measurements will be taken to ensure that significant degradation is not occurring and that the component intended function will be maintained during the extended period of operation.	A.2.2.3	Program to be implemented prior to the period of extended operation. Tank bottom UT inspections will also be performed prior to the period of extended operation.	Section B.2.2.3
44	Buried Non-Steel Piping Inspection	Buried Non-Steel Piping Inspection is an existing program that will be enhanced to include: 1. At least one opportunistic or focused excavation and inspection of buried	A.2.2.4	Program to be enhanced prior to the period of extended operation. Inspection Schedule identified in Commitment	Section B.2.2.4

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		reinforced concrete piping and components will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried reinforced concrete piping and components will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period. 2. At least one opportunistic or focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period. 3. Guidance for inspection of concrete aging effects.			
45	Boral Monitoring Program	Boral Monitoring is an existing program that will be enhanced to include:	A.2.2.5	Program to be enhanced prior to the period of	Section B.2.2.5

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		1. The program will be enhanced to perform a neutron attenuation measurement on one each of the three (no vent holes, one vent holes and two vent holes) flat plate sandwich Boral test coupons during the first three two-year inspection frequency periods and every six years thereafter for the Exxon spent fuel storage rack assemblies. 2. The program will be enhanced to include acceptance criteria of the neutron attenuation measurement on the Boral test coupons for the Exxon spent fuel storage rack assemblies: A decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements. The benchmark Boron-10 content used for comparison will be based on the nominal B-10 areal density in the design basis specification.		extended operation. Inspection Schedule identified in Commitment	
46	Nickel Alloy Aging Management	Existing program is credited.	A.2.2.6	Ongoing	Section B.2.2.6
47	Metal Fatigue of the Reactor Coolant Pressure Boundary	Metal Fatigue of the Reactor Coolant Pressure Boundary is an existing program that will be enhanced to include: 1. Adding transients beyond those defined in the Technical Specifications and the UFSAR, and expanding the fatigue monitoring program to encompass other components identified to have fatigue as an analyzed aging effect, which require	A.3.1.1	Program to be enhanced prior to the period of extended operation.	Section B.3.1.1

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		monitoring. 2. Using a software program to automatically count transients and calculate cumulative usage on select components. 3. Addressing the effects of the reactor coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant identified in NUREG/CR-6260. 4. Requiring a review of additional reactor coolant pressure boundary locations if the usage factor for one of the environmental fatigue sample locations approaches its design limit.			
48	Environmental Qualification of Electric Components (EQ)	Existing program is credited.	A.3.1.2	Ongoing	Section B.3.1.2
49	New P-T Curves	Revised Pressure-Temperature (P-T) limits will be submitted to the NRC when necessary to comply with 10 CFR 50 Appendix G.	A.4.2.4	Ongoing	Section 4.2.4

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APPENDIX B AGING MANAGEMENT PROGRAMS

B.1 Introduction

B.1.1 Overview

License Renewal Aging Management Program (AMP) descriptions are provided in this appendix for each program credited for managing aging effects based upon the Aging Management Review (AMR) results provided in Sections 3.1 through 3.6 of this application.

In general, there are four (4) types of AMPs:

- Prevention programs preclude aging effects from occurring.
- Mitigation programs slow the effects of aging.
- Condition monitoring programs inspect/examine for the presence and extent of aging.
- Performance monitoring programs test the ability of a structure or component to perform its intended function.

More than one type of AMP may be implemented for a component to ensure that aging effects are managed.

Part of the demonstration that the effects of aging are adequately managed is to evaluate credited programs and activities against certain required attributes. Each of the AMPs described in this section has ten (10) elements which are consistent with the attributes described in Appendix A.1, "Aging Management Review – Generic (Branch Technical Position RLSB-1)" and in Table A.1-1 "Elements of an Aging Management Program for License Renewal" of NUREG-1800. The 10-element detail is not provided when the program is deemed to be consistent with the assumptions made in NUREG-1801. The 10-element detail is only provided when the program is plant specific.

Credit has been taken for existing plant programs whenever possible. As such, all programs and activities associated with a system, structure, component, or commodity grouping were considered. Existing programs and activities that apply to systems, structures, components, or commodity groupings were reviewed to determine whether they include the necessary actions to manage the effects of aging.

Existing plant programs were often based on a regulatory commitment or requirement, other than aging management. Many of these existing programs included the required license renewal 10-element attributes, and have been demonstrated to adequately manage the identified aging effects. If an existing program did not adequately manage an identified aging effect, the program was enhanced as necessary. Occasionally, the creation of a new program was necessary.

B.1.2 Method of Discussion

For those AMPs that are consistent with the assumptions made in Sections X and XI of NUREG-1801, or are consistent with exceptions, each program discussion is presented in the following format:

- A Program Description abstract of the overall program form and function is provided.
- A NUREG-1801 Consistency statement is made about the program.
- Exceptions to the NUREG-1801 program are outlined and a justification for the exceptions is provided.
- Enhancements or additions to the NUREG-1801 program are provided. A proposed schedule for completion is discussed.
- Operating Experience (OE) information specific to the program is provided.
- A Conclusion section provides a statement of reasonable assurance that the program is effective, or will be effective, once enhanced.

The plant specific AMPs are described in terms of the 10 program elements in NUREG-1800, Section A.1.2.3 "Aging Management Program Elements".

B.1.3 Quality Assurance Program and Administrative Controls

The Quality Assurance Program implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)" of NUREG-1800. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls, and is applicable to the safety-related and non-safety related systems, structures, and components (SSCs) that are subject to AMR. In many cases, existing activities were found adequate for managing aging effects during the period of extended operation. Generically, the three elements are applicable as follows:

Corrective Actions:

A single corrective actions process is applied regardless of the safety classification of the system, structure, or component. Corrective actions are implemented through the initiation of a Notification in accordance with the Corrective Action Program established in response to 10 CFR 50, Appendix B. The Corrective Action Program requires the initiation of a Notification for actual or potential problems, including unexpected plant equipment degradation, damage, failure, malfunction, or loss. Site documents that implement aging management programs for license renewal will direct that a Notification be prepared in accordance with those procedures whenever non-conforming conditions are found (i.e., the acceptance criteria are not met). It is noted that previous Corrective Action Programs referred to Condition Reports (CRs) for documenting actual or potential problems and non-conforming conditions. These terms are synonymous with the term Notification.

Equipment deficiencies are corrected through the Work Control Program in accordance with plant procedures. Although equipment deficiencies may initially be documented by the Work Control Program, the Corrective Action Program specifies that a Notification also be initiated, if required, for condition identification, assignment of significance level and investigation class, investigation, corrective action determination, investigation report review and approval, action tracking, and trend analysis.

The Corrective Action Program implements the requirements of NO-AA-10, the Salem and Hope Creek Quality Assurance Topical Report (QATR), Chapter 16, "Corrective Action." Specifically, Conditions Adverse to Quality and Significant Conditions Adverse to Quality are resolved through direct action, the implementation of Corrective Actions, and where appropriate, the implementation of Corrective Actions to Prevent Recurrence.

Confirmation Process:

The focus of the confirmation process is on the follow-up actions that must be taken to verify effective implementation of corrective actions. The measure of effectiveness is in terms of correcting and precluding repetition of adverse conditions. The Corrective Action Program includes provisions for timely evaluation of adverse conditions and implementation of any corrective actions required, including root cause determinations and prevention of recurrence where appropriate (e.g., Significant Conditions Adverse to Quality). The Corrective Action Program provides for tracking, coordinating, monitoring, reviewing, verifying, validating, and approving corrective actions, to ensure effective corrective actions are taken. The Corrective Action Program also monitors for potentially adverse trends. The existence of an adverse trend due to recurring or repetitive adverse conditions will result in the initiation of a Notification. The AMPs required for license renewal would also uncover any unsatisfactory condition due to ineffective corrective action.

Since the same 10 CFR 50, Appendix B corrective actions and confirmation process is applied for nonconforming safety-related and nonsafety-related systems, structures, and components subject to Aging Management Review (AMR) for license renewal, the Corrective Action Program is consistent with the NUREG-1801 elements.

Administrative Controls:

The document control process applies to all generated documents, procedures, and instructions regardless of the safety classification of the associated system, structure, or component. Document control processes are implemented in accordance with the requirements of 10 CFR 50, Appendix B, "Quality Assurance Requirements for Nuclear Power Plants and Fuel Reprocessing Plants." Implementation is further defined in NO-AA-10, the Salem and Hope Creek Quality Assurance Topical Report (QATR), Chapter 6, "Document Control."

Administrative controls procedures provide information on procedures, instructions and other forms of administrative control documents, as well as guidance on classifying these documents into the proper document type and as-building frequency. Revisions will be made to procedures and instructions that implement or administer aging management program requirements for the purposes of managing the associated aging effects for the period of extended operation.

B.1.4 Operating Experience

Operating experience is used in two ways at Salem to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Salem. The first way in which operating experience is used is through the Salem Operating Experience process (OPEX). The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from external (also referred to as industry operating experience) and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), and other documents (e.g., 10 CFR Part 21 Reports, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action program.

Each AMP summary in this appendix contains a discussion of operating experience relevant to the program. This information was obtained through the review of in-house operating experience captured by the Corrective Action Program, Program Self-Assessments, and Program Health Reports, and through the review of industry operating experience. Additionally, operating experience was obtained through interviews with system and program engineers. New programs utilized plant and or industry operating experience as applicable, and discussed the operating experience and associated corrective actions as they relate to implementation of the new program. The operating experience in each AMP summary identifies past corrective actions that have resulted in program enhancements and provides objective evidence that the effects of aging have been, and will continue to be, adequately managed.

B.1.5 NUREG-1801 Chapter XI Aging Management Programs

The following AMPs are described in the sections listed in this appendix. The programs are either generic in nature as discussed in NUREG-1801, Section XI, or are plant-specific. NUREG-1801 Chapter XI programs are listed in Section B.2.1. Plant-specific programs are listed in Section B.2.2. All generic programs are fully consistent with or are, with some exceptions, consistent with programs discussed in NUREG-1801. Programs are identified as either existing or new.

1. ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section B.2.1.1) [Existing]
2. Water Chemistry (Section B.2.1.2) [Existing]
3. Reactor Head Closure Studs (Section B.2.1.3) [Existing]
4. Boric Acid Corrosion (Section B.2.1.4) [Existing]
5. Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (Section B.2.1.5) [Existing]
6. Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.6) [New]
7. PWR Vessel Internals (Section B.2.1.7) [New]
8. Flow-Accelerated Corrosion (Section B.2.1.8) [Existing]
9. Bolting Integrity (Section B.2.1.9) [Existing]
10. Steam Generator Tube Integrity (Section B.2.1.10) [Existing]
11. Open-Cycle Cooling Water System (Section B.2.1.11) [Existing]
12. Closed-Cycle Cooling Water System (Section B.2.1.12) [Existing]
13. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section B.2.1.13) [Existing]
14. Compressed Air Monitoring (Section B.2.1.14) [Existing]
15. Fire Protection (Section B.2.1.15) [Existing]
16. Fire Water System (Section B.2.1.16) [Existing]
17. Aboveground Steel Tanks (Section B.2.1.17) [Existing]
18. Fuel Oil Chemistry (Section B.2.1.18) [Existing]

19. Reactor Vessel Surveillance (Section B.2.1.19) [Existing]
20. One-Time Inspection (Section B.2.1.20) [New]
21. Selective Leaching of Materials (Section B.2.1.21) [New]
22. Buried Piping Inspection (Section B.2.1.22) [Existing]
23. One-Time Inspection of ASME Code Class 1 Small Bore-Piping (Section B.2.1.23) [New]
24. External Surfaces Monitoring (Section B.2.1.24) [New]
25. Flux Thimble Tube Inspection (Section B.2.1.25) [New]
26. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section B.2.1.26) [New]
27. Lubricating Oil Analysis (Section B.2.1.27) [Existing]
28. ASME Section XI, Subsection IWE (Section B.2.1.28) [Existing]
29. ASME Section XI, Subsection IWL (Section B.2.1.29) [Existing]
30. ASME Section XI, Subsection IWF (Section B.2.1.30) [Existing]
31. 10 CFR 50, Appendix J (Section B.2.1.31) [Existing]
32. Masonry Wall Program (Section B.2.1.32) [Existing]
33. Structures Monitoring Program (Section B.2.1.33) [Existing]
34. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section B.2.1.34) [Existing]
35. Protective Coating Monitoring and Maintenance Program (Section B.2.1.35) [Existing]
36. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.36) [New]
37. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section B.2.1.37) [New]
38. Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.38) [New]
39. Metal Enclosed Bus (Section B.2.1.39) [New]

40. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.40) [New]
41. High Voltage Insulators (Section B.2.2.1) [New]
42. Periodic Inspection (Section B.2.2.2) [New]
43. Aboveground Non-Steel Tanks (Section B.2.2.3) [New]
44. Buried Non-Steel Piping Inspection (Section B.2.2.4) [Existing]
45. Boral Monitoring Program (Section B.2.2.5) [Existing]
46. Nickel Alloy Aging Management Program (Section B.2.2.6) [Existing]

B.1.6 NUREG-1801 Chapter X Aging Management Programs

The following NUREG-1801 Chapter X AMPs are described in Section B.2.3 of this appendix as indicated. Programs are identified as either existing or new.

1. Metal Fatigue of Reactor Coolant Pressure Boundary (Section B.3.1.1) [Existing]
2. Environmental Qualification (EQ) of Electrical Components (Section B.3.1.2) [Existing]

B.2 *Aging Management Programs*

B.2.0 NUREG-1801 Aging Management Program Correlation

The correlation between the NUREG-1801 (Generic Aging Lessons Learned (GALL)) programs and the Salem Aging Management Programs (AMPs) is shown below. Links to the sections describing the Salem NUREG-1801 programs are provided.

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section B.2.1.1)
XI.M2	Water Chemistry	Water Chemistry (Section B.2.1.2)
XI.M3	Reactor Head Closure Studs	Reactor Head Closure Studs (Section B.2.1.3)
XI.M4	BWR Vessel ID Attachment Welds	Not Applicable (Salem is a PWR)
XI.M5	BWR Feedwater Nozzle	Not Applicable (Salem is a PWR)
XI.M6	BWR Control Rod Drive Return Line Nozzle	Not Applicable (Salem is a PWR)
XI.M7	BWR Stress Corrosion Cracking	Not Applicable (Salem is a PWR)
XI.M8	BWR Penetrations	Not Applicable (Salem is a PWR)
XI.M9	BWR Vessel Internals	Not Applicable (Salem is a PWR)
XI.M10	Boric Acid Corrosion	Boric Acid Corrosion (Section B.2.1.4)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.M11	Nickel-Alloy Nozzles and Penetrations	Not used. This AMP has been replaced in part by XI.M11A, Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program (Section B.2.1.5). Guidance for the aging management of other nickel-alloy nozzles and penetrations is provided in the AMR line items of Chapter IV and is addressed by the plant specific Nickel Alloy Aging Management Program (Section B.2.2.6).
XI.M11A	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (Section B.2.1.5)
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.6)
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Not used. The UFSAR Supplement commitment for PWR Vessel Internals (see XI.M16) will be used to manage Loss of Fracture Toughness/Thermal Aging and Neutron Irradiation Embrittlement for the cast austenitic stainless steel vessel internals.
XI.M14	Loose Part Monitoring	Not used. Not credited for aging management.
XI.M15	Neutron Noise Monitoring	Not used. Not credited for aging management.

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.M16	PWR Vessel Internals	Salem commits to the following activities for the PWR Vessel Internals program: 1. Participate in the industry programs for investigating and managing aging effects on reactor internals. 2. Evaluate and implement the results of the industry programs as applicable to the reactor internals. 3. Upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval. (Section B.2.1.7)
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (Section B.2.1.8)
XI.M18	Bolting Integrity	Bolting Integrity (Section B.2.1.9)
XI.M19	Steam Generator Tube Integrity	Steam Generator Tube Integrity (Section B.2.1.10)
XI.M20	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System (Section B.2.1.11)
XI.M21	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System (Section B.2.1.12)
XI.M22	Boraflex Monitoring	Not used. Not credited for aging management. This material is not used in the spent fuel pool racks.

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section B.2.1.13)
XI.M24	Compressed Air Monitoring	Compressed Air Monitoring (Section B.2.1.14)
XI.M25	BWR Reactor Water Cleanup System	Not Applicable (Salem is a PWR)
XI.M26	Fire Protection	Fire Protection (Section B.2.1.15)
XI.M27	Fire Water System	Fire Water System (Section B.2.1.16)
XI.M28	Buried Piping and Tanks Surveillance	Not Used. Salem has no buried tanks in scope for license renewal. The aging effects associated with buried piping are managed by XI.M34, Buried Piping Inspection program (Section B.2.1.22)
XI.M29	Aboveground Steel Tanks	Aboveground Steel Tanks (Section B.2.1.17)
XI.M30	Fuel Oil Chemistry	Fuel Oil Chemistry (Section B.2.1.18)
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Surveillance (Section B.2.1.19)
XI.M32	One-Time Inspection	One-Time Inspection (Section B.2.1.20)
XI.M33	Selective Leaching of Materials	Selective Leaching of Materials (Section B.2.1.21)
XI.M34	Buried Piping and Tanks Inspection	Buried Piping Inspection (Section B.2.1.22)
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore-Piping	One-Time Inspection of ASME Code Class 1 Small Bore-Piping (Section B.2.1.23)
XI.M36	External Surfaces Monitoring	External Surfaces Monitoring (Section B.2.1.24)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.M37	Flux Thimble Tube Inspection	Flux Thimble Tube Inspection (Section B.2.1.25)
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section B.2.1.26)
XI.M39	Lubricating Oil Analysis	Lubricating Oil Analysis (Section B.2.1.27)
XI.S1	ASME Section XI, Subsection IWE	ASME Section XI, Subsection IWE (Section B.2.1.28)
XI.S2	ASME Section XI, Subsection IWL	ASME Section XI, Subsection IWL (Section B.2.1.29)
XI.S3	ASME Section XI, Subsection IWF	ASME Section XI, Subsection IWF (Section B.2.1.30)
XI.S4	10 CFR 50, Appendix J	10 CFR Part 50, Appendix J (Section B.2.1.31)
XI.S5	Masonry Wall Program	Masonry Wall Program (Section B.2.1.32)
XI.S6	Structures Monitoring Program	Structures Monitoring Program (Section B.2.1.33)
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section B.2.1.34)
XI.S8	Protective Coating Monitoring and Maintenance Program	Protective Coating Monitoring and Maintenance Program (Section B.2.1.35)
XI.E1	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.36)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
XI.E2	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section B.2.1.37)
XI.E3	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.38)
XI.E4	Metal Enclosed Bus	Metal Enclosed Bus (Section B.2.1.39)
XI.E5	Fuse Holders	Not used. The metallic clamp portions of fuse holders have no aging effects requiring management.
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.40)
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Metal Fatigue of Reactor Coolant Pressure Boundary (Section B.3.1.1)
X.E1	Environmental Qualification (EQ) of Electric Components	Environmental Qualification (EQ) of Electric Components (Section B.3.1.2)
X.S1	Concrete Containment Tendon Prestress	Not Applicable (Salem has a reinforced concrete containment)
N/A	Salem plant specific program	High Voltage Insulators (Section B.2.2.1)
N/A	Salem plant specific program	Periodic Inspection (Section B.2.2.2)
N/A	Salem plant specific program	Aboveground Non-Steel Tanks (Section B.2.2.3)
N/A	Salem plant specific program	Buried Non-Steel Piping Inspection (Section B.2.2.4)
N/A	Salem plant specific program	Boral Monitoring Program (Section B.2.2.5)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	Salem PROGRAM
N/A	Salem plant specific program	Nickel Alloy Aging Management (Section B.2.2.6)

B.2.1 NUREG-1801 Chapter XI Aging Management Programs

This section provides summaries of the NUREG-1801 Chapter XI programs credited for managing the effects of aging.

B.2.1.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

Program Description

The Salem ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is an existing program that is part of the Inservice Inspection (ISI) program. The program includes inspections performed to manage cracking, loss of fracture toughness and loss of material in Class 1, 2, and 3 piping and components exposed to air, reactor coolant, steam, treated water and treated borated water environments within the scope of license renewal. The program provides for the periodic visual, surface, and volumetric examination and leakage testing of pressure-retaining piping and components including welds, pump casings, Steam Generator Components, nozzles and safe ends, valve bodies, integral attachments, and pressure-retaining bolting.

Although NUREG-1801 specifies the 2001 edition including the 2002 and 2003 Addenda of the ASME Section XI Code, Subsections IWB, IWC, and IWD for inspection, repair, and replacement, Salem ISI program plans for the third ten-year inspection interval, approved per 10 CFR 50.55a, are based on the 1998 edition including 2000 Addenda. In accordance with 10 CFR 50.55a(g)(4)(ii), the Salem ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval.

The Salem ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program (ISI Program) is augmented as identified in the GALL Report to manage effects of aging by other programs including, "Water Chemistry", "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors", "Nickel Alloy Aging Management Program", and "One-Time Inspection of ASME Code Class 1 Small Bore-Piping."

The Salem ISI Program details the requirements for the examination and testing, repair, and replacement of components specified in ASME Section XI Subsections IWB-1100, IWC-1100, and IWD-1100 for Class 1, 2, and 3, respectively, including pressure-retaining components and their integral attachments.

The Salem ISI Program includes an alternate method approved in accordance with 10 CFR 50.55a, which is used to determine the inspection locations, inspection frequency, and inspection techniques for Class 1 Category B-F and B-J, and Class 2 Category C-F-1 and C-F-2 welds in accordance with 10 CFR 50.55a(a)(3)(i). This method also addresses volumetric examination of welds less than NPS 4 inches.

The Salem ISI Program consists of condition monitoring activities that detect degradation of components before loss of intended function. No preventive or mitigating attributes are associated with these activities.

The Salem ISI program plans provide the ISI 10-Year Program and Schedules, which includes the examination categories and descriptions as identified in ASME Section XI, Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1.

The Salem ISI program plans provide the extent and schedule of inspections, and the plan's inservice inspection tables provide the examination categories, descriptions, and examination requirements, as specified in ASME Section XI, Table IWB-2500-1 for Class 1 components, Table IWC-2500-1 for Class 2 components, and Table IWD-2500-1 for Class 3 components. Alternative approved methods that meet the requirements of IWA-2240 are also specified in these tables and are identified in the ISI program plans as NRC accepted ASME Code Cases that are implemented as part of the program.

The Salem ISI program uses three types of examination: visual, surface, and volumetric, in accordance with the general requirements of Subsection IWA-2000.

The required examinations in each examination category for Class 1, 2, and 3 components subject to examination per Section XI, Subsection IWB, IWC, and IWD, will be completed during the inspection interval in accordance with the schedule and extent of Tables IWB-2412-1, IWC-2412-1, and IWD-2412-1, respectively, or alternatives approved by the NRC, per the Salem ISI program plans.

In accordance with the ASME Section XI Code requirements, the Salem implementing procedure requires flaw indications, or relevant conditions of degradation, to be evaluated in accordance with IWB-3132.3 or IWB-3142.4. If the component is qualified as acceptable for continued service, the areas containing such flaw indications or relevant conditions will be reexamined during the next three inspection periods for Class 1 components in accordance with IWB-2420 (b) and (c). If flaw indications, or relevant conditions of degradation are evaluated in accordance with IWC-3122.3 or IWC-3132.3, and the component is qualified as acceptable for continued service, the areas containing such flaw indications or relevant conditions will be reexamined during the next inspection period for Class 2 components in accordance with IWC-2420 (b) and (c). If flaw indications, or relevant conditions are evaluated in accordance with IWB-3100, and the component qualifies as acceptable for continued service, the areas containing such flaw indications or relevant conditions will be reexamined during the next inspection period for Class 3 components in accordance with IWD-2420 (b).

If examinations reveal flaws or indications exceeding the acceptance standards, the initial expansion of examinations will comply with the requirements of IWB-2430 (a), IWC-2430 (a), IWD-2430 (a) for Class 1, 2, or 3 respectively, or alternatives approved by the NRC. If the examinations reveal additional indications exceeding the standards of IWB-3000 and IWC-3000, then a second expansion of scope is required in the current outage.

This second expansion will comply with the requirements of IWB-2430 (b), IWC-2430 (b), and IWD-2430 (b) for Class 1, 2, or 3 respectively, or alternatives approved by the NRC.

Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI, Articles IWB-3000 for Class 1, IWC-3000 for Class 2 and IWD-3000 for Class 3, per the Salem ISI program.

NUREG-1801 Consistency

The Salem Inservice Inspection aging management program is consistent with the ten elements of aging management program XI.M1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking due to stress corrosion cracking, cracking due to thermal and mechanical loading, cracking due to cyclic loading, loss of fracture toughness due to thermal aging embrittlement and loss of material due to wear and general, pitting and crevice corrosion are being adequately managed. The following examples of operating experience provide objective evidence that the Salem ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. On 5/4/2006, while performing a VT-2 visual examination during an ASME system pressure test on the safety related service water pump and strainer at Salem Unit 2, an external pinhole leak was discovered on the bottom of the 20-inch diameter discharge nozzle of the strainer. It was leaking at a rate of approximately 1 drop per minute or less. Further inspection revealed that the minor leakage was evident from an approximately 1/16 inch rounded indication on the external surface of the discharge nozzle approximately 7 inches upstream of the discharge flange. This information was entered into the plant corrective action process and an Apparent Cause Evaluation was performed to determine the cause and corrective actions. The apparent cause of this condition was the presence of an original casting discontinuity such as porosity, sand or non-metallic inclusions or shrink cracks. Based on nondestructive examination results, it was postulated that these

casting discontinuities propagated or linked together over time due to normal operating conditions. Corrective actions consisted of a weld repair to restore the ASME Code pressure boundary and an extent of condition review that consisted of examinations (visual inspection) of the remaining strainers for similar leakage by the system engineer. No external leakage was observed on any of the other strainer bodies inspected. This example provides objective evidence that the ASME *Section* XI *Inservice Inspection*, Subsections IWB, IWC, and IWD program procedure provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate actions for extent of condition are taken as necessary to ensure effective condition monitoring is performed on piping and components within the scope of license renewal.

2. On 4/5/2005 ISI personnel reported weld indication concerns related to the ultrasonic baseline draft report for Salem Unit 2 replacement reactor vessel head into the plant corrective action process. They reported that the Examination Summary noted, "As a function of the baseline Control Rod Drive Mechanism, numerous fabrication indications were detected and recorded." Furthermore the report indicated that each of the 57 J-groove welds had exhibited fabrication indications detected with ultrasonics. The indications varied in length from 1/8 inch up to 2.3 inch. The average number of indications per weld was approximately 10. Most of the indications were orientated circumferentially, with a few oriented axially and the majority were contained within the weld. Twenty-one indications were embedded in the penetration tube outside diameter in the weld fusion zone. Ultrasonic baseline exams were performed by the head manufacturer on the penetration tubes for the 57 penetrations. The exams were performed in accordance with the in-service requirements of NRC Order EA-03-009. The purpose of this pre-service exam was to identify manufacturing discontinuities in order to be able to distinguish them from in-service flaws during future ultrasonic inspections. As this was an informational exam, no *acceptance criterion was specified for the weld material itself.* There was sufficient weld material to maintain the structural integrity of the 57 penetrations and all ASME code requirements and design specification exam requirements had been satisfied, therefore there were no structural or operational safety impacts. The indications were determined to most likely be weld fabrication indications as the result of embedded slag inclusions and oxides that occur along the weld fusion line. The type of material, inconel, requires painstaking care to ensure slag deposits are properly cleaned between deposited weld layers. The slag is difficult to thoroughly clean prior to the next weld pass due to accessibility. Slag inclusions generally do not impact the structural aspects of the weld. These fabrication indications did not extend to the J-groove weld wetted surface therefore Pressurized Water Stress Corrosion Cracking was not a concern. Corrective actions

consisted of an independent structural evaluation for the indications in the J-groove weld to ensure there were no structural issues due to the indications, and to have the manufacturer mitigate the situation as much as possible by improving the workmanship in removing the slag for the manufacturing of Salem Unit 1 replacement reactor vessel head. The results of the independent evaluation indicated there were no structural issues due to the indications. This example provides objective evidence that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program procedure provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate actions are taken as necessary to ensure effective condition monitoring is performed on components within the scope of license renewal.

3. On 10/18/2000 during an ISI dye penetrant examination at Salem Unit 2, weld 6-SJ-1222-6 was found to have indications. This information was entered into the corrective action process for resolution. The indications were re-cleaned and dye penetrant exam was re-performed with similar results. Ultrasonic examination of the lower 1/3 exam volume was performed with no indications noted. In addition ultrasonic examination of the upper 2/3 of the weld and adjacent base material were examined where some indications were identified. In accordance with ASME Section XI IWB 3514.3 where indications on the outer surface of the piping as detected by surface examination method during an inservice examination exceed the allowable standards, the indications may be examined by the volumetric method. The indications observed in the upper 2/3 of the weld and the adjacent base material were found to be acceptable when evaluated against the allowable flaw standards for the volumetric examination method in table IWB-3514-2. This example provides objective evidence that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program procedure provides appropriate guidance for the inspection and evaluation of indications and that deficiencies are entered into the corrective action process, and that appropriate actions are taken as necessary to ensure effective condition monitoring is performed on piping and components within the scope of license renewal.

A review of approximately five years of inservice inspection results for Salem Units 1 and 2 revealed that two thousand one hundred and forty nine inspections have been performed with only 19 unacceptable conditions noted. The majority of the unacceptable conditions were related to pipe supports for issues such as spring can settings and the remaining unacceptable conditions were not considered significant and would not impact safe operation of the plants. The operating experience of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program provides reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.2 Water Chemistry

Program Description

The Salem Water Chemistry aging management program is an existing program that provides activities for monitoring and controlling the chemical environments of the Salem primary cycle and secondary cycle systems such that aging effects of system components are minimized. This program manages the aging effects of cracking, loss of material, reduction of neutron-absorbing capacity and reduction of heat transfer. The program mitigates damage caused by corrosion and stress corrosion cracking (SCC) and other aging mechanisms. This program includes provisions specified by NUREG-1801 for the verification of proper chemistry control and aging management, such that the intended functions of plant components will be maintained during the period of extended operation for Salem.

The primary scope of this program consists of the reactor coolant system and related auxiliary systems containing treated water, reactor coolant, treated borated water and steam, including the primary side of the steam generators. Major component types include reactor vessel, reactor internals, piping, piping elements and piping components, heat exchangers and tanks. The primary water portion of the program is consistent with the EPRI 1014986, PWR Primary Water Chemistry Guidelines, Revision 6 and includes UFSAR limits for fluorides, chlorides, and dissolved oxygen. The secondary cycle scope of the program includes the various secondary side systems and the secondary side of the steam generators that contain treated water or steam. The secondary water portion of this program is consistent with the EPRI 1008224, PWR Secondary Water Chemistry Guidelines, Revision 6.

The Salem Water Chemistry aging management program includes periodic sampling of primary and secondary water for the known detrimental contaminants specified in the EPRI PWR water chemistry guidelines, such as chlorides, fluorides, dissolved oxygen, and sulfates, to maintain their concentrations below levels known to result in loss of material or cracking. Sampling frequencies and action limits for each control parameter are defined in Salem specific procedures.

Salem follows the guidance set forth in EPRI 1014986, PWR Primary Water Chemistry Guidelines, Revision 6 and the EPRI 1008224, PWR Secondary Water Chemistry Guidelines, Revision 6, which are later revisions to the guidelines referenced in NUREG-1801, XI.M2 (EPRI TR-105714 and EPRI 102134). However, NUREG-1801, XI.M2 states that later revisions are acceptable. The primary water portion of the program is consistent with the EPRI 1014986, PWR Primary Water Chemistry Guidelines, Revision 6 and includes Plant UFSAR limits for fluorides, chlorides, and dissolved oxygen. The chemistry control strategy for Salem primary water systems, including the reactor coolant system and related auxiliary systems containing reactor coolant and treated borated water, is defined in the primary strategic water chemistry plan for recirculating steam generator plants. This program includes routine sampling of specific chemical control parameters including chloride, fluoride, sulfate, sodium, dissolved oxygen, hydrogen, and other parameters. The program functions to maintain these concentrations below recommended levels to mitigate SCC of austenitic stainless steel, Alloy 600, and Alloy 690 components in accordance with the EPRI guidelines. Additionally, limits are specified for chemistry parameters associated with PWR auxiliary systems and components, including the boric acid storage tanks, volume control tank, spent fuel pool, and other primary side auxiliaries. Routine control of reactor coolant and related auxiliary system contaminants is maintained by using submicron filters and mixed bed demineralizers, which provide mechanical filtration and ion exchange functions to remove contaminants. Lithium hydroxide addition is used to control reactor coolant pH, while hydrogen addition is utilized for oxygen scavenging.

Similarly, chemical control of the secondary water systems is consistent with the EPRI 1008224, PWR Secondary Water Chemistry Guidelines, Revision 6. Chemistry control for Salem secondary water systems is defined in the secondary water strategic chemistry plan for recirculating steam generator plants. The secondary cycle scope of the program includes the various secondary side systems and the secondary side of the steam generators. Chemical control of the Salem secondary water systems is established and maintained by removing contaminants with condensate demineralizers combined with steam generator blowdown. This program includes routine sampling of specific chemical control parameters including chloride, sulfate, sodium, hydrazine, dissolved oxygen, silica, total iron, pH, cation conductivity, and other parameters to mitigate steam generator tube degradation cause by denting, intergranular attack (IGA), outside diameter stress corrosion cracking (ODSCC), or crevice and pitting corrosion. Monitoring and control of these parameters is also intended to mitigate general, crevice, and pitting corrosion of the steam generator shell and secondary side plant components. Routine control of secondary water system contaminants is maintained by using condensate mixed bed demineralizers and steam generator blowdown. Volatile chemical addition, including use of an approved amine, is utilized for pH control. Hydrazine is used to scavenge oxygen in secondary water systems.

Routine primary and secondary system sampling frequencies and action limits for each control parameter are specified in station procedures in accordance with EPRI water chemistry guidelines. Critical parameters are monitored continuously while non-critical parameters have defined monitoring frequencies. For primary water systems, parameter-specific corrective actions include consideration of increased sampling frequencies until the parameters are returned to specifications. Increased sampling is considered and performed as required for primary and secondary system parameters with action level values. Increased sampling frequency is required when monitoring instruments are out of service in the feedwater and condensate systems.

Industry experience has shown that water chemistry programs may not be effective in low flow or stagnant flow areas of plant systems. The Water Chemistry aging management program does not provide for detection of aging effects. However, components located in selected areas at Salem will receive a one-time visual inspection prior to the period of extended operation. This inspection will be performed as part of the Salem One-Time Inspection aging management program. This program includes provisions specified by NUREG-1801 for the verification of proper chemistry control and aging management; such that the intended functions of plant components will be maintained during the period of extend operation for Salem.

Site quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

NUREG-1801 Consistency

The Water Chemistry Program is consistent with the ten elements of aging management program XI.M2, "Water Chemistry Program", specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The Water Chemistry aging management program is a mitigation program that assures contaminants are maintained below applicable limits to mitigate the aging of plant piping and components. Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking, loss of material, reduction of neutron-absorbing capacity and reduction of heat transfer are being adequately managed. The following examples of operating experience provide objective evidence that the Salem Water Chemistry aging management program will be effective in assuring that intended functions will be maintained consistent with the current licensing bases for the period of extended operation:

1. During startup from a steam generator replacement outage in the early 2008, Salem Unit 2 experienced an unexpected RCS dissolved oxygen (DO) transient after starting the third and fourth reactor coolant pumps (RCP). Prior to the DO transient Salem Unit 2 performed RCS vacuum refill in Mode 5, establishing 22.3" Hg vacuum before the RCS was filled with oxygenated RWST water. Two RCPs were started and 12 liters of hydrazine were added to bring DO to 16 ppb with 700 ppb residual hydrazine. The plant entered Mode 4 and started the additional two RCPs. A sample taken following the last RCP start indicated DO had increased to greater than 1000 ppb, and cobalt 58 activity increased from

0.02 μCi/g to 1.04 μCi/g. An additional 12 liters of hydrazine was added, and plant heat up was held below 250°F until DO was below 100 ppb. During the Unit 2 restart, the Vacuum Refill procedure established a minimum of 21" Hg vacuum on the RCS for 15 minutes prior to refilling the RCS. The apparent cause of the DO transient was that sufficient air remained in the RCS after establishing the vacuum refill conditions to create a hydraulic lock preventing back flow through the new steam generator U-tubes. To prevent recurrence of this event, corrective actions were put in place. The Vacuum Refill procedure was revised to require a minimum of 25" Hg vacuum or to start or bump all RCPs prior to raising RCS temperature above 250°F. During the subsequent Unit 1 Cycle 20 restart, 27" Hg vacuum was drawn and held prior to refilling the RCS. This allowed a restart with minimal dissolved oxygen in the RCS. This demonstrates that the Salem Chemistry program is able to identify the cause of unexpected transients and modify conditions to prevent recurrence of such conditions.

2. From mid August through late September 2008, Unit 2 Steam Generator Blowdown (SGBD) sodium samples increased slowly from 0.2 ppb to about 0.6 ppb. Grab samples were used to confirm the On-Line Monitor indications. The sodium value remained below the goal of 0.8 ppb sodium. Newly regenerated Condensate Polishers did not reduce the sodium as expected. The Salem 2 SGBD heat recovery system was in service during this adverse trend. Due to Chemistry monitoring of the SGBD sodium, a small condenser leak was discovered in the Salem 2 main condenser. This leak caused the increase in the SGBD sodium due to bypass flow that is not purified. The heat recovery system uses condensate flow from the discharge of the condensate pumps to cool the SGBD heat exchanger. The SGBD Demineralizers or the condensate polishers, when in service, do not purify this 300-gpm-bypass flow. The 300-gpm-bypass flow was contaminated with leakage from river water into the condenser. Although the Salem 2 condenser leaks were too small to accurately quantify, it was enough to elevate the SGBD sodium concentration and allow the Chemistry program to identify the condenser leak. The SGBD heat recovery was removed from service as part of a troubleshooting plan, and the SGBD sodium concentration returned to normal values. This demonstrates that the Salem chemistry program is able to detect and identify the source of relatively small excursions by their current monitoring and troubleshooting techniques.

3. On 8/27/05, chemistry technicians observed Steam Generator (SG) chlorides beginning an upward trend from a baseline concentration of 1.00 ppb. On 8/28/05 the chloride concentration exceeded the goal of 1.6 ppb at a concentration of 1.75 ppb. Per Chemistry recommendation, Steam Generator blowdown (SGBD) was increased from 40,000 lbm/SG to 100,000 lbm/SG. As SG chloride concentration decreased below the goal, SGBD was reduced to 80,000 lbm/SG, which controlled the chloride concentration at 1.25 ppb. This level was steady for several days until 9/4/05 when the chloride concentration started to increase again. Chlorides continued to increase between 9/9/05 and 9/16/05 when it peaked on the 9/16/05 at 3.2 ppb with SGBD at 120,000 lbm/SG. SG

chlorides decreased to a concentration of 2.5 ppb on 9/17/05. On 9/18/05 and 9/19/05, two anion resin charges were changed. The SG chloride concentration trended down to the goal by mid-day on 9/19/05. The Water Chemistry team developed and implemented a successful troubleshooting plan. The condensate polisher and regeneration system performances were closely monitored, while secondary plant samples were drawn and analyzed for abnormal chloride indications. The apparent cause was determined to be a delivery of sodium hydroxide with chloride levels higher than the maximum allowable concentration of 100 ppm. The source of the contamination was a delivery of sodium hydroxide that was contaminated either by a previous delivery of a less pure grade of sodium hydroxide, or some other previous contents. This illustrates the Water Chemistry program's attention to detail, implementation of effective corrective actions and resolution of unanticipated anomalies.

4. On March 27, 2009 a resin intrusion caused a secondary chemistry sulfate and cation conductivity excursion that resulted in a plant shutdown. Salem Unit 1 initiated a plant shutdown to less than 5% power on 3/27/09 at 11:07 am due to a secondary chemistry excursion above EPRI chemistry Action Level 3 for steam generator (SG) blowdown sulfate concentration and cation conductivity. The first indication of the chemistry excursion was receipt of the control room "Cation Conductivity High" alarm at 10:00 am, approximately 26 minutes after returning the 11 condensate polisher demineralizer vessel (DMV) to service following resin regeneration with an extended purge rinse to support DMV bed management. The 11 DMV was promptly removed from service, confirmatory samples analyzed, individual SG blow down flow rate increased to 120,000 lbm/hr, and the station initiated a shutdown to less than 5% at 30% per hour in accordance with the abnormal operating procedures. SG blowdown sulfate concentration initially exceeded Action Level 3 (250 ppb) and peaked at 568 ppb early in the transient, based on hourly grab sample analysis. Once the plant power was less than 5% power, sulfate levels increased to about 1000 ppb at 4:00 pm due to hideout return, and then decreased exponentially through secondary plant clean up using SG blowdown to the condenser and cleanup with the other DMVs. The plant remained in Mode 2 (reactor critical) and above 546°F for more rapid cleanup. Sulfate levels decreased to less than 100 ppb at 07:38 am on 3/28 and the plant entered Mode 1. The plant was synchronized to the grid and power was increased to 28%. The plant remained below 30% power until sulfates were reduced to less than 20 ppb on 3/29 at 4:30 pm. Reactor power was increased slowly and the elevated SG blowdown flow continued until the sulfate concentration in the highest SG was less than 10 ppb on 3/31 at 8:30 pm. SG blowdown cation conductivity levels were trended using the continuous conductivity system and were consistent with the grab sample sulfate trends.

   The apparent cause of the excursion was latent original equipment manufacturer (OEM) workmanship errors (an incomplete condensate polisher DMV internal lateral filter screen weld and a missing bolt on the downstream resin trap) allowed resin to enter the feedwater system following an extended purge rinse.

In summary, following the abnormal conditions identified by the Water Chemistry program, the 11 DMV was removed from service and reactor power was reduced to less than 5% power per plant procedures and EPRI guidance. Secondary chemistry clean up was performed using the remaining DMVs and SG blowdown and Chemistry sampling frequencies were increased to closely monitor the clean up. This operating experience illustrates that the Salem Water Chemistry program identifies abnormal conditions in a timely manner and promptly implements station procedures and EPRI guidelines.

The operating experiences discussed above are examples of abnormal transients that were identified by routine monitoring activities and corrective actions that were put in place to correct or prevent reoccurrence of such transients in the future. Historical operating experience with respect to secondary chemistry had deleterious effects on the Unit 1 & Unit 2 first-generation steam generators. Evidence of poor aging management included tube denting in early cycles, steep rates of tube plugging, and heavy sludge loading. Inadequate Westinghouse chemistry guidelines and susceptible steam generator design and materials collectively resulted in the decision to replace the steam generators. Enhancements to the Salem chemistry program, both programmatic and operational, have ensured the long-term reliability of the secondary plant equipment. Replacement steam generators for both units were manufactured with designs and materials more resilient to the corrosive mechanisms that plagued the original steam generators. Initiatives such as the implementation of the EPRI PWR Secondary Water Chemistry Guidelines, installation of condensate polishers and steam generator blowdown demineralizers, and injection of ethanolamine have also bolstered the aging management program. Objective evidence lies in the reduced steam generator tube plugging frequencies, reduced secondary cycle sludge transport, and improved secondary plant chemistry control as noted by the INPO Chemistry Effectiveness Indicator.

This evidence is indicative of healthy plant equipment and supports the conclusion that aging effects are being managed at Salem station. In addition, assessments of the Water Chemistry program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Water Chemistry aging management program, supplemented by the One-Time Inspection Program, provides reasonable assurance that cracking, loss of material, reduction of neutron-absorbing capacity and reduction of heat transfer aging effects are adequately managed such that the systems and components within the scope of the program will continue to perform their intended functions consistent with the current licensing basis during the period of extended operation.

B.2.1.3 Reactor Head Closure Studs

Program Description

The Reactor Head Closure Studs Aging Management Program is an existing program that provides for ASME Section XI inspections of reactor head closure studs, nuts and washers for cracking, loss of material, loss of fracture toughness and coolant leakage from reactor vessel closure stud bolting in an air environment. The Reactor Head Closure Studs program is a condition based monitoring program that effectively monitors and detects the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation. The program is based on the examination and inspection requirements specified in the 1998 ASME Section XI B&PV Code, Subsection IWB, including 2000 addenda, Table 2500-1, and preventive measures described in NRC Regulatory Guide 1.65, "Materials and Inspection for Reactor Vessel Closure Studs."

The Reactor Closure Head Studs program implements ASME Section XI inspection requirements through the ISI program plan. The inspections monitor for size of cracking, loss of material, and coolant leakage from reactor vessel closure stud bolting.

The program uses visual and volumetric examinations in accordance with the general requirements of Section XI Subsection IWA-2000. The Reactor Head Closure Studs program was developed in accordance with the requirements detailed in the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsections IWA, IWB, Mandatory Appendices, and Inspection Program B of IWA-2432.

ASME Section XI allows for a number of examinations methods to be used for volumetric and visual inspections. The applicable editions of the ASME Codes do not require surface examinations, thus, surface examinations of the head studs are not performed. This is acceptable in accordance with the approved code year requirements under 10 CFR 50.55a. The flange threads receive a volumetric examination and the surfaces of nuts and washers are inspected using a VT-1 examination. Bushing examinations are not required since no bushings exist on the reactor studs. All pressure-retaining boundary components in Examination Category B-P receive a visual VT-2 examination during the system leakage test and the system hydrostatic test.

The extent and schedule for examining and testing the reactor head closure studs, nuts, and washers are as specified in Table IWB-2500-1 for B-G-1 components, "Pressure Retaining Bolting Greater than 2 Inches in Diameter".

Indications and relevant degraded conditions detected during examinations are evaluated in accordance with ASME Section XI Subsection IWB-3100, for Class 1 components by comparing ISI results with the acceptance standards of IWB-3400 and IWB-3500. Specifically, flaw indications or relevant degraded conditions are evaluated in accordance with IWB-3515 or IWB-3517 as indicated in Table IWB-2500-1 and Table 3410-1 of ASME Section XI.

The Salem Reactor Head Closure Studs program includes the preventive measures to mitigate cracking described in NRC Regulatory Guide 1.65, which includes the use of approved corrosion inhibitors and lubricants. The reactor head closure studs, nuts, and washers are not metal-plated and are surface treated with an acceptable phosphate coating to inhibit corrosion and reduce SCC and IGSCC. In addition, approved lubricants are applied to the nuts and threads and all bearing surfaces of the nuts and washers prior to reactor vessel head re-installation.

The reactor head closure studs are constructed of ASME A540 Grade B23, Class 3 material, which has a maximum tensile strength of less than 170 ksi, which complies with NRC Regulatory Guide 1.65.

NUREG-1801 Consistency

The Reactor Head Closure Studs aging management program is consistent with the ten elements of aging management program XI.M3, Reactor Head Closure Studs, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The Reactor Head Closure Studs aging management program has provisions regarding inspection techniques and evaluation, material specifications, corrosion prevention, and other aspects of reactor pressure vessel head stud cracking. Implementation of the program provides reasonable assurance that the effects of cracking due to SCC or IGSCC and loss of material due to wear are adequately managed.

The following examples of operating experience provide objective evidence that the Reactor Head Closure Studs program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

<u>Salem Unit 1</u>

1. Per ISI Program requirements, Reactor Closure Head Studs 37 through 54 were examined by the UT method; and Reactor Closure Head Nuts and Washers 37 through 54 were examined by the VT-1 method during the Fall 2008 outage with no recordable indications.

2. Reactor Closure Head Studs 19 through 36 were examined by the UT method; and Reactor Closure Head Nuts and Washers 19 through 36 were examined by the VT-1 method during the Fall 2005 outage with no recordable indications.

3. Reactor Closure Head Studs 1 through 18 were examined by the UT method; and Reactor Closure Head Nuts and Washers 1 through 18 were examined by the VT-1 method during the Fall 2002 outage with no recordable indications.

Salem Unit 2

1. Reactor Closure Head Studs 19 through 37 were examined by the UT method; and Reactor Closure Head Nuts and Washers 19 through 37 were examined by the VT-1 method during the Spring 2008 outage with no recordable indications.

2. Reactor Closure Head Nuts and Washers 1 through 18 were examined by the VT-1 method during the Fall 2006 outage with no recordable indications.

3. Reactor Closure Head Studs 1 through 18 were examined by UT during the Spring 2005 outage with no recordable indications.

The operating experience of the Reactor Head Closure Studs program shows there are no signs of age related degradation. This has been demonstrated by the past satisfactory test and inspection results. Since no age related degraded conditions have existed, no investigations and corrective actions have been required. Historically, inspections have found the reactor studs, nuts, and washers to be in satisfactory condition and no studs, nuts or washers have ever been replaced or repaired as a result of age related conditions. This provides objective evidence that the current Reactor Head Closure Studs program effectively monitors for stress corrosion cracking.

The operating experience of the Reactor Head Closure Studs program did not show any adverse trend in performance. There is sufficient confidence that the implementation of the Reactor Head Closure Studs program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Reactor Head Closure Studs program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Reactor Head Closure Studs program provides reasonable assurance that aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.4 Boric Acid Corrosion

Program Description

The Boric Acid Corrosion aging management program is an existing program that manages loss of material on piping, piping elements, heat exchangers, bolting, panels, racks, cabinets and enclosures, insulation jacketing, cable trays, concrete anchors, concrete embedments, manhole covers, conduit, containment liner plate, airlocks, penetration sleeves, component supports, miscellaneous steel, and other structural components; cracking, blistering, flaking, peeling, and delamination of coatings; and corrosion of electrical connector contact surfaces, in an environment of air with borated water leakage. The program includes provisions to identify, inspect, examine and evaluate leakage, and initiate corrective action. The program relies in part on implementation of recommendations contained in NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Components in PWR plants".

Borated water leakage from piping and components that are outside the scope of the program established in response to GL 88-05 may affect structures and components that are subject to aging management review. Therefore, the scope of the monitoring and inspections of this program includes all components that contain borated water that are in proximity to structures and components that are subject to aging management review. Systems and structures inside the containment building, auxiliary building, spent fuel building and inner penetration area are included in the program.

Borated water leakage may be discovered by activities other than those established specifically to detect such leakage; therefore, the program also includes provisions to assess when leakage is discovered via other activities.

Visual examinations by qualified personnel include the identification of the location where the leakage was detected, the leakage sources, and adjacent locations that may be affected by the observed leakage. The examinations for specified areas are performed with insulation or other visual obstructions removed to allow access for examination of bare metal surface.

Evaluations are performed and corrective actions are implemented for inspection results that do not satisfy established provisions of NRC GL 88-05 in accordance with the Salem 10 CFR Part 50, Appendix B corrective action program. The corrective action program ensures that conditions adverse to quality are promptly corrected. If the inspection results are assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence of the boric acid corrosion degradation, as part of the corrective action program. Corrective actions may include changes to operating procedures or modifications to the plant design including the use of corrosion resistant materials or protective coatings. Any detected boric acid deposits or crystal buildup are cleaned.

The Boric Acid Corrosion aging management program establishes the controls and expectations for monitoring reactor coolant leakage and timely repair of detected leakage. Monitoring for boric acid leaks and repairing leaks in a timely manner is used to prevent or mitigate boric acid corrosion. Modifications to prevent or mitigate boric acid corrosion damage also include procedure revisions and the use of corrosion resistant materials or protective coatings. Components and bolted connections that experience repeated boric acid leaks will be considered for replacement in accordance with applicable Technical Specification and ASME Code Section XI requirements. Boric acid examinations inside containment are performed during each refueling outage in accordance with the requirements of NRC GL 88-05. Borated water systems outside of containment are periodically examined in accordance with ASME Section XI. ASME Class 1, 2, and 3 bolted connections are periodically examined in accordance with ASME Section XI. Preventive actions also include the pre-emptive replacement of components susceptible to small boric acid leakage that could result in boric acid degradation of contacted material.

NUREG-1801 Consistency

The Boric Acid Corrosion program is consistent with the ten elements of aging management program XI.M10, Boric Acid Corrosion, specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry operating experience indicates that boric acid leakage can cause significant corrosion damage to susceptible plant structures and components. Boric acid corrosion has been observed in nuclear power plants and has resulted in significant impairment of component intended functions in areas that are difficult to access/observe.

NRC Generic Letter (GL) 88-05 describes several events where the reactor coolant pressure boundary suffered boric acid corrosion caused by small reactor coolant leaks. GL 88-05 includes the events in NRC Information Notice (IN) 86-108 (and supplements 1 through 3). The preventive measures implemented at Salem in response to GL 88-05, including the Boric Acid Corrosion aging management program, are sufficient to prevent repetition of the events described in NRC Information Notice (IN) 86-108 (and supplements 1 through 3).

NRC Bulletin 2002-01 requires licensees to implement reactor pressure vessel head inspections to ensure that degradation of the reactor pressure vessel head would not impact the reactor coolant pressure boundary. The necessary examinations are described in B.2.1.5, Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized

Water Reactors aging management program as well as in the Boric Acid Corrosion aging management program.

Information Notice 2003-02 requires licensees to perform examinations of the RPV lower head penetrations. The RPV lower head penetration examinations performed by Salem are described separately in B.2.2.6, Nickel Alloy aging management program.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Boric Acid Corrosion Program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. On August 7, 1987, a pile of rust-colored boric acid crystals was discovered on the reactor head of Salem Unit 2, and a thin white film of boric acid crystals was found coating several areas of the head and extending up the control rod mechanism housings (IN 86-108, Supplement 2). The source of the boric acid was reactor coolant leakage through three pinholes in the seal weld of the threaded connection (cono-seals) for top-mounted thermocouple instrumentation.

   Nine corrosion pits were found on the reactor vessel head. In the corroded area, actual wall thickness still exceeded the minimum thickness of the head specified by design, and calculations confirmed that the affected areas still met applicable ASME Code requirements. Containment walkdowns determined that this was the only area of significant boric acid corrosion.

   The corrective actions were to clean up the deposits, remove the leaking Cono-seals and cut and cap the top-mounted thermocouple lead penetration nozzles. The top-mounted thermocouples were replaced with thermocouples inside the bottom mounted incore nuclear instrumentation flux thimbles.

   This event provided input into GL 88-05 which mandated that stations develop boric acid corrosion programs.

   This example provides objective evidence that the Boric Acid Corrosion program includes provisions for modifications to plant design to reduce the probability of leaks at locations where they may cause corrosion damage.

2. Leakages (60 dpm) from the 11 RHR Heat Exchanger and brown boron deposits on the floor were discovered at Salem Unit 1 during operator rounds in March 2002. The Boric Acid Corrosion program manager was notified of this issue for evaluation. Boric acid corrosion was found on the bottom flange area and studs and nuts of the heat exchanger. Inspection of the studs and nuts found that the corrosion exceeded 10% of the stud diameter and the nut thickness. The boric acid corrosion on the bottom flange area was determined to be minor after it was cleaned up.

The boric acid that caused the corrosion was reactor coolant leaking out past a failed gasket. The gasket failure was caused by asbestos washing out from the spiral wound gasket over an installed life of 25 years. The gaskets on the RHR heat exchangers were replaced with a gasket of a different design. The carbon steel studs and nuts were replaced with corrosion resistant stainless steel studs and nuts.

When the heat exchanger was placed in service in December 2004 for the first time since the gasket replacement, it developed a leak at 0.5 gpm, which was attributed to inadequate torque during the gasket installation. The studs were re-tightened and the leakage stopped. A root cause evaluation determined that the torquing procedure used on the replacement gasket was inadequate. The gasket manufacturer's requirement for hot retorque had not been adequately communicated.

The initial corrective actions were to remove the boric acid deposits and replace the studs, nuts, and gaskets with a new design. The final corrective action was to correctly torque the studs for the new gasket design including hot retorque. The maintenance procedures were revised to improve the torquing guidance and to state that post maintenance leak testing should be performed at normal operating temperature and pressure and be commensurate with system/component design and/or construction code. Additionally, Engineering personnel were trained on selection of proper engineering design change package types, proper gasket selection, torque calculations, hot retorque requirements and the dangers of inadequate screening and over reliance on vendor expertise. The heat exchanger has not leaked since the completion of the corrective actions. The extent of condition was limited to the 11 RHR Heat Exchanger, because this was the only place where the Flexitallic Kammprofile gasket had been installed.

This example provides objective evidence that when leakage is discovered by activities other than those established specifically to detect boric acid leakage, the Boric Acid Corrosion program is implemented to perform evaluations and assessments. It also provides objective evidence that the Boric Acid Corrosion program includes modifications to plant procedures to reduce the probability of leaks at locations where they may cause corrosion damage.

3. Boric acid residue was observed at Salem Unit 2 on the 21 reactor coolant pump loop flow channel II block valve weld during the boric acid corrosion program walkdowns for a forced shutdown in September 2006. The residue was cleaned and the weld re-inspected two days later with no evidence of residue or leakage present. In October 2006, during the S2R15 refueling outage containment walkdowns, boric acid residue was discovered on the 21 reactor coolant pump loop flow channel II block valve weld and two adjacent lengths of tubing. The boric acid leakage was caused by pitting corrosion and stress corrosion cracking of the weld and tubes. During S2R15 (October 2006), the valve segment and adjacent lengths of tubing of tubing were removed and sent to a hot cell metallurgical laboratory for examination. The examination proved that the

tubing leaks were caused by chloride attack (pitting corrosion and stress corrosion cracking) from the outside. The chloride had been deposited on the tubing outside diameter by service water leakage from the containment fan cooler units above. The root cause was the absence of an implementing procedure to enforce cleanliness requirements for removing contaminants (e.g., chlorides) from components in containment. The affected segments of tubing were replaced and are now leak tight. The following mitigative actions have been implemented:

- Operations developed an implementing procedure for responding to leaks in containment.
- Chemistry revised their procedure to provide clear departmental roles and responsibilities including swiping for chlorides, and clearly define the chloride acceptance criteria for stainless steels.
- Revised chloride contamination limits for exterior surfaces of stainless steels to technically acceptable levels.
- A plant walkdown of other tubing subject to leakage identified an additional five segments that were vulnerable to SCC. Four segments have been replaced and the fifth is being tracked under the corrective action system.

This example provides objective evidence that the Boric Acid Corrosion program provides frequent monitoring of the locations where potential leakage could occur, timely repair if leakage is detected and includes modifications to operating procedures to reduce the probability of leaks at locations where they may cause corrosion damage.

4. Dried boron buildup was discovered at Salem Unit 1 on the outside of the 13 Reactor Coolant Pump (RCP) during the 1R17 outage walkdown in October 2005. Boric acid corrosion products were found on the low alloy carbon steel bolting near the seal assembly. The seal housing area was cleaned and investigated. No degradation was observed. A stud was pulled during the outage and the corrosion was found to be minimal. The RCP seal 3 leaked briefly during startup and settled back in to be leak free after about two hours. An evaluation concluded that the corrosion would be acceptable until the seal is replaced, because the leak is active only two hours with each startup cycle. The boric acid dries quickly when the leak becomes inactive, and the corrosion rate is minimal when the acid is dry. Planned actions include monitoring Seal leak off rate and pump seal replacement. The other reactor coolant pumps have not had similar leaks.

   This example provides objective evidence that the Boric Acid Corrosion program evaluates any detected borated water leakage or crystal buildup to confirm the intended functions of affected structures and components will be maintained consistent with the design basis prior to continued service.

Review of plant operating experience since 2002 shows that 1124 occurrences of boric acid leakage have been identified and dispositioned. Analysis shows no adverse trend. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Boric Acid Corrosion Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Boric Acid Corrosion Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Boric Acid Corrosion program provides reasonable assurance that the aging effects of loss of material are adequately managed so that the intended functions of structures and components within the scope license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.5 Nickel-Alloy Penetration Nozzles Welded To the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors

Program Description

The Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program is an existing program that is part of the Inservice Inspection (ISI) program. The program provides for condition monitoring of nickel-alloy components and welds for the effects of cracking in a reactor coolant environment. The program consists of a combination of periodic bare metal visual inspections of the outer surface of the upper reactor vessel closure head and periodic surface and volumetric examinations of the upper vessel head penetration (VHP) nozzles and associated J-groove welds, for assessment, identification of signs of degradation, and establishment of corrective actions.

Preventive measures for monitoring and maintaining reactor coolant water chemistry to mitigate primary water stress corrosion cracking (PWSCC) are described separately in the B.2.1.2, Water Chemistry aging management program. The reactor coolant water chemistry program is in accordance with EPRI 1014986, the version of EPRI Topical Report TR-105714 on record at Salem.

The reactor heads are visually inspected for boric acid leakage residues at every outage.

The program manages cracking and includes the closure head, upper VHP nozzles, and associated J-groove welds. The nickel alloy closure head components at Salem include control rod drive mechanism (CRDM) nozzles (housing bodies), the vent line nozzle, the reactor vessel instrument line (RVLIS) nozzle and associated J-groove welds. Salem has no control element drive mechanism (CEDM), in core instrumentation (ICI) or thermocouple (TC) nozzles on the closure head. Salem uses CRDMs rather than CEDMs; therefore there are no CEDM nozzles. The in-core instrumentation (ICI) nozzles are mounted on the lower head of the reactor vessel. The thermocouples are inserted through the bottom mounted in-core instrumentation nozzles, therefore there are no TC nozzles. The aging management of the bottom mounted in-core instrumentation nozzles (BMI) is described in the Nickel Alloy aging management program, B.2.2.6. The Salem Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program was developed in compliance with NRC Order EA-03-009. The Salem original closure heads were calculated to have a "Moderate" susceptibility to PWSCC. Salem replaced the Unit 1 closure head in October 2005 and the Unit 2 closure head in April 2005. The upper VHP nozzles on the closure head replacements and the weld filler material for the J-Groove welds are of all PWSCC resistant materials, alloy UNS N06690 for the nozzles and alloy UNS N06052 or UNS W86152 for the J-groove welds. Salem used the manufacturer's inspections for the baseline inspection required under NRC

Order EA-03-009, Rev 1. After the closure head replacement in 2005, the susceptibility category changed to "Replaced" in accordance with NRC Order EA-03-009, Rev 1.

The NRC revoked Order EA-03-009 as the regulatory requirement for closure head inspection, and replaced it with ASME Code Case N-729-1, as modified in 10 CFR 50.55a per 10 CFR 50.55a(g)(6)(ii)(D). The program was modified to comply with the augmented inspection requirements in paragraphs 10 CFR 50.55a(g)(6)(ii)(D). Inspection schedules and frequencies are implemented in accordance with the requirements of 10 CFR 50.55a(g)(6)(ii)(D).

Relevant flaw indications detected as a result of these examinations are evaluated in accordance with ASME Code Case N-729-1, endorsed by the NRC in 10 CFR 50.55a(g)(6)(ii)(D). Relevant flaws will be documented and corrected or dispositioned using the Corrective Action Process.

The frequency of examinations is adequate to prevent significant degradation. The program ensures the structural integrity of the closure head, VHP nozzles, and associated J-groove welds, and the detection of cracking and any loss of material/wastage prior to a loss of intended function. The program includes examinations, and monitoring and trending of results to confirm that aging effects are managed. This condition monitoring program will be effective in detecting the applicable aging effects and the frequency of monitoring will be adequate to prevent significant degradation.

NUREG-1801 Consistency

The Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program is consistent with the ten elements of aging management program XI.M11A, Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors, specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Salem has not detected PWSCC in the VHP nozzles and J-groove welds of its closure heads. Inspections of the closure heads, VHP nozzles and J-groove welds are scheduled in accordance with the requirements of 10 CFR 50.55a(g)(6)(ii)(D).

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program will be effective in assuring that intended functions will be maintained consistent with the CLB for the period of extended operation:

1. In February 2003, Salem began planning to proactively replace the closure heads on both Salem 1 and 2. The replacement heads used materials (Inconel alloy 690 and 52) resistant to PWSCC and fabrication techniques that reduced residual tensile stresses. The replacement would delay the onset of PWSCC in CRDM nozzles, reduce overall future inspection and repair costs, and increase reliability for the period of the current licensed basis and for future license renewal. Additionally, the replacement would reduce the potential for emergent extended forced outage repairs and reduced generation due to CRDM leaks. This decision was based on information from NRC Bulletin 2001-01, NRC Bulletin 2002-01 and SOER 02-04, and information developed in response to those documents. The Salem 2 reactor head was replaced in April 2005. The Salem 1 reactor head was replaced in October 2005.

   This example provides objective evidence that the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program addressed the onset of PWSCC in the closure head VHP nozzles and associated J-groove welds, by replacing the existing closure heads with new ones resistant to PWSCC.

2. In April 2005 Salem ISI personnel discovered that the manufacturer's ultrasonic baseline exams on the Salem 2 reactor vessel replacement head VHP nozzles and their J-groove welds had multiple indications. The exams were performed, for information only, in accordance with the in-service requirements of NRC Order EA-03-009 to identify manufacturing discontinuities so that they can be distinguished from in-service indications during future ultrasonic inspections. Salem ISI personnel found that the report identified 585 indications varying in length from 0.13 inch up to 2.3 inch.

   The indications did not impact the structural aspects of the J-groove weld. Salem had a structural evaluation performed for the indications in the J-groove weld. The analysis verified the ASME Section III requirements for structural integrity were satisfied with the indications, therefore ensuring structural integrity of the Unit 2 reactor head for installation.

   These fabrication indications do not extend to the J-groove weld wetted surface therefore PWSCC is not a concern. The PT examination verified the integrity of the wetted surface of the J-groove weld.

   All J-groove examinations that included acceptance criteria were performed with satisfactory results. These examinations included those required by the replacement closure head assembly specification, the examinations required by ASME Section III, and the PT examinations of the J-groove weld wetted surfaces, recommended by the EPRI Materials Reliability Project (EPRI MRP 2003-013, Pre-Service Inspection Guidance for New Reactor Pressure Vessel Heads, June 26, 2003).

Salem worked with the manufacturer to improve their fabrication techniques. This was effective in reducing the number of indications on the Unit 1 replacement head to 388 compared to 585 on the Unit 2 head. In addition, the total circumferential extent of indication for the Unit 1 worst-case weld was less than that on the Unit 2 worst-case weld. The structural evaluation of the Unit 2 head bounds the indications found on the Unit 1 head, therefore the Unit 1 head was determined to also be acceptable for installation.

This example provides objective evidence that indications are evaluated in accordance with acceptable flaw evaluation criteria and that the corrective action process was used to improve the quality of the second closure head.

3. The NRC amended its regulations 10 CFR 50.55a on 10/10/2008 to incorporate by reference the ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds", with conditions. Once implemented this Code Case supersedes the First Revised NRC Order EA-03-009. Salem has revised the ISI program to comply with this change.

   This example provides objective evidence that the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors aging management program incorporates NRC requirement revisions into the ISI program.

The closure heads were replaced in 2005. The replacement closure head nozzles and the weld filler material for the J-Groove welds are PWSCC resistant materials. Prior to installation, the closure heads passed all state of the art acceptance inspections. A baseline ultrasonic inspection was also performed prior to installation to identify manufacturing discontinuities so that they can be distinguished from in-service indications during future ultrasonic inspections. Ongoing surface and volumetric inspections have been scheduled in accordance with the requirements of 10 CFR 50.55(a), beginning with visual inspections of Salem Unit 2 in October 2009, and Salem Unit 1 in April 2010. The volumetric exams begin on Salem Unit 2 in April 2014 and on Salem Unit 1 in October 2014.

Since the replacement of the closure heads two boric acid leakage inspections have been performed on Unit 1 and two boric acid leakage inspections have been performed on Unit 2. No signs of boric acid leakage residue have been found.

This provides sufficient confidence that the closure heads are in good condition, and that the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program is sufficient to detect any flaws prior to the loss of intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Nickel-Alloy Penetration

Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program provides reasonable assurance that the cracking aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.6 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)

Program Description

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel aging management program is a new program that includes condition monitoring activities to provide assurance that reactor coolant system CASS components susceptible to thermal aging embrittlement meet the intended functions. The reactor coolant system CASS components are maintained by inspecting and evaluating the extent of thermal aging embrittlement in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1998 Edition, 2000 Addenda. The Salem ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is augmented by the implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program which monitors the aging effect of loss of fracture toughness due to thermal aging embrittlement of CASS components.

The Thermal Aging Embrittlement of CASS program will include a screening for components susceptible to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For "potentially susceptible" components, thermal aging embrittlement will be managed through either an enhanced volumetric inspection or a component-specific flaw tolerance evaluation. Additional inspections or evaluations are not required for components that are determined not to be susceptible to thermal aging embrittlement. Screening for CASS components susceptible to thermal aging embrittlement is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481, Alternate Examination Requirements for Cast Austenitic Pump Casings, are adequate for all pump casings and valve bodies. This new program will be implemented prior to the period of extended operation.

The program will provide for either an inspection or a flaw tolerance evaluation of susceptible components; it will not provide guidance on methods to mitigate thermal aging embrittlement. The flaw tolerance evaluation will be based on specific geometry and stress information to verify that the thermally-embrittled material has adequate toughness throughout the period of extended operation.

Inspection schedules for the ASME Section XI program are completed during the inspection interval in accordance with the schedule and extent of Tables IWB-2412-1, and IWC-2412-1. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program plans direct the inspection schedules and the extent of the inspections in the program planning documents, "Salem Unit 1 Nuclear Generating Station Inservice Inspection Program Third 10-Year Interval Long Term Plan", and "Salem Unit 2 Nuclear Generating Station Inservice Inspection Program Third 10-Year Interval Long Term Plan", as required to provide timely detection of cracks.

Flaws detected in reactor coolant system CASS components are evaluated in accordance with the applicable procedures of IWB-3500. Flaw tolerance evaluation for components with ferrite content up to 25% is performed according to the principles associated with IWB-3640 procedures for submerged arc welds (SAW).

Ferrite content is calculated by using the Hull's equivalent factors (described in NUREG/CR-4513, Rev. 1).

Repairs and Replacements are performed in accordance with the 1998 ASME Section XI Code, 2000 addenda, which specify the requirements in IWA-4000, per the Salem ISI program.

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel aging management program is a condition monitoring program whose methods will effectively monitor the applicable aging effects and will be adequate to prevent significant degradation.

NUREG-1801 Consistency

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program is consistent with the ten elements of aging management program XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS), specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Research data on both laboratory-aged and service-aged materials has confirmed that loss of fracture toughness could occur in some reactor coolant system components. Furthermore, a search of industry operating experience found one cracking issue in 1984 involving cast austenitic stainless steel where the cause was likely related to thermal aging embrittlement . This event is discussed below.

The thermal aging embrittlement condition was first discovered in 1984. During investigation, an impeller vane was found with cracking. The condition was found in all four reactor coolant pumps, which had been in service since 1971 (~535°F cold leg temperature), two of which had lost parts from the impeller. Plant personnel began a pump rebuild project in 2000 and recently (April 2009) completed rebuilding the last pump. Again, impeller vane pieces were found missing. This was expected since the parts were found in the bottom of the reactor during their 2007 outage. Two other pumps were rebuilt in the early 2000's, and their vanes were also found with cracks but no missing parts of the impeller. The areas of cracking showed evidence of vane weld repair discrepancies during fabrication. Due to the hardness of the impellers, the vanes were difficult to decontaminate. This increased hardness was an indication of decreased ductility and increased embrittlement. No material tests of the impeller material were performed to evaluate their ductility. This operating experience demonstrates the possibility of CASS embrittlement due to thermal aging.

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel is a new program to be implemented prior to the period of extended operation. Therefore there is no existing site specific operating experience to validate the effectiveness of this program at Salem. The program is based on the program description in NUREG-1801, which in turn is based on industry operating experience. As such, operating experience assures that implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program will manage the effects of aging such that applicable components will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation.

There is sufficient confidence that the implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will effectively evaluate CASS components and identify degradation prior to failure through the continued effectiveness of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will be performed to identify the areas needing improvement to maintain the quality performance of the program.

Conclusion

The new Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program will provide reasonable assurance that the loss of fracture toughness aging effect will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.7 PWR Vessel Internals

Program Description

Salem commits to the following activities for the new PWR Vessel Internals aging management program:

1. Participate in the industry programs for investigating and managing aging effects on reactor internals.

2. Evaluate and implement the results of the industry programs as applicable to the reactor internals.

3. Upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

Conclusion

The new PWR Vessel Internals aging management program will provide reasonable assurance that the changes in dimensions, cracking, loss of fracture toughness, and loss of preload aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.8 Flow Accelerated Corrosion

Program Description

The Flow-Accelerated Corrosion (FAC) aging management program at Salem is an existing program that is based on EPRI guidelines in NSAC-202L-R3, "Recommendations for an Effective Flow Accelerated Corrosion Program." The program provides for predicting, detecting, and monitoring wall thinning in piping and fittings, valve bodies, and heat exchangers due to FAC in closed cycle cooling water, steam and treated water environments.

Analytical evaluations and periodic examinations of locations that are most susceptible to wall thinning due to FAC are used to predict the amount of wall thinning in pipes and fittings, and feedwater heater shells. Program activities include analyses to determine critical locations, baseline inspections to determine the extent of thinning at these critical locations, and follow-up inspections to confirm the predictions. Inspections are performed using ultrasonic, visual or other approved testing techniques capable of detecting wall thinning. Repairs and replacements are performed as necessary.

Where applicable, analyses to determine critical locations in piping and other components susceptible to FAC is performed utilizing CHECWORKS, a predictive code that uses the implementation guidance of NSAC-202L-R3 to satisfy the criteria specified in 10 CFR Part 50, Appendix B for development of procedures and control of special processes. For each examined component, a verified and validated PC-based computer program, called FAC Manager, is utilized in conjunction with CHECWORKS to calculate component wear, wear rate, projected thickness, and remaining life. If a component's remaining life cannot be demonstrated to be more than one operating cycle, then corrective action is required, such as repair, replacement, or reevaluation.

No preventive or mitigative attributes are directly associated with the FAC program. However, it is recognized that monitoring of water chemistry to control pH and dissolved oxygen content is effective in reducing FAC. The program considers water treatment changes that may affect the FAC rates (e.g., water treatment amines, hydrogen water chemistry, hydrazine addition, or any other change that affects the pH or dissolved oxygen concentration).

The FAC program, which was originally outlined in NUREG-1344, is implemented as required by NRC Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning". NUREG-1801 specifies in XI.M17 that the program relies on implementation of the Electric Power Research Institute (EPRI) guidelines in the Nuclear Safety Analysis Center (NSAC)-202L-R2 for an effective FAC program. As noted above, the FAC program is based on the EPRI guidelines in NSAC-202L, R3, "Recommendations for an Effective Flow-Accelerated Corrosion program."

NUREG-1801 Consistency

The Flow-Accelerated Corrosion aging management program is consistent with the ten elements of aging program XI.M17, "Flow-Accelerated Corrosion," specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 *specifies in* XI.M17 *that the program relies on* implementation of the Electric Power Research Institute (EPRI) guidelines in the Nuclear Safety Analysis Center (NSAC)-202L-R2 (EPRI 1011838) for an effective FAC program. The Salem FAC Program is based on the EPRI guidelines found in NSAC-202L-R3. **Program Elements Affected: Scope of Program (Element 1) and Detection of Aging Effect (Element 4).**

Justification for Exception

The sections of NSAC-202L associated with the program elements were reviewed to show that Revision 2 and 3 of the guidelines are equivalent with one main difference: Revision 3 allows an additional method for determining the wear of piping components from UT inspection. This method is called the Averaged Band Method. This method is a derivation of the Band Method and builds upon the years of experience with the Band Method, which remains an option in NSAC-202L-R3 for determining the wear of piping components from UT inspection. As explained in NSAC-202L-R3, overly conservative methods, such as Band Method, can lead to unnecessary inspections or re-inspections. The Averaged Band Method provides a more realistic estimate of piping wear than the Band Method.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that wall thinning due to flow-accelerated corrosion is being adequately managed. The following examples of operating experience provide objective evidence that the Flow-Accelerated Corrosion program will be effective in assuring that intended function(s) would be maintained consistent with the CLB for the period of extended operation:

1. In response to industry events OE 9941 and OE 9632, both in 1999, which document wall thinning in feedwater heater shells due to flow-accelerated corrosion, Salem proactively inspected a sampling of High Pressure (HP) and Low Pressure (LP) feedwater heater shells, and subsequently had to replace the Salem Unit 1 (#15A, B & C) feedwater heater shell sections with in kind material during the 1R13 refueling outage in the Fall of 1999. Salem issued OE11020 to document the findings. At Salem Unit 2, the #25A, B, & C feedwater heater shell sections were replaced with upgraded FAC resistant stainless steel clad shell sections during the 2R11 refueling outage in 2000, as a planned replacement. Additionally, during Salem

Unit 1 refueling outages in 2004 and 2005, engineering follow-up evaluation of flow-accelerated corrosion program UT data information indicated that the shell wall thickness of the #15A feedwater heater in the areas around both south and north bleed steam inlet nozzles would remain above the FAC minimum criteria through 2008, but may not meet their minimum required thickness requirements thereafter. The corrective actions for Salem Unit 1's #15A, B & C Feedwater heater shell sections for the areas around both bleed steam inlet nozzles involved replacing the plate section around the nozzles with FAC resistant stainless steel cladding in 2008 during the 1R19 Outage.

Continuous monitoring of the feedwater heater shells at Salem Units 1 and 2 has been ongoing since they were first identified as being susceptible to wall thinning due to flow-accelerated corrosion. No wall thinning has been identified since upgrade of feedwater heater shell materials was implemented on Salem Unit 1 and Unit 2.

Salem was one of the first plants to inspect its feedwater heater shells in 1999 after learning of the industry experience with wall thinning. Salem Unit 1 was also one of the first plants to perform the shell section replacement "window" after the discovery of FAC damage to the heater shell. In addition to documenting the feedwater heater shell section inspection and replacement in OE 11020, this information was presented as part of the industry sharing at the January 2003 EPRI CHECWORKS User's Group Meeting in explicit detail.

This example provides objective evidence that the FAC aging management program effectively monitors and trends the aging effects of FAC on piping and components. In addition the program takes corrective actions prior to loss of function, and industry operating experience is being used to improve program implementation.

2. UT inspections in support of the flow-accelerated corrosion program scope during the Salem Unit 1 1R19 refueling outage in 2008, identified the need to replace a 3-inch diameter pipe bend and two elbows in the moisture separator and reheater (MSR) drains system going to the 16B feedwater heater. The component was selected for inspection based on CHECWORKS results. The need for replacement of this 3 inch pipe was further increased because of identification of external corrosion, whose informational UT examination identified that its thickness in this area was close to minimum wall. UT data review and evaluation was performed in accordance with the FAC program procedure. Corrective actions completed as a result of the analyses of this event identified internal pipe wall thinning to be caused by FAC over the course of this component's life, whereas the external corrosion was due to a leaking boot in the roof penetration directly above the subject bend. This section of the pipe, including a 3-inch diameter pipe bend and two elbows, which were made of carbon steel were replaced with upgraded FAC resistant Chromium-Molybdenum components during the Salem Unit 1 refueling outage in 2008. Similar work was performed on a parallel line going to the 16A feedwater heater for Salem Unit 1 in 2005 during the 1R17 refueling outage. The parallel trains at Salem Unit 2 have also been examined and no FAC related problems have been identified.

This example provides objective evidence that the FAC program uses effective predictive tools to monitor and trend susceptible piping and components, and takes timely corrective actions to prevent recurrence and address extent of condition.

3. Based on engineering evaluation of flow-accelerated corrosion program UT data obtained during refueling outages 1R16 and 1R17 in 2004 and 2005, the wall thickness of carbon steel piping in the area upstream of a Salem Unit 1 BF19 steam generator feedwater control valve was determined to reach its minimum design criteria during Cycle 19. As a result of this engineering evaluation a plan was developed to correct the wall thinning sections of the carbon steel piping during the 2006 Salem Unit 1 refueling outage (1R18). The corrective action involved replacement of the 14" x 12" reducer, 4" x 14" weldolet and approximately 4 ft of carbon steel piping upstream of the 11BF19 steam generator feedwater control valve with piping made of Chromium-Molybdenum material, which is FAC resistant. The inspections and evaluations were evaluated in accordance with the FAC program detailed procedures.

   The similar locations on the Salem Unit 2 BF19 steam generator feedwater control valves were also replaced. The original material used on the reducer, pipe and weldolet was carbon steel. No problem has been identified since this material replacement was completed on both units.

   This example provides objective evidence that the inspection activities built into the FAC program are effective in identification of susceptible locations and that the FAC program takes effective corrective measures prior to loss of intended function.

The operating experience of the Flow-Accelerated Corrosion program shows that the program effectively monitors and trends the aging effects of FAC on piping and components and takes appropriate corrective action prior to loss of intended function. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken. There is sufficient confidence that the implementation of the Flow-Accelerated Corrosion program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Flow-Accelerated Corrosion program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Flow-Accelerated Corrosion aging management program provides reasonable assurance that wall thinning aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.9 Bolting Integrity

Program Description

The Bolting Integrity aging management program is an existing program that provides for condition monitoring of pressure retaining bolted joints within the scope of license renewal. The Bolting Integrity program incorporates NRC and industry recommendations delineated in NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," EPRI TR-104213, "Bolted Joint Maintenance & Applications Guide," and EPRI NP 5769, "Degradation and Failure of Bolting in Nuclear Power Plants," as part of the comprehensive corporate component pressure retaining bolting program. The program provides for managing cracking, loss of material and loss of preload by performing visual inspections for pressure retaining bolted joint leakage in the following environments: air, raw water and soil.

The Salem ISI program plan tables provide the examination category and description as identified in ASME Section XI, Table IWB-2500-1 for Class 1 components, Table IWC-2500-1 for Class 2 components, and Table IWD-2500-1 for Class 3 components.

Examinations are currently performed in accordance with the ASME Section XI, 1998 edition up through and including 2000 addenda for Salem 1 and 2 per the Salem ISI program plans. Examinations for the period of extended operation will be in accordance with the appropriate code edition and addenda for the Salem ISI Program Plan. In accordance with 10 CFR 50.55a(g)(4)(ii), the program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval. The extent and schedule of the inspections is in accordance with IWB-2500-1, IWC-2500-1 and IWD-2500-1 and assures that detection of leakage or fastener degradation will occur prior to loss of system or component intended functions. Bolting associated with Class 1 vessel, valve and pump flanged joints receive VT-1 inspection. For other pressure retaining bolting, routine observations will document any leakage before the leakage becomes excessive.

The integrity of non-ASME Class 1, 2 and 3 system and component bolted joints, other than containment, is evaluated by detection of visible leakage during maintenance or routine observation such as system walkdowns. Containment pressure retaining bolting is monitored using the ASME Section XI, Subsection IWE, B.2.1.28, aging management program.

High strength bolting material with actual yield strength ≥ 150 ksi is used for NSSS Class 1 component supports. The bolts are installed in sliding connections, with no preload to allow for thermal movements. Aging management review determined that stress corrosion cracking (SCC) is not an applicable aging effect/mechanism since the bolts are not subject to high sustained tensile stress. The applicable aging effects are managed as part of the ASME Section XI, Subsection IWF, B.2.1.30, aging management program.

Procurement controls and installation practices, defined in plant procedures, ensure that only approved lubricants, sealants, and proper torque are applied. The activities are implemented through station procedures.

Other aging management programs also manage inspection of bolting and supplement this bolting integrity program. The ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD, B.2.1.1, aging management program manages the inspection of safety-related bolting and supplements this bolting integrity program. The ASME Section XI, Subsection IWF, B.2.1.30, aging management program addresses aging management of ASME Section Class 1, 2 & 3 piping and component support bolting. The ASME Section XI, Subsection IWE, B.2.1.28, aging management program addresses aging management of containment pressure retaining bolting. Other structural bolting is managed as part of the Structures Monitoring Program, B.2.1.33. The aging management of crane and hoist bolting is addressed by the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems, B.2.1.13, aging management program. Aging Management of heating and ventilation bolted joints is addressed by the External Surfaces Monitoring, B.2.1.24, aging management program. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring has been adequate to prevent significant degradation. Inspection activities for bolting in a buried environment are performed in conjunction with buried piping and component inspections as part of the Buried Piping Inspection, B.2.1.22, aging management program or the plant specific Buried Non-Steel Piping Inspection, B.2.2.4, aging management program.

Class 1, 2 and 3 bolted joint repair falls within the scope of the ASME Section XI Repair and Replacement Program. Flanged joint welding repairs are implemented in accordance with IWA-4000. Pressure bolting replacements are implemented in accordance with IWA-7000. Other pressure retaining bolting maintenance evaluations and repairs follow the EPRI bolting guidelines for the evaluation and repair of the flanges and replacement bolts. The ASME Section XI, Subsection IWF, B.2.1.30, program addresses replacement of NSSS component support bolting. Corrective actions are addressed in accordance with 10 CFR Part 50, Appendix B.

The Bolting Integrity program will be enhanced, as noted below, to provide reasonable assurance that the aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Bolting Integrity aging management program is an existing program that is consistent with the ten elements of aging management program XI.M18, Bolting Integrity specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 indicates that if a bolted connection for pressure retaining components (not covered by ASME Section XI) is reported to be leaking, then it may be inspected daily. If the leak rate does not increase, the inspection frequency may be decreased to biweekly or weekly. Salem uses the Corrective Action Program to determine an appropriate inspection frequency for identified leaks in bolted connections. **Program Elements Affected: Monitoring and Trending (Element 5)**

Justification for Exception

For periodic inspection of bolting, other than ASME Class 1, 2 or 3 bolting, Salem uses the Corrective Action Program to document and manage those locations where leakage was identified during routine observations including engineering walkdowns and equipment maintenance activities. Based on the severity of the leak and the potential to impact plant operations, nuclear or industrial safety, a leak will be repaired immediately, scheduled for repair, or monitored for change. If the leak rate changes (increases, decreases or stops), the monitoring frequency is re-evaluated and may be revised. Salem operating experience has not indicated a need for a set frequency (e.g., daily) of leakage inspections involving bolting.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program element:

1. The existing program will be enhanced to state that the following bolting material should not be reused:

    a. Galvanized bolts and nuts

    b. ASTM A490 bolts

    c. Any bolt and nut tightened by the turn of nut method.

    Program Elements Affected: Corrective Actions (Element 7).

Operating Experience

Salem has experienced isolated cases of bolt corrosion, loss of bolt preload and bolt torquing issues. In all cases, the existing inspection and testing methodologies have discovered the deficiencies and corrective actions were implemented prior to loss of system or component intended functions.

1. In 2005, a notification was issued to evaluate the torque procedure and resulting gasket preload to determine if this was the cause of leaks in the plant requiring equipment outage or leak repair to correct. A previous change in gasket design, from asbestos to non-asbestos replacement gaskets, was determined to be the cause for failures. The non-asbestos replacement gaskets such as Garlock 3400 and G9900 require higher seating stresses to obtain an adequate seal. Action was taken to incorporate EPRI bolting practices into the applicable procedures, and the bolt torquing procedure was revised. This example provides objective evidence that the corrective action process was used to determine the cause of leaking bolted joints, and implemented the necessary procedure changes to improve the program.
2. In 2006, while performing the tagging release on a service water pump and strainer tag out, an operator found a stud broken off the strainer bonnet. In addition, broken aluminum bronze studs were found on the service water strainer. The investigation into the failure of the bolts found that the cause of the failure was packing leakage of brackish water onto the aluminum bronze bolting. A strainer inspection on both units every 3 years was created to preclude future failures. This example provides objective evidence that the corrective action process was used to determine the cause of the failed bolting, and implement an appropriate monitoring program to preclude additional failures.
3. During an 89-13 inspection of the Safety Injection (SI) pump lube oil cooler in 2004, all eight studs on one of the heat exchanger end bells were found corroded and required replacement. The failure was caused by corrosion due to service water leaking onto the carbon steel end bell bolting. Carbon steel bolting in contact with the titanium tubesheet and the 316 stainless steel end bell caused a severe galvanic cell when it became wetted from service water leakage. A walkdown identified evidence of previous leakage on the SI lube oil cooler. All oil coolers (on both units) were subsequently inspected. Only one additional cooler was found to have a leak that was inactive. All studs on both end bells were replaced in-kind. Integrity of the bolts can be controlled through proper maintenance and regular inspection as evident in the previous inspection results. This example provides objective evidence that existing programs and maintenance practices identify degraded bolting prior to loss of component intended function. Corrective actions are taken, including identification of the cause and replacement of the degraded components.
4. In 2006, during a system walkdown, it was noted that the Number 11 RHR heat exchanger developed a leak. The leakage was observed after an increase in heat exchanger temperature during system startup. A notification was initiated in accordance with the corrective action process. The problem was determined to be a gasket replacement performed during the previous outage. Specifically, the gasket vendor did not provide instructions to perform hot re-torquing during the startup. The vendor's recommendations were incorporated into maintenance and operating procedures, and no similar problems have since been observed. This example provides objective evidence that walkdowns are effective in detecting degraded bolted connections, before loss of function, and that

the corrective action process is effectively used to identify and correct deficiencies.

The operating experience of the Bolting Integrity program demonstrates that the problems identified do not impact intended function, and adequate corrective actions are taken to prevent recurrence. There is sufficient confidence that the implementation of the Bolting Integrity program will effectively identify degradation prior to loss of intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Bolting Integrity program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Bolting Integrity aging management program will provide reasonable assurance that the identified aging affects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.10 Steam Generator Tube Integrity

Program Description

The Steam Generator Tube Integrity aging management program is an existing program that provides for managing aging of the steam generators, including the tubes, plugs, and tube support plates in reactor coolant or treated water environments. Salem does not currently use tube sleeving repair methods. If the Salem were to implement sleeving repair methods in the future, a Technical Specification change would be required and the sleeving would be implemented in the Steam Generator Tube Integrity program.

The Steam Generator Tube Integrity program provides for the operation, maintenance, testing, inspection and repair of the steam generators to ensure that Technical Specification surveillance requirements, ASME Code requirements and the Maintenance Rule performance criteria are met. Aging effects include cracking, loss of material, reduction of heat transfer and wall thinning. The dominant degradation mode at this time for thermally treated alloy 600 (Salem Unit 1) and 690 (Salem Unit 2) steam generator tubes is wear.

The Steam Generator Tube Integrity program identifies and maintains the steam generator design and licensing bases. The program implements NEI 97-06. NEI 97-06 establishes a framework for prevention, inspection, evaluation, repair and leakage monitoring measures. The program includes preventive measures to mitigate degradation related to corrosion phenomena, assessment of degradation mechanisms, inservice inspection (ISI) of steam generator tubes, plugs, and tube supports to detect degradation, evaluation, and plugging or repair, as needed, and leakage monitoring to maintain the structural and leakage integrity of the pressure boundary. Operational leakage limits are included to ensure that, should substantial tube leakage develop, prompt action is taken. These limits are included in plant technical specifications. Tube inspection scope and frequency, plugging or repair, and leakage monitoring are in accordance with plant technical specifications and the program implemented in accordance with NEI 97-06.

The Steam Generator Tube Integrity program includes preventive measures to mitigate degradation related to corrosion phenomena through foreign material exclusion as a means to inhibit wear degradation and water chemistry control. Salem monitors and controls reactor water chemistry and secondary water chemistry consistent with the latest EPRI guidelines applicable to reactor water chemistry and secondary water chemistry, and the implementing plant procedures. Salem implements foreign material exclusion via plant procedures, including those activities related to steam generator inspection and maintenance; thereby providing a means to inhibit wear degradation to the tubing.

The Steam Generator Tube Integrity program detects flaws in tubing, plugs, and degradation of tube supports needed to maintain tube integrity. Nondestructive examination (NDE) techniques are used to inspect all tubing materials to identify tubes with degradation that may need to be removed from service or repaired in accordance with plant technical specifications. The program provides criteria for the qualification of personnel, specific techniques, and the associated acquisition and analysis of data, including procedures, probe selection, analysis protocols, and reporting criteria. Assessment of tube integrity and plugging or repair criteria of flawed tubes is in accordance with plant technical specifications and the program implementing procedures. Compliance with NRC Regulatory Guide 1.121 for plugging or repairing steam generator tubes is achieved through implementation of the NEI 97-06 criteria as incorporated into the program and plant technical specifications. Degraded plugs and tube supports are evaluated for corrective actions in accordance with the Salem Corrective Action Program and the Salem Steam Generator Tube Integrity program. Condition monitoring assessments are performed to determine whether structural and accident leakage criteria have been satisfied. Operational assessments are performed after inspections to verify that structural and leakage integrity will be maintained for the operating interval between inspections, which is selected in accordance with the technical specifications and NEI 97-06 guidelines. Comparison of the results of the condition monitoring assessment with the predictions of the previous operational assessment provides feedback for evaluation of the adequacy of the operational assessment and additional insights that can be incorporated into the next operational assessment.

The 10 CFR Part 50, Appendix B corrective action process ensures that conditions adverse to quality are corrected in a timely manner. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to prevent recurrence and address extent of condition.

The Steam Generator Tube Integrity program is consistent with Regulatory Guide 1.121, NUREG-1431, Generic Letter 97-06, Generic Letter 95-05, NEI 97-06, and EPRI documents 1008219, 1014983, 1012987, 1014986, 1008224, and 1009933.

NUREG-1801 Consistency

The Steam Generator Tube Integrity aging management program is consistent with the ten elements of aging management program XI.M19, Steam Generator Tube Integrity, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that the stress corrosion cracking, loss of material, and reduction of heat transfer are being adequately managed. The following examples of operating experience provide objective evidence that the Steam Generator Tube Integrity program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The Unit 1 Westinghouse Model 51 steam generators (Inconel 600 mill-annealed tubes) were replaced with Westinghouse Model F steam generators (Inconel 600 thermally-treated tubes) in 1996. As required by the Steam Generator Tube Integrity Program (SGTIP), a Degradation Assessment (DA) was performed for the replacement steam generators prior to the Fall 2002 refueling outage. This DA, documented in a Salem engineering evaluation, delineated the scope of examination, the inspection techniques, and the sizing performance parameters. The proposed Eddy Current Testing (ECT) techniques used were EPRI-qualified techniques that were site-validated in accordance with site validation documents, thus qualifying their use at the Salem Unit 1 during the Fall 2002 refueling outage.

   The condition monitoring and operational assessment evaluation provided the ECT examination results, in addition to the review of the data in terms of the number of tubes plugged, the ongoing cumulative number of plugged tubes, and the mode of degradation for each of the four replacement steam generators. There has been three operating cycles for the Unit 1 replacement steam generators. The tube plugging data shows that the total number of plugged tubes for all four steam generators was 33, and the cumulative plugging percentage was 0.404%.

   The primary mode of degradation found was anti-vibration bar (AVB) wear. There were no indications as a result of Intergranular Attack/Stress Corrosion Cracking (IGA/SCC). Tube repairs (plugging) were performed in accordance with the criteria established in the SGTIP. The Fall 2002 refueling outage activities related to steam generator tube inspection had also incorporated operating experience (OE) from the Seabrook Station (OE13898) into the inspections that specifically looked for an eddy current signal "signature" representative of degraded tubes at Seabrook. No similar eddy current signal signatures were found during the Fall 2002 refueling outage.

   A separate report following the 2004 outage indicated that the estimated steam generator deposit ingress (sludge) has been decreasing per cycle since the replacement of the steam generators in 1996. For example, the estimated sludge accumulation for all four steam generators in the fourth cycle following replacement was 1,086 lbs as compared to 2,677 lbs estimated in the first cycle following replacement.

   This example provides objective evidence that the Steam Generator Tube

Integrity program will be capable of both monitoring and detecting of aging effects associated with the steam generator tubes, and that future industry operating experience will be incorporated as applicable to identify degradation modes that have occurred at other plants.

2. Salem Unit 2 replaced their Westinghouse Model 51 steam generators (Inconel 600 mill-annealed tubes) with AREVA 61/19T steam generators (Inconel 690 thermally-treated tubes) during the Spring 2008 refueling outage. This decision was made based on industry and Salem experience with tube degradation and the Salem condition monitoring program results.

   The materials of construction for the replacement steam generators have better resistance to aging effects than those in the original steam generators. Examples include the use of Inconel 690 thermally-treated tubes in the replacement steam generators as compared to the Inconel 600 mill-annealed tubes of the original steam generators. Also, the tube support plates and anti-vibration bars in the replacement steam generators are made of stainless steel as compared to the carbon steel components in the original steam generators.

   This example provides objective evidence that the Steam Generator Tube Integrity program will be capable of continuously evaluating the materials of construction of the steam generators, based on operating experience, to select materials that provide better performance against aging effects.

3. As required by the Salem Steam Generator Tube Integrity Program (SGTIP), secondary side inspections and maintenance activities were performed during the Spring 2004 Unit 1 refueling outage. Water lancing was performed on all four steam generators that collectively removed 64.5 pounds of sludge from the steam generators. A foreign object search and recovery activity was performed as required by the SGTIP, and removed several loose parts. Upper secondary side inspections of the steam drum component found no signs of erosion, corrosion, or structural defects. This example provides objective evidence that the Steam Generator Tube Integrity program will be capable of implementing preventive measures to inhibit wear degradation (from foreign material) and monitoring of secondary side components for erosion, corrosion, or structural defects.

There is sufficient confidence that the implementation of the Steam Generator Tube Integrity program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Steam Generator Tube Integrity program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Steam Generator Tube Integrity program provides reasonable assurance that stress corrosion cracking, loss of material, and reduction of heat transfer aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.11 Open-Cycle Cooling Water System

Program Description

The Salem Open-Cycle Cooling Water System aging management program is an existing program that includes mitigative, performance-monitoring, and condition-monitoring activities to manage the internal corrosion of piping to minimize susceptibility of corrosion and to verify that corrosion has not exceeded acceptance limits. More than one type of aging management program is necessary to ultimately ensure that the aging effects are adequately managed and the intended function(s) are maintained for the extended period of operation. These activities provide assurance that cracking, loss of material, increase in porosity and permeability, loss of strength, hardening and reduction of heat transfer aging effects are maintained at acceptable levels for systems and components within the scope of license renewal.

The GL 89-13 activities provide for management of aging effects in raw water cooling systems through tests and inspections per the guidelines of NRC Generic Letter 89-13. System and component testing, visual inspections, non-destructive examination (e.g., RT-Radiographic Testing, UT-Ultrasonic Testing, and/or ECT-Eddy Current Testing), and sodium hypochlorite injection are conducted to ensure that aging effects are managed such that system and component intended functions and integrity are maintained. Major component types include pumps, piping, piping elements, piping components, heat exchangers, and tanks.

The Salem Open-Cycle Cooling Water System (OCCWS) aging management program primarily consists of station GL 89-13 activities that include sodium hypochlorite injection, system testing, periodic inspections and non-destructive examination. The program includes surveillance and control techniques to manage aging effects caused by bio-fouling, corrosion, erosion, protective coating failures, and silting in the OCCW system or structures and components serviced by the OCCW system. Other activities include station maintenance inspections, component preventive maintenance, plant surveillance testing, and inspections. These activities provide for management of cracking, loss of material (without credit for protective coatings) and reduction of heat transfer (including fouling from biological, corrosion product, and external sources) aging effects where applicable in system components exposed to a raw water environment.

Corporate and station procedures provide instructions and controls for mitigative actions through raw water chemistry control (sodium hypochlorite injection), performance-monitoring through station testing, and condition-monitoring through inspection and testing of Salem raw water systems in the scope of license renewal. These methods and associated frequencies are effective in detecting the applicable aging effects and adequate to prevent significant degradation.

OCCWS aging management program testing and inspections at Salem have detected cracking, material loss, and heat transfer reduction aging effects in raw water system components prior to loss of system intended functions. GL 89-13 program assessments have been performed and corrective actions have been implemented.

For heat exchangers, an aging management program that uses multiple attributes is considered necessary to effectively address all aging effects. These aging management program activities provide input into a total program that includes primary and secondary operating fluid chemistry controls, performance monitoring and inspections of all heat exchangers in the scope of license renewal at Salem to manage cracking, material loss, and heat transfer reduction aging effects where applicable.

Inspection scope, method (e.g., visual or nondestructive examination [NDE]), and testing frequencies are in accordance with the commitments under NRC GL 89-13.

Evaluations are performed for test or inspection results that do not satisfy established criteria and a corrective action report is initiated in accordance with the corrective action process to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action process ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the problem is determined and an action plan is developed to prevent recurrence.

NUREG-1801 Consistency

The Open-Cycle Cooling Water System aging management program is consistent with the ten elements of aging management program XI.M20, Open-Cycle Cooling Water System, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Some microbiologically-influenced corrosion, failure of protective coatings, and fouling has been observed in a number of heat exchangers since the beginning of unit operation. The guidance of NRC GL 89-13 has been implemented for approximately twenty years and has been effective in managing aging effects due to bio-fouling, corrosion, erosion, protective coating failures, and silting in structures and components serviced by OCCW systems. Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling, reduction of heat transfer due to fouling, cracking and expansion due to reaction with aggregates, cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide are being adequately managed. The following examples of operating experience provide objective evidence that the Open-Cycle Cooling Water System program will be effective in assuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

1. In 1989, the Service Water Improvement project began the replacement of most of the safety-related carbon steel piping with 6% molybdenum stainless steel. This project resolved several recurrent problems with leaks on the system. Additionally, Salem initiated a program of continuous sodium hypochlorite injection of the Service Water System to ensure that the macro-fouling that occurred in the early years of operation was virtually eliminated. The safety-related heat exchangers tube bundles also were changed out with different material as follows:

    - Auxiliary Building Ventilation room cooler tubes were replaced with 6% molybdenum stainless steel.
    - Component Cooling heat exchanger tubes were replaced with titanium.
    - Containment Fan Cooling Unit tubes were replaced with 6% molybdenum stainless steel.
    - Chiller Condenser, Emergency Diesel Generator jacket water and lube oil unit tube bundles were replaced with titanium.
    - Diesel Generator heat exchanger tubes were replaced with titanium tubes.
    - ECCS Pump lube oil heat exchangers were replaced with titanium coolers.

    The tube sheets on the Auxiliary Building Ventilation room coolers, Component Cooling heat exchanger, and the Containment Fan Cooling Units were coated with epoxy to minimize the corrosion on these components. Salem has also upgraded the material for other component types (valve, orifice, etc.) in the Service Water System. This operating experience example provides objective evidence that the Open-Cycle Cooling Water program is detecting and taking effective corrective action ensuring the long-term reliability of the system for the period of extended operation.

2. In November 2001, the Salem unit operators discovered an underground Service Water leak outside the east side of the Service Water Intake. Further investigation of the problem determined that a joint on the Unit 1 Service Water nuclear header 12 had started leaking due to a crack in the

steel ring of the bell and spigot joint, which was apparently due to corrosion of the carbon steel and loads on the piping from the roadway. This buried piping (reinforced concrete) is constructed of pre-stressed carbon steel with an internal concrete lining and external concrete coating. The carbon steel was initially designed with caulking in the bell-and-spigot joint to protect the metal from the raw water. The apparent cause evaluation determined that over the years the caulking was displaced from the joint and exposed the carbon steel to the service water. This joint was repaired by the installation of a WEKO (elastomer) seal. This repair was initially evaluated for the short term and eventually determined to be the best long-term solution. An extent of condition was performed for Unit 2 on the other safety-related and on the non safety-related Service Water headers, as well as, the Hope Creek Service Water System.

Design change modifications were made to the Service Water System to install WEKO seals on each of the joints for the inlet nuclear headers. These modifications have been completed on the 12, 21, and 22 Service Water nuclear headers, and 11 Service Water nuclear header is scheduled for completion in Spring 2010. During the interim period, in addition to the visual inspection of the piping joints and concrete lining of the Service Water System, Broadband Electromagnetic (BEM) technology has been used to inspect the carbon steel pipe. Recurring maintenance items have been established to inspect the joints on the nuclear headers in conjunction with the piping inspections at a frequency of every other outage.

This operating experience example provides objective evidence that the Open-Cycle Cooling Water program identifies deficiencies associated with Open-Cycle Cooling Water systems and takes effective corrective action to correct problems that challenge the long-term operability and reliability of the system.

3. In April 2005, Maintenance technicians were performing an 89-13 inspection on the 22 Component Cooling heat exchanger, and determined that copper-nickel lining on the heat exchanger end cover had decreased from 0.125 inches to 0.107 inches at some locations. This degradation of the copper-nickel lining was due to the erosion of the soft material over time. The lining was subsequently repaired during the refueling outage and the other applicable component cooling heat exchangers on both units were examined for a similar problem. The end covers on the other heat exchangers also exhibited a similar problem with the lining. The covers on these heat exchangers were repaired during the refueling outage. These covers are now inspected during the component cooling heat exchanger inspections every other outage.

   This operating experience example provides objective evidence that the Open-Cycle Cooling Water program is effective in monitoring the condition of the equipment and in correcting deficiencies discovered during the Open-Cycle Cooling Water program activities through the corrective action process.

Modifications to the Open-Cycle Cooling Water System as part of the Service Water Improvement project, completed in the 1990s, included replacement of most safety-related carbon steel piping with 6% molybdenum stainless steel, replacement of the copper alloy tube bundles with titanium tube bundles, and replacement of the other material heat exchanger tube bundles with 6% molybdenum stainless steel tube bundles. Similarly, the safety-related carbon steel and regular stainless steel valves are being replaced on a programmatic basis with the 6% molybdenum stainless steel valves. A review of the operating experience of the Open-Cycle Cooling Water program since the completion of the Service Water Improvement project and the implementation of the NRC Regulatory Guide 89-13 guidance shows that the Open-Cycle Cooling Water System has performed well. While individual problems, such as, those discussed above, have been identified, the problems identified would not cause significant impact on the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Open-Cycle Cooling Water System program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Open-Cycle Cooling Water System program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Open-Cycle Cooling Water System program provides reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.12 Closed-Cycle Cooling Water System

Program Description

The Closed-Cycle Cooling Water System aging management program is an existing program that provides for managing aging of piping, piping components, piping elements and heat exchangers that are included in the scope of license renewal for cracking, loss of material and reduction of heat transfer and are exposed to a closed cooling water environment.

The program provides for mitigation, performance monitoring, and condition monitoring activities that are implemented through station procedures. Mitigation activities include measures to maintain water purity and the addition of corrosion inhibitors to minimize corrosion based on EPRI 1007820. Performance monitoring provides indications of degradation in closed-cycle cooling water systems, with plant operating conditions providing indications of degradation in normally operating systems. In addition, station maintenance inspections and nondestructive examination provide condition monitoring of heat exchangers exposed to closed-cycle cooling water environments.

System managers perform monitoring and trending activities in accordance with the plant engineering procedures. For pumps, the parameters monitored include flow, discharge pressures, and suction pressures. For heat exchangers the parameters monitored include flow, temperatures and differential pressures. System and component performance test results are evaluated in accordance with system and component design basis requirements. System monitoring, trending, and walk down results, inspection results, and test results are evaluated by engineering to determine if any corrective actions are required.

A one-time inspection of selected components in stagnant flow areas will be conducted to confirm the absence of aging effects resulting from exposure to closed-cycle cooling water.

Performance monitoring provides indications of degradation in Closed-Cycle Cooling Water systems, with plant operating conditions providing indications of degradation in normally operating systems. In addition, station maintenance inspections and nondestructive examination provide condition monitoring of heat exchangers exposed to closed-cycle cooling water environments.

The Closed-Cycle Cooling Water program will be enhanced, as noted below, to provide reasonable assurance that the aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Closed-Cycle Cooling Water System aging management program is consistent with the ten elements of aging management program XI.M21, Closed Cycle Cooling Water System, specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 refers to EPRI TR-107396 1997 Revision. Salem implements the guidance provided in EPRI 1007820, which is the 2004 Revision to TR-107396. **Program Elements Affected: Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

Justification for Exception

EPRI periodically updates industry water chemistry guidelines, as new information becomes available. Salem has reviewed EPRI 1007820 and has determined that the most significant difference is that the new revision provides more prescriptive guidance and has a more conservative monitoring approach. EPRI 1007820 meets the same requirements of EPRI TR-107396 for maintaining conditions to minimize corrosion and microbiological growth in closed cooling water systems for effectively managing loss of material, cracking, and reduction of heat transfer.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The Component Cooling System is not currently analyzed for sulfates, which is not consistent with the EPRI standard. The program will be enhanced to include monitoring this parameter as part of the Closed-Cycle Cooling Water program. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

2. The emergency diesel generator jacket water system is not currently analyzed for azole or ammonia, chlorides, fluorides, and microbiologically-influenced corrosion in accordance with the current EPRI standard. The program will be enhanced to include monitoring these parameters as part of the Closed-Cycle Cooling Water program. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

3. The Closed-Cycle Cooling Water program for the Chilled Water System will have a program or hardware change to bring the system chemistry parameters into compliance with EPRI 1007820, prior to the period of extended operation. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

4. New recurring tasks will be established to enhance the performance monitoring of selected heat exchangers cooled by Component Cooling System. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

5. New recurring tasks will be established for enhancing the performance monitoring of selected Chilled Water System components. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

6. A one-time inspection of selected components will be established for selected Chilled Water System piping to confirm the effectiveness of the Closed-Cycle Cooling Water program. These inspections will be performed prior to the period of extended operation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

7. A one-time inspection of selected Closed-Cycle Cooling Water program components in stagnant flow areas will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program. These inspections will be performed prior to the period of extended operation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Acceptance Criteria (Element 6)**

8. A one-time inspection of selected Closed-Cycle Cooling Water program chemical mixing tanks and associated piping will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program on the interior surfaces of the tanks and associated piping. These inspections will be performed prior to the period of extended operation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects Element 4), and Acceptance Criteria (Element 6)**

9. The program will be enhanced such that the Heating Water and Heating Steam System will have a pure water control program instituted, in accordance with EPRI 1007820, prior to the period of extended operation. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

10. New recurring tasks will be established for enhancing the performance monitoring of selected Heating Water and Heating Steam System components. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

11. A one-time inspection of selected Heating Water and Heating Steam System piping will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program. These inspections will be performed prior to the period of extended operation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

These enhancements will be implemented prior to entering the period of extended operation. In addition, the one-time inspections will be performed prior to the period of extended operation.

Operating Experience

Degradation of Closed-Cycle Cooling Water systems due to corrosion product buildup or through-wall cracks in supply lines has been observed in operating plants. Accordingly, operating experience demonstrates the need for this program. Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking, loss of material, and reduction of heat transfer are being adequately managed. The following examples of operating experience provide objective evidence that the Closed-Cycle Cooling Water System program will be effective in assuring that intended function(s) are maintained consistent with the CLB for the period of extended operation:

1. In February 2003, Nuclear Chemistry conducted a self-assessment of the Closed Cycle Cooling systems for Salem. The technicians initiated corrective action notifications for the times where the pH was out of specification to develop a trend. Based on a review of the notifications from the previous three years, the self-assessment team determined that the pH on the Component Cooling System had been out of specification low for a total of forty-four days in the previous year. The assessment of the program identified the trend from the corrective action program and performed a more detailed review of the apparent cause. Salem Chemistry performed the investigation and determined that the probe for measuring the pH was giving inconsistent readings. A new ROSS Caustic probe was installed and determined to be giving more consistent and accurate readings. Since this change, there has only been one incident on each where the pH has been out of the control band. In both cases, the CCCW program was able to detect the increase and respond by adding potassium hydroxide to the system. This action restored the pH to the normal band. This operating experience example provides objective evidence that Closed Cycle Cooling Water chemistry monitoring deficiencies are evaluated and corrective actions are properly implemented to maintain system functions.

2. During the Salem Unit 1 and 2 refueling outages in 2005 new nitrite-based control program was installed on the jacket water systems for the emergency diesel generators. These new chemicals, along with high jacket water temperature, normally kill off most bacteria in the jacket water. However, in May 2005 Chemistry technicians discovered aerobic bacteria in the jacket water of the Salem 2 diesel generators. The anaerobic bacteria, which are the acid- and sulfate-reducing bacteria, were below the established limits. Then in September 2006, the technicians discovered anaerobic bacteria in the 2A and 2C diesel generators.

   The 2A diesel generator showed one positive sample near 1000 bacteria/ml for organic acid-producing bacteria. The 2C diesel generator had approximately 10 bacteria/ml. Because of this trend, the Chemistry program changed out the jacket water on Salem 2 during the October 2006 refueling outage. Since this change there have not been any instances of anaerobic bacteria in the diesel generator jacket water. The cause of the bacteria was thought to be contamination from the 2005 water change out. In January 2005, Salem Chemistry performed a self-evaluation of the Salem emergency diesel generator chemistry. As a result of numerous jacket water leaks on the diesel generators over the life of the plant, the station decided to change the corrosion control on the diesel generators from chromates to a nitrite-based control program. This example illustrates that chemistry periodically evaluates their current control programs and make the necessary changes to correct any deficiencies. Additionally, this operating experience indicates that the chemistry program monitors parameters (bacteria in this case) effectively and initiates corrective actions (replacing the water) in order to eliminate parameters that are outside of their limits.

The operating experiences discussed above are examples of abnormal transients that were identified by routine monitoring activities and corrective actions that were put in place to correct or prevent recurrence of such transients in the future. Over the past five years Salem has not exceeded an Action Level 1 limit on the chromated water or nitrite-control programs. There have been no age- related failures on the piping or components on these systems. Similar programs are being developed for the Chilled Water and Heating Water and Steam Systems to ensure the long-term reliability of those systems. This provides objective evidence that the current Closed-Cycle Cooling Water aging management program is effective in mitigating the aging effects at Salem.

There is sufficient confidence that the implementation of the Closed-Cycle Cooling Water System program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Closed-Cycle Cooling Water System program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Closed-Cycle Cooling Water System aging management program will provide reasonable assurance that loss of material, cracking, and reduction of heat transfer aging effects will be adequately managed so that the intended functions of components exposed to closed-cycle cooling water environments within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.13 Inspection of Overhead Heavy Load and Light Load (Related To Refueling) Handling Systems

Program Description

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is an existing program that provides for periodic visual inspections of cranes and hoists in the scope of 10 CFR 54.4. The program includes structural components, including structural bolting that make up the bridge, the trolley, lifting devices, and rails in the rail system and includes cranes and hoists that meet the provisions of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is a condition monitoring program.

The aging management program is implemented through station procedures that are based on ASME/ANSI B30.2, B30.10, B30.11, and B30.16 and rely upon visual inspection to manage loss of material in an indoor air and outdoor air environment. Structural bolting is monitored for loss of preload by inspecting for loose or missing bolts, or nuts in an indoor air and outdoor air environment. Cranes and hoists accessible during normal plant operation are inspected on a frequency specified in accordance with station procedures and prior to use. Cranes and hoists are inspected approximately every 12 months. The inspection methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

The program evaluates the effectiveness of the maintenance monitoring activities to ensure the structural reliability of cranes and hoists. The program activities verify structural integrity of crane and hoist elements required to maintain their intended function and comply with ASME/ANSI B30.2 and B30.16.

The program will be enhanced to include visual inspection of rails in the rail system for loss of material due to wear. The program will be enhanced to include visual inspection of structural components and structural bolts for loss of material due to general corrosion, pitting, and crevice corrosion and structural bolting for loss of preload due to self-loosening. The acceptance criteria will be enhanced to require evaluation of significant loss of material due to corrosion for structural components and structural bolts, and significant loss of material due to wear of rail in the rail system. The enhancements will be implemented prior to entering the period of extended operation.

NUREG-1801 Consistency

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is consistent with the ten elements of aging management program XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The program will include visual inspection of structural components and structural bolts for loss of material due to general corrosion, pitting, and crevice corrosion and structural bolting for loss of preload due to self-loosening. **Program Elements Affected: Scope of Program (Element 1) and Parameters Monitored or Inspected (Element 3)**

2. The program will be enhanced to require visual inspection of the rails in the rail system for loss of material due to wear. **Program Elements Affected: Scope of Program (Element 1) and Parameters Monitored or Inspected (Element 3)**

3. The acceptance criteria will be enhanced to require evaluation of significant loss of material due to corrosion for structural components and structural bolts, and significant loss of material due to wear of rail in the rail system. **Program Element Affected: Acceptance Criteria (Element 6)**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging affects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2002, there were five industry events or operating experience (OE) dealing with cranes and hoists reviewed by the Salem operating experience (OE) group over a six-month period. The specific events reviewed were OE13701, OE13702, OE14001, OE14762 and OE14920. For these five events, a common theme involving inadequate upkeep, inadequate preventative maintenance (PM), and inadequate storage of cranes and hoists had been presented in each of these events. Due to the increase in the number of events seen within the nuclear industry at

the time, including events where a load was dropped, the operating experience (OE) group prompted a generic implication review at Salem. The operating experience (OE) group initiated a corrective action report to look at programs, policies and procedures for the upkeep, preventative maintenance (PM) and storage of hoists and other lifting devices at Salem.

The site Maintenance organization performed a review of existing programs and procedures to determine the effectiveness of the station's preventative maintenance and storage procedures of lifting devices relative to the review of the operating experiences noted in the events. Existing procedures for the various station hoists and lifting devices were reviewed and it was concluded they provide sufficient guidance for performing inspections and preventative maintenance activities. Salem procedures require that any lifting device that has major maintenance must be load tested prior to being returned to service, and this step reduces the potential of a load drop incidence. Based on the review of OE events and station procedures, it was determined that the existing program and procedures were adequate and no enhancements were warranted. This example provides objective evidence that industry operating experience is reviewed for applicability to the station and consideration is given for process enhancements to the program or procedures for inspection of cranes and hoists.

2. A review of plant operating experience at Salem shows no history of corrosion-related degradation that has impaired cranes. A review of approximately 360 Salem corrective action reports did not identify any history of loss of material due to corrosion in cranes and hoists structural members or loss of material due to wear in the rail system. In all cases, the existing Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program has identified only event-driven (not age related) conditions, discussed further below. The experience at Salem with the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program shows that the program is effective in managing general corrosion on structural components, and wear on the rails, for the cranes and trolleys.

   In 2004, a broken trolley rail hold down clamp, on the upper catwalk area of the Salem Unit 1 Turbine Building crane, was discovered during preventative maintenance painting of the crane. A corrective action report was issued to document, and repair of the condition. Additional inspections of the remaining rail hold down clamps were performed to determine the extent of the condition. There were no additional degraded conditions noted. The extent of condition also included an inspection of the Unit 2 Turbine Building crane which also did not reveal any other deteriorated hold down clamps. The cause of the broken bolt was not reported to be age related due to corrosion or wear, as verified by inspection of the remaining clamps. The trolley rail hold down clamp was restored to design configuration by welding a stud bolt to the support beam, replacing the hold down plate and torquing the nut. This example provides objective evidence that the station's program is effective in detecting and correcting structural conditions adverse to quality that could affect an intended function.

In 2006, a degraded condition was identified on the crane rail of the Salem Unit 2 Turbine Building crane. A corrective action report was issued to document, evaluate and repair the condition. A crack in a splice plate aligning the crane rails at an expansion joint was identified during a crane inspection prior to crane usage. This crane is located outdoors, on top of the Unit 2 Turbine Building. The Turbine Building crane is a gantry type crane that moves north and south along the turbine deck on a set of roof top crane rails. A structural engineer evaluated the condition and the recommendation was that the splice plate be replaced. There was corrosion noted on the plate but the exact cause of the condition was not determined but the cause of the cracked plate was not reported to be age related due to corrosion or wear. Additionally, it was noted during the walkdown by design engineering that there was blockage in the crane rail gutters and drains due to debris accumulation. The splice plate was repaired under a maintenance work order. It was also recommended that the roof crane rail drains and gutters be cleaned periodically to avoid accumulation of moisture from the area. This would help to mitigate potential corrosion on rail components. This example provides objective evidence that the station's program is effective in detecting and correcting structural conditions adverse to quality that could affect an intended function.

As discussed in the example 2 above, the operating experience of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program will provide reasonable assurance that the loss of material and loss of preload aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.14 Compressed Air Monitoring

Program Description

The Compressed Air Monitoring aging management program is an existing program that manages piping, piping components, and piping elements, compressor housings, and tanks for loss of material in an air or gas environment in the Compressed Air System. The Salem Compressed Air Monitoring aging management activities consist of preventive maintenance and condition monitoring measures to manage the effects of aging.

The Compressed Air Monitoring program is based on the Salem response to NRC Generic Letter 88-14, "Instrument Air Supply Problems" and utilizes guidance and standards provided by INPO SOER 88-01. The Compressed Air Monitoring program activities implement the criteria in EPRI TR-108147 (revised guide to EPRI NP-7079) and ASME OM-S/G-1998, Part 17 regarding periodic air quality sampling and sampling locations.

Program activities include air quality checks at various locations in the system to ensure that dew point, particulates, lubricant content, and contaminants are kept within the specified limits in accordance with ANSI/ISA 7.0.01-1996, paragraph 5.

Salem performs testing and inspection of the air system within the scope of license renewal. Pressure decay tests and subsequent stroke tests require inspections for leakage if acceptance criteria are not met.

The effects of corrosion and the presence of contaminants are detected during system manager walkdowns, leak rate tests, and preventive maintenance inspections of air filters, accumulators, receiver tanks and air traps. The procedures and work orders for these inspections include specific performance limits.

These periodic tests in conjunction with post maintenance testing, emergency operating procedures and the operator training associated with these operating procedures provide assurance that the air system within the scope of license renewal will fulfill its intended function.

Results from the above inspections and tests are compared with established acceptance criteria to provide for timely detection of aging effects. Evaluations are performed for test or inspection results that do not satisfy established criteria and a corrective action report (SAP Notification) is initiated in accordance with the corrective action process to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the problem is determined and an action plan is developed to prevent recurrence.

NUREG-1801 Consistency

The Compressed Air Monitoring aging management program is consistent with the ten elements of aging management program XI.M24, Compressed Air Monitoring, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry operating experience indicates that internal degradation can cause significant degradation to susceptible plant components. The following examples of operating experience provide objective evidence that the Compressed Air Monitoring program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation.

1. In 2006, during an NRC Compressed Air (CA) System walkdown on Salem Unit 1, the inspector reported that the general condition of CA Manifolds in Unit 1 Auxiliary Building appeared to be showing signs of surface rust. There are approximately 15 valves on the manifold. It was determined that this condition was not a threat to the integrity of the system, and did not impair its design function of providing low-moisture high-pressure air for controlling of plant components. No other components were affected. This example provides objective evidence that items identified during walkdowns are placed into the work planning system for corrective action and addressed prior to loss of intended function.

2. In 2006, during Auto-Start of Salem #3 Station Air Compressor (SAC) the 2nd stage intercooler developed a leak from a recessed Allen head plug. The #3 SAC was in standby service when it automatically started and developed the leak. It was suspected that service water caused the corrosion of the cooler plug. Leakage was approximately 1 gpm and did not affect the operability of the intercooler; however, a larger leak could cause potential operability issues with the newly installed compressors. All wetted surfaces of the new compressor coolers are designed with AL6XN material. The corroded plug was visually examined and a field walkdown of the SAC showing the installed location of these plugs. The results of this visual examination and field walkdown concluded that the carbon steel plug is in contact with AL6XN material in a service water environment (i.e., is wetted by service water while in contact with AL6XN). This is a galvanic corrosion cell with the carbon steel plug being the sacrificial material (i.e. the material that will corrode). A work order was implemented that replaced the plug with compatible material on all station air compressors. This example provides objective evidence of using the

system walkdown and corrective action process to correct field-identified problems prior to loss of intended function.

As demonstrated in the operating experience examples above, the Compressed Air Monitoring aging management program is effectively managing the aging effects. Based on these examples, station procedures are utilized to identify and document conditions adverse to quality in accordance with the corrective action program. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Compressed Air Monitoring program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Compressed Air Monitoring program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Compressed Air Monitoring aging management program provides reasonable assurance that the loss of material aging effects are adequately managed so that the intended functions of components within the scope license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.15 Fire Protection

Program Description

The Salem Fire Protection program is an existing program that will manage the identified aging effects for the fire barriers, diesel fire pumps fuel oil supply lines, and the Halon and Carbon Dioxide systems and associated components, through the use of periodic inspections and functional testing to detect aging effects prior to loss of intended functions. System functional tests and inspections are performed in accordance with guidance from NFPA Codes and Standards. The program applies to piping, piping elements, piping components, fire doors, dampers and fire barriers exposed to air/gas wetted, outdoor air and indoor air environments.

The Fire Protection program is a condition and performance monitoring program whose monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation. The Fire Protection program provides for visual inspections of fire barriers and penetration seals for signs of degradation such as cracking, loss of material and hardening, through periodic inspection and *functional testing. The program requires performance of visual inspections* of at least 10% of each type of penetration seal at least once per refuel cycle (18-months). The program specifies visual examinations of fire barrier walls, ceilings and floors in structures within the scope of license renewal at a frequency of once each refueling cycle (18-months). Periodic visual and functional tests are used to manage the aging effects of fire doors is 6-months. All fire dampers equipped with fusible links, which penetrate fire barriers are to be visually and functionally tested at least once per refuel cycle (18-months).

Operational tests of the diesel-driven fire pumps are performed at least once every refueling cycle to record flow and discharge pressures, sequential starting capability and controller and alarm functional tests. The performance tests will be used to detect degradation (corrosion) of the fuel supply lines before the loss of the component intended function, and provide data for trending purposes.

The program also provides for aging management of external surfaces of the Halon and Carbon Dioxide fire suppression system components through periodic functional tests and visual inspections for any loss of material.

These inspections and tests are implemented through station procedures and recurring task work orders. Personnel performing inspections are qualified and trained to perform the inspection activities. Unacceptable conditions are entered into the Corrective Action Program for proper disposition.

The Fire Protection program will be enhanced, as noted below, to provide reasonable assurance that aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Fire Protection program is consistent with the ten elements of aging management program XI.M.26, Fire Protection, specified in NUREG- 1801 with the following exception:

Exception to NUREG-1801

1. NUREG-1801 recommends visual inspection and functional testing of the Halon and Carbon Dioxide fire suppression systems at least once every six months. The Halon and Carbon Dioxide fire suppression systems currently undergo functional testing every refueling cycle (18-months). **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4).**

Justification for Exception

In addition to the 18-month functional testing, the Halon fire suppression system undergoes more frequent visual inspections for system charge (storage tank weight at least every 6-months), and the low-pressure Carbon Dioxide fire suppression system undergoes a weekly visual storage tank level and pressure check. These test and inspection frequencies are considered sufficient to ensure system availability and operability based on the station operating history (corrective actions, completed surveillance test results) that shows no aging related events have been found that have adversely affected system operation.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The Fire Protection aging management program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors for aging effects, such as cracking, spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. Program Elements Affected: **Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**

2. The program will be enhanced to provide specific guidance for examining exposed external surfaces of the fire pump diesel fuel oil supply line for corrosion during pump tests. Program Elements Affected: **Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the fire protection program will be effective in assuring that intended function(s) will be maintained consistent with the CLB or the period of extended operation:

1. In June 2002, during main control room tracer gas testing in preparation of full cardox concentration testing, unacceptable leakage was identified coming from fire doors that where tested. Troubleshooting revealed that the bottom seals on the doors where degraded. The seal was not in complete contact with the door and doorsill allowing the gas to escape. Engineering performed an interim evaluation to determine operability of the fire doors. Other fire door seals were also inspected for signs of degradation and were corrected to prevent gas leakage. The door seals were replaced and adjusted to ensure proper contact of seal and the doorsill to contain carbon dioxide. This example provides objective evidence that the Fire Protection program satisfactory identifies deficient fire door seal conditions, and the deficient condition is entered into the *corrective action program and corrected.*

2. In January 2001, during routine fire door inspection and testing, the fire door failed to securely latch in the closed position. The top hinge of the door was found bent. The failure was determined to be due to normal wear and age caused by frequent use. The door latch was replaced and tested satisfactory after repair. This example provides objective evidence that the functional testing of fire doors is sufficient to identify conditions adverse to quality. This example also demonstrates the effectiveness of the corrective action program to repair deficient conditions when found.

3. In August 2003, when conducting routine fire door surveillance testing, fire door C8-2 would not properly close and latch. The doors drop bolt was replaced and the door was retested with satisfactory results. This example provides objective evidence that the routine testing of fire doors is capable of identifying deficient conditions, which are in turn appropriately entered into the corrective action program. Current functional tests for fire doors are sufficient to identify conditions adverse to quality.

Salem complies with NFPA codes, which require comprehensive fire barrier inspections, testing of fire pumps, and inspections and functional testing of fire protection systems (CO_2, halon) system components. NFPA code *requirements are followed to ensure that the design features of Fire Protection* system equipment are properly maintained and functionally tested to ensure that these features are maintained. Deficiencies found during these inspections and functional tests are appropriately entered into the corrective action program for disposition. These examples provide sufficient confidence that implementation of the Fire Protection program will effectively identify age-related degradation prior to loss of intended function.

Conclusion

The enhanced Fire Protection program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.16 Fire Water System

Program Description

The Fire Water System program is an existing program that will manage identified aging effects for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing. The program provides for periodic monitoring measures and inspection activities to detect aging effects prior to loss of intended functions. System functional tests, flow tests, flushes and inspections are performed in accordance with guidance from NFPA-25 codes. The program applies to water-based fire protection systems that consist of sprinklers, nozzles, hydrants, hose stations, standpipes, water storage tanks, heat exchanger, pumps and aboveground and underground piping and components that are exposed to raw water, air/gas wetted, outdoor air, indoor air and air with steam or water leakage. Fire system main header flow tests, sprinkler system inspections, visual yard hydrant inspections, fire hydrant hose inspections, hydrostatic tests, gasket inspections, volumetric inspections, and fire hydrant flow tests and pump capacity tests are performed periodically assure that the aging effect of loss of material is managed such that the system intended functions are maintained. Fifty-year sprinkler head inspections will be conducted using the guidance provided in NFPA-25. The initial 50-year inspections will be determined based on the date of the sprinkler system installation. Subsequent inspections will be performed every 10 years after the initial 50-year inspections.

Selected portions of the fire protection system piping located aboveground and exposed to water, will be inspected by non-intrusive volumetric examinations, to ensure that aging effects are managed and that wall thickness is within acceptable limits. The initial wall thickness inspections will be performed prior to the period of extended operation and will be performed every 10 years thereafter. These inspections will be capable of evaluating (1) wall thickness to ensure against catastrophic failure and (2) the inner diameter of the piping as it applies to the flow requirements of the fire protection system.

The Fire Water Storage Tanks are internally inspected in accordance with NEIL requirements. The internal inspections of the fire water storage tank heat exchangers to inspect the tubes, shells and tube sheet condition will also be periodically inspected.

The Aboveground Steel Tanks aging management program addresses aging management of the Fire Water Storage Tanks external surfaces. The Buried Piping Inspection aging management program addresses the buried fire main piping external surfaces.

The fire water system is maintained at the required normal operating pressure and monitored such that a loss of system pressure is immediately detected and corrective actions initiated. The fire protection program ensures that testing and inspection activities have been performed and the results have been documented and reviewed by the Fire System Engineer for analysis and trending.

The system flow testing, visual inspections and volumetric inspections assure that the aging effect of loss of material due to corrosion, microbiologically-influenced corrosion (MIC), or biofouling are managed such that the system intended functions are maintained.

The Fire Water System program will be enhanced, as noted below, to provide reasonable assurance that the aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Fire Water System aging management program is consistent with the ten elements of aging management program XI.M27, "Fire Water System," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The Fire Water System aging management program will be enhanced to inspect selected portions of the water based fire protection system piping located aboveground and exposed to the fire water internal environment by non-intrusive volumetric examinations. These inspections shall be performed prior to the period of extended operation and will be performed every 10 years thereafter. **Program Elements Affected: Preventative Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**
2. The Fire Water System aging management program will be enhanced to replace or perform 50-year sprinkler head inspections and testing using the guidance of NFPA-25 "Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems" (2002 Edition), Section 5-3.1.1. These inspections will be performed by the 50-year in-service date and every 10-years thereafter. **Program Elements Affected: Detection of Aging Effects (Element 4).**

Enhancements will be implemented prior to the period of extended operation, with the inspections and testing performed in accordance with the schedule described above.

Operating Experience

The Fire Water System tests and procedures that are performed at the plant are based on NFPA standards to ensure that the system and fire components will have reliable performance when required to function.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that the loss of material aging effect is being adequately managed. The following examples of operating experience provide objective evidence that the Fire Water System program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In July 2003, during routine fire water system walk down a small leak was found at a flow switch. This condition was evaluated and determined not to cause the fire water system to be inoperable since the leakage found was minimal. The leak was due to a leaking gasket and seal on the switch. This flow switch was replaced and returned to service. To date, no other leaks have been found on any other flow switches on the fire water system. This OE provides objective evidence that routine system walkdowns and inspections performed monitor the condition on the fire water system piping, discover degraded conditions, and identified deficient conditions are entered into the corrective action program for proper evaluation and resolution.

2. In February 2005, during the routine monthly fire water flow path verification, corrosion was found externally on the fire pipe header. Paint on the 6" header was found to be blistered and some of the exterior surface of the pipe could be manually removed by rubbing the surface. This degraded condition was attributed to an isolation valve-packing leak located above this section of piping. An ultrasonic test was not required as determined by inspection performed by engineering. The corrosion was determined only to be surface rust and could be easily removed. The piping was cleaned, painted and returned to service. This OE provides objective evidence of detection of aging effects. Periodic system walkdowns of the fire water system provides early detection of deficient conditions to ensure the design functions of the fire water piping is maintained. The walkdowns performed ensure the function of the fire water system is maintained during current operation and provides evidence that the walkdowns should continue to be effective during the period of extended operations.

3. In February 2005, during the routine monthly fire water flow path verification walkdown, a 4" wet pipe sprinkler valve was found to have surface corrosion. This corrosion was determined to have originated from a packing leak from the valve. The packing leak slowly corroded the valve body over time. The valve was removed and replaced with a new valve. This new valve was painted prior to installation on the system. Based on internal OE review, no further corrosion or leakage has occurred at this location. This OE demonstrates evidence that walkdowns currently being performed can detect and correct aging effects to ensure operability of the

fire protection system. It also demonstrates that these walkdowns should be effective during the period of extended operation.

4. The fire protection system manager has performed visual inspections of piping internal conditions when exposed during maintenance activities. The piping internals have been observed to be in good condition with no significant internal fouling or corrosion buildup. This provides objective evidence that system flushing procedures are effective in preventing fouling or corrosion product buildup. The external piping condition is also routinely inspected and maintained by station procedures. Plant operating experience did not reveal any age related events associated with corrosion on the internal or external piping surfaces, which could have prevented the Fire Protection system from performing its intended function.

The operating experience of the Fire Water System program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Fire Water System program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Fire Water System program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Fire Water System program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.17 Aboveground Steel Tanks

Program Description

The Aboveground Steel Tanks aging management program is an existing program, which will be enhanced to provide for management of loss of material aging effects for outdoor carbon steel tanks. The Aboveground Steel Tanks program is comprised of outdoor steel tanks, subject to outdoor air and soil environments (Fire Protection Water Storage Tanks). This program is a condition monitoring program and credits the application of paint as a corrosion preventive measure. This program also performs periodic visual inspections to monitor the condition or degradation of the paint and any resulting metal degradation for the carbon steel tanks. This program also credits the internal UT inspections that will be performed on the bottom of the tanks that are supported by concrete foundations to ascertain the condition of the tank bottom in contact with the foundation.

The exterior painted surfaces of the tanks are inspected for signs of degradation such as flaking, cracking and peeling to manage the effects of corrosion and prevent conditions similar to those documented in GL 98-04 *from occurring. Grout or sealant at the tank-foundation interfaces will* be periodically inspected for degradation to ensure the seal is intact to limit water intrusion at the tank bottom.

Enhancements to this existing program, including performance of internal UT inspections and routine visual inspections of the grout/sealant between the tank bottom and sand bed located on top of the concrete foundation, will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The Aboveground Steel Tank aging management program is consistent with the ten elements of aging management program XI.M29, specified in NUREG-1801:

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented:

1. The program will be enhanced to include UT measurements of the bottom of the tanks that are supported on concrete foundations (Fire Protection Water Storage Tanks). Measured wall thickness will be monitored and trended if significant material loss is detected. These thickness measurements of the tank bottom will be taken and evaluated against design thickness and corrosion allowance to ensure that significant

degradation is not occurring and the component intended function would be maintained during the extended period of operation. **Program Elements Affected: Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**

2. The program will be enhanced to provide routine visual inspections of the Fire Protection Water Storage Tanks external surfaces. The visual inspection activities will include inspection of the grout or sealant between the tank bottom and the concrete foundation for signs of degradation. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material general/corrosion, pitting, crevice and microbiological-influenced corrosion are being adequately managed. The following examples of operating experience provide objective evidence that the Aboveground Steel Tanks program will be effective in assuring that intended function(s) would be maintained consistent with the CLB for the period of extended operation:

1. In July 2005, during routine equipment walkdown of the Fire Protection Water Storage Tanks, the exterior surface coatings of the 'A' tank showed signs of aging. The coating degradation was determined to be due to normal outdoor exposure conditions. The corrective actions implemented was to have the exterior surface both of the tanks to be re-coated with two coats of primer and one coat of exterior paint, restoring and protecting of the exterior surfaces of both the carbon steel Fire Protection Water Storage Tanks. To date, no further coating issues have been documented within the corrective action program. These corrective actions demonstrate that the Fire Protection Water Storage Tanks external surfaces protective coatings are periodically inspected and when required, repaired to protect the exterior steel surfaces of these tanks. This operating experience provides objective evidence that carbon steel components subject to the outdoor air environment are not experiencing loss of material.

2. In May 2006, during routine tank visual inspection while performing the Storage Tank Integrity Testing procedure, the 1 Fuel Oil Storage Tank, exterior surface of the tank was found to be in need of recoating. The cause of this coating wear was determined to be from normal external surface wear and exposure to the outdoor elements including contact with the salt-water mist from the river. This tank was cleaned and repainted to restore protective coating for the Fuel Oil Storage Tank. To date, no other exterior tank coating issue has been identified for the Fuel Oil Storage Tank. This operating experience provides objective evidence that carbon steel components subject to the outdoor air environment, are not experiencing loss of material.

A review of operating experience identified few problems with Aboveground Steel Tanks. Of the issues identified, only the two discussed above were age related. The problems identified would not cause significant impact to the tanks in the Aboveground Steel Tank program. There was no adverse trend in performance identified. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Aboveground Steel Tanks program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Aboveground Steel Tanks program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Aboveground Steel Tanks aging management program will provide reasonable assurance that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.18 Fuel Oil Chemistry

Program Description

The Fuel Oil Chemistry aging management program is an existing program that includes preventive activities to provide assurance that contaminants are maintained at acceptable levels in fuel oil for systems and components within the scope of license renewal, to prevent loss of material. The fuel oil tanks within the scope of the program are maintained by monitoring and controlling fuel oil contaminants in accordance with the guidelines of the American Society for Testing and Materials (ASTM). Fuel oil sampling activities meet the requirements of ASTM D 4057 or provide a more conservative sample for the detection of contaminants and water and sediment. Fuel oil will be periodically sampled and analyzed for particulate in accordance with modified ASTM Standard D 2276-00 Method A and for the presence of water and sediment in accordance with ASTM Standard D 1796-97. Fuel oil sampling and analysis is performed in accordance with approved procedures for new fuel and stored fuel. Fuel oil tanks are periodically drained of accumulated water and sediment and periodically drained, cleaned, and internally inspected. These activities effectively manage the effects of aging by providing reasonable assurance that potentially harmful contaminants are maintained at low concentrations.

The Fuel Oil Chemistry program will be enhanced, as noted below, to provide reasonable assurance that the aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Fuel Oil Chemistry aging management program is consistent with the ten elements of aging management program XI.M30, "Fuel Oil Chemistry," specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 requires periodic multilevel sampling of tanks in accordance with the manual sampling standards of ASTM D 4057-95 (2000). The 20,000-barrel Fuel Oil Storage Tank (S1DF-1DFE13) samples are single point samples obtained from the tank drain line located off of the bottom of the tank. This sample is not considered a multilevel sample as described in ASTM D 4057. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6)**

   Justification for Exception

   Although the actual sample location is a single point taken from the tank bottom, the lower sample elevation is more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this a conservative and effective sampling location for fuel oil contaminants. Operating experience has shown that this sample method has yielded consistently acceptable sample results. In addition, the 20,000-barrel Fuel Oil Storage Tank is located outside and multilevel sampling in accordance with ASTM D 4057-95 (2000) would be hazardous during inclement weather.

2. NUREG-1801 requires periodic sampling of tanks in accordance with the manual sampling standards of ASTM D 4057-95 (2000). The 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23) samples are single point samples obtained from the tank sight glass drain line located a few inches above the bottom of the tank. This sample is not in accordance with the manual sampling as described in ASTM D 4057. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6)**

   Justification for Exception

   For fuel oil storage tanks of less than 159 cubic meters spot sampling recommendations in ASTM D 4057-95 (2000) include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). The 350-gallon Fire Pump Day Tanks are 1.3 cubic meters so the spot sampling recommendations in ASTM D 4057 are applicable. Although the actual sample location for tanks is lower than prescribed by the ASTM D 4057 standard, the sample results are more likely to capture contaminants, water, and sediment, thus making this a conservative sample location for fuel oil containments.

3. NUREG-1801 requires periodic sampling of tanks in accordance with the manual sampling standards of ASTM D 4057-95 (2000). The 30,000-gallon Diesel Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-1DFE1 and S2F-1DFE2) samples consist of 4 samples drawn from 2 locations on the tank. One is from the level instrumentation block drain, which is located a few inches above the bottom of the tank. The remaining three samples are taken from the sump drain, which is located on the other side of the tank and is from the bottom of the tank. This sample is not in accordance with the manual sampling as described in ASTM D 4057. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6)**

   Justification for Exception

   For fuel oil storage tanks of less than 159 cubic meters spot sampling recommendations in ASTM D 4057-95 (2000) include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). The 30,000-gallon Diesel Fuel Oil Storage Tanks are 113.6 cubic meters so the spot sampling recommendations in ASTM D 4057 are applicable. Although the actual sample locations for tanks is lower than prescribed by the ASTM D 4057 standard, the sample results are more likely to capture contaminants, water, and sediment, thus making this a conservative sample location for fuel oil containments.

4. NUREG-1801 states that the program serves to reduce the potential of exposure of the tank internal surface to fuel oil contaminated with water and biological organisms. This is accomplished by analyzing multilevel samples for water and sediment, biological activity, and particulate on a periodic basis (at least quarterly). Fuel oil tanks should also be periodically drained of accumulated water and sediment, and, periodically drained, cleaned, and internally inspected. The following is an exception to these requirements:

   Multilevel sampling, tank bottom draining, cleaning, and internal inspection of the 550-gallon Diesel Fuel Oil Day Tanks (S1DF-1DFE3, S1DF-1DFE4, S1DF-1DFE5, S2DF-1DFE3, S2DF-1DFE4 and S2DF-1DFE5) is not periodically performed at Salem. To confirm the absence of any significant aging effects, a one-time inspection of each of the 550-gallon Diesel Fuel Oil Day Tanks will be performed as part of the Salem Fuel Oil Chemistry aging management program. Should the one-time inspection reveal evidence of aging effects, this condition will be entered into the corrective action process for resolution. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)**

   Justification for Exception

   These tanks are integral to the routine operation of the Emergency Diesels and are filled with fuel oil that has been previously analyzed within its managed source tanks, the 30,000-gallon Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2). The fuel oil within the 550-gallon Diesel Fuel Oil Day Tanks is recirculated to the 30,000-gallon Fuel Oil Storage Tanks quarterly to prevent the accumulation of contaminants and water and sediment. Additionally, the Diesel Fuel Oil Day Tanks are enclosed within the Auxiliary Building, which is maintained at a constant temperature during cold periods. Maintaining a constant temperature during cold periods minimizes Diesel Fuel Oil Day Tanks thermal cycling and reduces the potential for condensation formation within the Day Tanks. Therefore, the periodic draining of water and sediment from the bottom of the 550-gallon Diesel Fuel Oil Day Tanks, and, the periodic draining, cleaning, and internal inspections are not necessary.

5. NUREG-1801 states that the quality of fuel oil is maintained by additions of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, and corrosion inhibitors to mitigate corrosion. The Salem fuel oil chemistry program does not currently include the addition of biocides, stabilizers or corrosion inhibitors. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)**

   Justification for Exception

   NUREG-1801 directs addition of biocides, stabilizers and inhibitors as a preventative measure. However, Salem fuel oil chemistry program will be enhanced to require addition of these biocides, stabilizers and inhibitors if sampling or inspection activities detect biological activity, biological breakdown of the fuel or corrosion products. Additionally, the Salem fuel oil chemistry program is being enhanced to include the analysis for particulate contamination in new and stored fuel oil. The analysis for particulate contamination will be in accordance with modified ASTM D2276-00, Method A and analysis using this method is sufficient for the detection of corrosion products at an early stage. Fuel contaminants and degradation products will normally settle to the tank bottom where they will be detected by routine analysis or by periodic draining of water and sediment from the storage tank bottoms.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented:

1. The Fuel Oil Chemistry program will be enhanced to invoke equivalent requirements for fuel oil purity and fuel oil testing as described by the Standard Technical Specifications. NUREG-1801 states in XI.M30 that the fuel oil aging management program is in part based on the fuel oil purity and testing requirements of the plant's Technical Specifications that are based on the Standard Technical Specifications of NUREG-1430 through NUREG-1433. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

2. The program will be enhanced to include the analysis for particulate contamination in new and stored fuel oil. The analysis for particulate contamination will be in accordance with modified ASTM D2276-00, Method A. The modification consists of using a filter with a pore size of 3.0 μm, instead of 0.8 μm. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)**

3. The Salem fuel oil chemistry program will be enhanced to require addition of biocides, stabilizers and inhibitors if sampling or inspection activities detect biological activity, biological breakdown of the fuel or corrosion products. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Corrective Actions (Element 7)**

4. The Salem fuel oil chemistry program does not currently analyze for bacteria for the 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23). Additionally, the Salem Fuel Oil chemistry aging management program currently performs biological activity testing every 12 months on the 20,000 barrel Main Fuel Oil Storage Tank (S1DF-1DFE13) and the 30,000-gallon Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2). Standard Technical

Specifications as invoked in XI.M30 requires biological testing to be performed quarterly. The program will be enhanced to include quarterly analysis for bacteria in new and stored fuel oil. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5)**

5. The Salem fuel oil chemistry program currently does not open and inspect the 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23). The Salem fuel oil program will be enhanced to ensure the internal inspection of 350-gallon Fire Pump Day Tanks (S1DF-1DFE21 and S1DF-1DFE23) include visual inspections to detect potential degradation and ultrasonic thickness examination of tank bottoms to ensure that significant degradation is not occurring. This includes the internal surface of the tanks that are drained for cleaning and sediment removal. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

6. Sampling of new fuel oil deliveries for water and sediment and viscosity is currently performed prior to off load. The Salem fuel oil program will be enhanced to require API gravity and flash point of new fuel prior to off load. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5)**

7. The Salem fuel oil chemistry program currently does not open and inspect the 30,000-gallon Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2). The Salem fuel oil program will be enhanced to ensure the internal inspection of the 30,000-gallon Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-2DFE1 and S2DF-2DFE2) include visual inspections to detect potential degradation and ultrasonic thickness examination of tank bottoms to ensure that significant degradation is not occurring. This includes the internal surface of the tanks that are drained for cleaning and sediment removal. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

8. The Fuel Oil Chemistry program will be enhanced to perform a one-time inspection of each of the 550-gallon Diesel Fuel Oil Day Tanks to confirm the absence of any significant aging effects. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

These enhancements will be implemented prior to the period of extended operation. In addition, the one-time inspections will be performed prior to the period of extended operation.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling are being adequately managed. The following examples of operating experience provide objective evidence that the Fuel Oil Chemistry aging management program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2006, a notification was written to correct the frequency of the cleaning of the 20,000 barrel Main Fuel Oil Storage Tank (S1DF-1DFE13) and the Diesel Fuel Oil Storage Tanks (S1DF-1DFE1, S1DF-1DFE2, S2DF-1DFE1 and S2F-1DFE2). These cleanings were previously scheduled to be done every 20 years, which was not in accordance with industry standard of 10 years. This notification changed the frequency of the cleaning to every 10 years. Additionally, in 2008, S1DF-1DFE1 and S1DF-1DFE2 were cleaned and inspected and no significant degradation was found. This operating experience provides objective evidence that the Fuel Oil Chemistry program self identifies program deficiencies and proactively corrects their program in order to align with industry standards.

2. In July of 2005, the analysis of the 92-day surveillance sample of the S2DF-2DFE1 indicated that the sample failed to conform to testing specifications as defined in SC.FO-LB.ZZ-0001 for 10% residual carbon residue. The established specification limit is less than or equal to 0.20%. Testing yielded a value of 0.21%. A review of the other tanks (S1DF-1DFE13, S1DF-1DFE2, S1DF-1DFE1 and S2DF-2DFE2) was performed and all results were satisfactory for the other tanks. The investigation of the increased value did not result in a root cause for the testing result. However, the fuel oil was determined to meet the engine manufacturer's specifications and was acceptable for use in the engines. Additionally, the review indicated that there are some variations in the test results (+/- 0.03%), which could account for the reading being out of specification. Subsequent tests have indicated satisfactory results. This operating experience demonstrates the fuel oil chemistry program's attention to detail in review of testing results and proper corrective actions such as an extent of condition on the other tanks in the program.

3. In June 2002, one of the S1DF-1DFE4 (1B 550-gallon Diesel Fuel Oil Day Tank) was inspected as part of justification for inspection of these tanks. The results of the inspection concluded that there was no significant degradation of the internal surface of the tank. This inspection provides objective evidence that the frequent recirculation of the fuel prevents the accumulation of contaminants and water and sediment and therefore, the periodic draining of water and sediment from the bottom of the 550-gallon Diesel Fuel Oil Day Tanks, and, the periodic draining, cleaning, and internal inspections is not necessary.

The operating experiences discussed above are examples of abnormal conditions that were identified by routine monitoring activities and corrective actions that were put in place to correct or prevent reoccurrence or proactive improvements to the program. Over the past five years the Salem Fuel Oil Chemistry program has not experienced any significant issues. The examples provided above were the only significant concerns identified during review of the operating experience over the past five years. This provides objective evidence that the current Fuel Oil Chemistry aging management program is effective in mitigating the aging effect of loss of material at Salem. There is sufficient confidence that the implementation of the Fuel Oil Chemistry aging management program will effectively identify degradation prior to failure.

Conclusion

The enhanced Fuel Oil Chemistry aging management program will provide reasonable assurance that the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.19 Reactor Vessel Surveillance

Program Description

The Reactor Vessel Surveillance program is an existing program that manages the loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline materials. The program complies with 10 CFR 50, Appendix H. The program evaluates neutron embrittlement by projecting Upper Shelf Energy (USE) for reactor materials with projected neutron exposure greater than 10^{17} n/cm^2 (E > 1.0 MeV) after 60 years of operation.

The Reactor Vessel Surveillance Program is plant-specific to each of the Salem reactor vessels, as each vessel has plant-specific limiting materials, availability of surveillance capsules, and projected fluence levels. Salem Units 1 and 2 each have in-vessel capsules, therefore, alternative dosimetry to monitor neutron fluence during the period of extended operation is not required.

The condition monitoring methods, i.e., removal and analysis of capsules for *neutron fluence and changes to embrittlement characteristics, are consistent* with Regulatory Guide 1.99, Rev. 2 requirements. All capsules pulled to date have met the testing and reporting requirements of ASTM E185-82.

The Reactor Vessel Surveillance Program consists of capsules with a projected fluence of less than the 60-year fluence at the end of 40 years. There are four remaining capsules in each reactor vessel. For Unit 1, there are four standby capsules with none scheduled for withdrawal before the period of extended operation. For Unit 2, one capsule is scheduled for withdrawal prior to the period of extended operation (at 32 EFPYs), leaving three standby capsules.

Based on the 60-year projections, one (1) capsule will be pulled from each of the Salem Units 1 and 2 vessels during the period of extended operation to monitor the effects of long-term exposure to neutron embrittlement. At the time of this withdrawal, the remaining capsules will be pulled and placed in storage since any further exposure would not provide meaningful metallurgical data. In accordance with 10 CFR Part 50, Appendix H, Salem Units 1 and 2 will submit their proposed capsule withdrawal schedules for approval prior to implementation. Salem Units 1 and 2 have documented the extent of embrittlement for Upper-Shelf Energy (USE) and Pressure-Temperature (P-T) limits for sixty (60) years, corresponding to fifty (50) effective full power years (EFPYs), in accordance with Regulatory Guide 1.99, Rev. 2, "Radiation Embrittlement of Reactor Vessel Materials". The projections used both the Chemistry Tables and existing Surveillance Data as applicable. Specifically, the calculations used Table 1, Chemistry Factor for Welds, °F, and Table 2, Chemistry Factor for Base Metal, °F from the Regulatory Guide to determine the chemistry factors required for equation (2) in Position 1.1, which in turn, is used in the methodology in Position 2.1. Additionally, surveillance capsule data from all capsules withdrawn to date was used to obtain the relationship of the mean value of the Reference Temperature (ΔRT_{NDT}) to fluence as discussed in Position 2.1. The USE calculations for both methods concluded that all of the beltline and extended beltline materials in the Salem Units 1 and 2 reactor vessels are projected to remain above the USE screening criterion of 50 ft-lbs at the end of the period of extended operation (50 EFPYs).

Heatup and Cooldown P-T limit curves for the period of extended operation (50 EFPYs) were calculated using the most limiting value of ΔRT_{NDT} corresponding to the most limiting material in the beltline region of the reactor vessel. The limit curves were determined in accordance with the requirements of 10 CFR50, Appendix G as augmented by Appendix G to Section XI of the ASME Boiler and Pressure Vessel Code.

The applicable limitations in Regulatory Position 1.3 of Regulatory Guide 1.99, Rev. 2 were used in determining the embrittlement of reactor beltline materials.

Each of the applicable limitations from Regulatory Position 1.3 of the Regulatory Guide has been satisfied, and Regulatory Position 1 is acceptable for use in determining embrittlement of Salem Units 1 and 2 reactor vessel beltline materials.

The Reactor Vessel Surveillance program will be enhanced, as noted below, to provide reasonable assurance that the aging effects are adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Reactor Vessel Surveillance Program is consistent with the aging management program XI.M31, Reactor Vessel Surveillance, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The Reactor Vessel Surveillance Program will be enhanced to state the bounding vessel inlet temperature (cold leg) limits and fluence projections, and to provide instructions for changes.
    a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max)
    b. Fluence Limitation (max.): 1.00×10^{20} n/cm^2 (E > 1.0 MeV)

    Program Elements Affected: (Element 3)

2. The Reactor Vessel Surveillance Program will be enhanced to describe the storage requirements and the need to retain future pulled capsules. **Program Elements Affected: (Element 4)**

3. The Reactor Vessel Surveillance Program will be enhanced to specify a scheduled date for withdrawal of capsules including pulling one of the remaining four capsules during the period of extended operation to monitor the effects of long-term exposure to neutron embrittlement for each Salem Unit. Those dates shall be approved by the NRC prior to withdrawal of the capsules, in accordance with 10 CFR Part 50, Appendix H. **Program Elements Affected: (Elements 5 and 6)**

4. The Reactor Vessel Surveillance Program will be enhanced to incorporate the requirements for (1) withdrawing the remaining capsules when the monitor capsule is withdrawn during the period of extended operation and placing them in storage for the purpose of reinstituting the Reactor Vessel Surveillance program if required if the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, and subsequently the basis for the projection to 60 years warrant the reinstitution, and (2) changes to the reactor vessel exposure conditions and the potential need to re-institute a vessel surveillance program will be discussed with the NRC staff prior to changing the plant's licensing basis. **Program Elements Affected: (Element 6)**

5. Enhancements to the current Reactor Vessel Surveillance Program will be made to require that if future plant operations exceed the limitations or bounds specified for cold leg temperatures (vessel inlet) or higher fluence projections, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC shall be notified.

    a. Inlet Temperature Range Limitation: 525°F (min) to 590°F (max)

    b. Fluence Limitation (max.): 1.00×10^{20} n/cm^2 (E > 1.0 MeV)

    Program Elements Affected: (Element 8)

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of fracture toughness due to neutron irradiation embrittlement is being adequately managed. The following examples of operating experience provide objective evidence that the Reactor Vessel Surveillance Program will be effective in assuring that intended function(s) would be maintained consistent with the CLB for the period of extended operation:

1. Capsule X was the third capsule removed from the Salem Unit 2 reactor vessel in 1992 to support the continuing surveillance program. Westinghouse performed the analysis of the capsule. The results of the analysis indicated that the capsule received an average fast neutron fluence (E > 1.0 MeV) of 1.16 x 10^{19} n/cm^2 after 6.2 EFPY of plant operation. Subsequent calculations of Upper Shelf Energy (USE) using this fluence value for the weld metal and base metal specimens predict that the materials will be greater than the 50 ft-lb acceptance criteria contained in Regulatory Guide 1.99, Rev. 2. The calculated 40-year (32 EFPY) maximum neutron fluence (E > 1.0 MeV) are as follows; (1) Vessel Inner Radius = 1.76 x 10^{19} n/cm^2, (2) Vessel ¼ T = 9.27 x 10^{18} n/cm^2, and (3) Vessel ¾ T = 1.85 x 10^{18} n/cm^2. The surveillance capsule materials exhibited a more than adequate USE for continued safe operation. Therefore, this example provides objective evidence that the existing Reactor Vessel Surveillance program will be capable of monitoring the aging effects associated with the loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline materials.

2. Capsule S was the fourth capsule removed from the Salem Unit 1 reactor vessel in 1996 to support the continuing surveillance program. Westinghouse performed the analysis of the capsule. The results of the analysis indicated that the capsule received an average fast neutron fluence (E > 1.0 MeV) of 1.97 x 10^{19} n/cm^2 after 10.8 EFPY of plant operation. The analysis also indicated that the limiting materials were the same as those evaluated in the previous capsule analysis, thus the normal heatup and cooldown curves produced in the previous capsule analysis remain valid, based on the current analysis. The results from the surveillance capsule material evaluation concluded that the materials met the requirements for continued safe operation. Therefore, this example provides objective evidence that the existing Reactor Vessel Surveillance program will be capable of monitoring the aging effects associated with the loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline materials.

3. Capsule Y was the fourth capsule removed from the Salem Unit 2 reactor vessel in 2000 to support the continuing surveillance program. Westinghouse performed the analysis of the capsule. The results of the analysis indicated that the capsule received an average fast neutron fluence (E > 1.0 MeV) of 1.81 x 10^{19} n/cm^2 after 10.8 EFPY of plant operation. Subsequent calculations of Upper Shelf Energy (USE) using this fluence value for the weld metal and base metal specimens predict that the materials should be greater than the 50 ft-lb acceptance criteria contained in Regulatory Guide 1.99, Rev. 2. The actual average fast neutron fluence (E > 1.0 MeV) of 1.81 x 10^{19} n/cm^2 after 10.8 EFPY is consistent and less than the predicted average fast neutron fluence (E > 1.0 MeV) of 2.05 x 10^{19} n/cm^2 after 11 EFPY from the previously pulled Capsule X. The results from the surveillance capsule material evaluation concluded that the materials met the requirements for continued safe operation. Therefore, this example provides objective evidence that the existing Reactor Vessel Surveillance program will be capable of

monitoring the aging effects associated with the loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline materials.

There is sufficient confidence that the implementation of the Reactor Vessel Surveillance Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Reactor Vessel Surveillance Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Reactor Vessel Surveillance Program will provide reasonable assurance that loss of fracture toughness due to neutron irradiation embrittlement will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.20 One-Time Inspection

Program Description

The One-Time Inspection aging management program is a new program that will provide reasonable assurance that an aging effect is not occurring, or that the aging effect is occurring slowly enough to not affect a components intended function during the period of extended operation, and therefore will not require additional aging management. The program will be credited for cases where either (a) an aging effect is not expected to occur but there is insufficient data to completely rule it out, (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected, or (c) the characteristics of the aging effect include a long incubation period. Major component types covered by the program include, piping, piping elements and piping components, steam generators, heat exchangers and tanks.

The One-Time Inspection aging management program will be used for the following:

1. To confirm the effectiveness of the Water Chemistry program to manage the loss of material, cracking, and the reduction of heat transfer aging effects for aluminum, copper alloy, nickel alloy, steel, stainless steel, and cast austenitic stainless steel in treated water, treated borated water, steam, and reactor coolant environments.

2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for aluminum, copper alloy, gray cast iron, steel and stainless steel in a fuel oil environment.

3. To confirm the effectiveness of the Lubricating Oil Analysis program to manage the loss of material and the reduction of heat transfer aging effects for aluminum, copper alloy, ductile cast iron, gray cast iron, steel, stainless steel, cast austenitic stainless steel and titanium alloy in a lubricating oil environment.

The new program elements include (a) determination of the sample size based on an assessment of materials of fabrication, environment, plausible aging effects and mechanisms, and operating experience; (b) identification of the inspection locations in the system or component based on the aging effect; (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined; and (d) evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the period of extended operation. When evidence of an aging effect is revealed by a one-time inspection, the engineering evaluation of the inspection results will identify appropriate corrective actions.

The inspection sample includes one-time inspection of more susceptible materials in potentially more aggressive environments (e.g., low or stagnant flow areas) to manage the effects of aging. Qualified personnel following station procedures that are based on applicable codes and standards, including ASME, and 10 CFR 50, Appendix B, will perform the inspections. Examination methods will include volumetric examination (UT or RT) or visual examination (VT-1, VT-3, or equivalent). Acceptance criteria are in accordance with industry guidelines, codes, and standards, including ASME Boiler and Pressure Vessel Code, Section XI, 1998 Edition, 2000 Addenda.

The One-Time Inspection aging management program is a condition monitoring program with elements that are effective in detecting the identified aging effects and evaluating the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the period of extended operation.

The inspections will be scheduled within 10 years prior to the period of extended operation, as close to the end of the current operating license as practical with margin provided to ensure completion and evaluation of the inspection results including identification of any appropriate corrective actions prior to commencing the period of extended operation.

NUREG-1801 Consistency

The One-Time Inspection Program is consistent with the ten elements of aging management program XI.M32, “One-Time Inspection Program”, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The One-Time Inspection aging management program will be used to verify the system-wide effectiveness of aging management programs that are designed to prevent or minimize aging to the extent that it will not cause a loss of intended function during the period of extended operation. The program provides inspections that either verifies that unacceptable degradation is not occurring or that triggers additional actions that will assure the intended function of affected components will be maintained during the period of extended operation. Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately identified and managed. The following examples of operating experience demonstrate that the inspection techniques to be utilized for the One-Time Inspection program can be used to identify degrading conditions, and that deficiencies identified are entered into the corrective action process, where they are evaluated and appropriate action is taken. These examples coupled with the discussion that follows concerning the overall condition of the involved systems provide objective evidence that the One-Time Inspection program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation.

1. On 10/24/2002 at Salem Unit 1 during the replacement of valve 13BF51 (16C High Pressure Feedwater Heater outlet Vent Valve) technicians reported what they believed could be a suspect wall thinning condition on piping upstream of the valve. This condition was reported and evaluated as part of the corrective action process, where UT measurements were specified to provide data for the evaluation of the condition of the section of piping. The results of the UT measurements were reviewed by engineering. The pipe (nominal wall 0.179") had a measured wall thickness of 0.157" and a predicted wall thickness of 0.154" for the operating conditions and time in service. This data was evaluated by engineering and determined to be considerably above the code minimum wall thickness of 0.057" for the piping. The piping was determined acceptable for continued service with no corrective action needed.

   This example provides objective evidence that suspect or questionable degraded conditions are entered into and evaluated as part of the corrective action process. It also demonstrates that inspection techniques utilized such as UT are effective in providing the necessary data to evaluate extent of material loss to determine if any additional actions are needed. Inspection techniques and evaluation of data similar to the above will be used as part of the One-Time Inspection program. This will ensure effective condition monitoring of piping and components within the scope of license renewal.

2. On 4/11/2002 at Salem Unit 2 during inspections being performed for the program related to GL 89-13 - Service Water System Problems Affecting Safety Related Equipment, a degraded condition was discovered in a spool piece in the service water system. The spool piece designated 2-SW-P-WS147 was a section of A333 GR 1 pipe with a 24 inch nominal diameter, 0.5 inch wall thickness and raised face flanges. The spool piece was located in a line on the inlet header to the Unit 2 Diesels. Visual inspection revealed deep eroded/corroded areas on the inside of the pipe wall approximately 3/8" in depth that were below minimum wall thickness. The above information was entered into the corrective action process. The cause was determined to be the corrosive nature of the plant service water. Periodic inspections were already in place as part of the GL 89-13 inspection program for the both units. Corrective actions consisted of weld repair of the affected areas including the flange faces to restore degraded areas to original thickness and a restoration of the protective coatings on the interior of the spool piece and flange faces.

   This example provides objective evidence on the effectiveness of internal visual inspections for the detection of degrading conditions inside piping and components and that deficiencies identified are entered into the corrective action process where they are evaluated for any required actions to ensure intended function of components is maintained. Actions such as these will ensure effective condition monitoring of piping and components within the scope of license renewal.

3. On 06/22/2006 during on-line UT inspections at Salem Unit 2 for the Flow Accelerated Corrosion (FAC) program a 4-inch diameter elbow in the Moisture Separator Drains system was identified as having two readings just below minimum wall thickness based on hoop stress. The subject elbow (FAC component ID C157) is the 4" elbow immediately downstream of valve 21RD42, coming from 21W Moisture Separator going to the No. 22 Bleed Steam Coil Drain Tank. It is located at 128'-2 1/2" elevation of the Turbine building (under 21W MSR). The elbow nominal wall thickness was 0.237", minimum thickness based on Hoop Stress (Pressure) was 0.062", and the minimum measured thickness in two spots was 0.060" and 0.061", with some surrounding readings of 0.075 to 0.094". The above results of the inspection were reported in the corrective action process for evaluation and resolution. A technical evaluation was performed that indicated that the component still had adequate safety margin to remain in service until Salem Unit 2 refueling outage S2R15 (October 2006). Piping analysis was also performed using computer software to assess the impact of degraded thickness of subject elbow and the section of downstream pipe. Based on this analysis, it was concluded that the affected piping was capable of meeting design basis loads due to pressure, deadweight, and thermal loads in the degraded condition. The analysis was run with 0.050" wall thickness that demonstrated about a 30% margin against sustained load stress allowable. The predicted wall thickness at the end of the operating cycle was estimated to be at 0.056", which meets the intent of pressure design for operating conditions and other design basis loads discussed above. Therefore, the affected piping was considered safe to operate to the S2R15 outage (October 2006) when it would be repaired or replaced. The cause of the elbow thinning was attributed to flow-accelerated corrosion over the course of this component's life, which was approximately 144,305 hours of operation. In accordance with the FAC program requirements and to address extent of condition a sample expansion was specified, which included three additional components, one within a similar parallel train and the other two being the two next highest wear components specified in CHECWORKS, the program used to manage the FAC program. The expanded inspection results were acceptable with the exception of the parallel train component (C084), which had UT readings below 55% of nominal wall thickness. Both of the components identified with degraded conditions were replaced during Salem Unit 2 refueling outage S2R15 (October 2006).

   This example provides objective evidence that UT inspection techniques that will be used as part of the One-Time Inspection program are proven techniques for identifying degraded conditions such as loss of material and that the corrective action process will provide an appropriate and effective process for evaluating any degraded conditions identified, and specify appropriate corrective actions. Inspections and evaluations similar to these will be a part of the One-Time Inspection program and will ensure effective condition monitoring of piping and components within the scope of license renewal.

A review of Maintenance Rule and System Health reports for systems common to those that credit the One-Time Inspection program for aging management was conducted. The review revealed the aging effects that the One-Time Inspection program is credited for are not contributing to any adverse trend in performance or loss of component intended functions for these systems. The overall condition of the systems with respect to the applicable aging effects, coupled with the one-time inspections to confirm that an aging effect is not occurring, or that the aging effect is occurring slowly enough to not affect a components intended function during the period of extended operation provide sufficient confidence that the implementation of the One-Time Inspection program will effectively identify and manage degradation that could lead to failure. Assessments of the One-Time Inspection program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new One-Time Inspection program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.21 Selective Leaching of Materials

Program Description

The Selective Leaching of Materials aging management program is a new program that consists of one-time inspection to determine if loss of material due to selective leaching is occurring. The scope of the program will include components made of susceptible materials and located in potentially aggressive environments. Susceptible materials at Salem are gray cast iron, copper alloy with greater than 15% zinc and aluminum bronze with greater than 8% aluminum. Environments include raw water, closed cooling water, soil and treated water.

The Selective Leaching of Materials aging management program will be implemented prior to the period of extended operation. The program will provide for visual inspections, hardness tests, and other appropriate examinations, as required, to identify and confirm existence of the loss of material due to selective leaching. If degradation is found, the condition of affected components will be evaluated to determine the impact on their ability to perform intended functions during the period of extended operation. Condition monitoring and expanded sampling will be utilized, as required, to ensure the components perform as designed.

The Selective Leaching of Materials Program will develop a new procedure to perform visual inspections and hardness tests to determine if selective leaching is occurring. As such, there are no preventative or mitigative attributes associated with this program. In treated water and closed cycle cooling water environments, chemistry is monitored in accordance with the Water Chemistry and Closed-Cycle Cooling Water System Programs, respectively, to minimize corrosive contaminants and to control pH. In some cases, corrosion-inhibiting additives are used. These activities are considered effective in reducing selective leaching.

NUREG-1801 Consistency

The Selective Leaching of Materials program is consistent with the ten elements of aging management program XI.M33, Selective Leaching of Materials, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material due to selective leaching is being adequately managed. The following examples of operating experience provide objective evidence that the Selective Leaching of Materials program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The review of the Salem operating experience identified the de-alloying of a strainer drum. In September of 2008, de-alloying of a service water aluminum bronze strainer drum in brackish water was identified by a visual inspection. Selective leaching was identified after an unexpected material failure occurred, during a planned maintenance evolution at an offsite repair facility. The maintenance evolution involved rigging the strainer drum into position for a machining operation. During the rigging, the strainer drum material failed at the rigging attachment point to the strainer. This failure of the strainer drum exposed the inner portion of the drum material where de-alloying of the drum was visually observed during an inspection. The cause of the material failure was determined to be human performance error as result of improper lifting practices being used during the rigging.

   As part of the corrective action program it was determined additional examinations and evaluations would be performed as a result of the visual inspection that identified the de-alloying of the strainer drum. A sample of the strainer was sent to a laboratory for analysis to identify the possible extent of loss of material properties due to selective leaching. The strainer bodies are also made of aluminum bronze but have sacrificial anodes to protect the aluminum bronze material from de-alloying. A boat sample was also taken from the strainer body and was sent to a laboratory for analysis. Engineering performed an extent of condition evaluation and identified that all the service water strainer drums are most likely in the same condition since every one of the strainer drums have been in service for 22 years. The evaluations and corrective actions are currently being tracked in the corrective action program.

   As stated above, the service water strainer drum rotating assemblies have planned maintenance. This routine planned maintenance for refurbishment or replacement is on a six year cycle due to strainer drum wear ring erosion that occurs during normal operation. This planned maintenance evolution on the strainer drum at the offsite repair facility includes the removal and replacement of the short lived filter elements with new filter elements. The six year planned refurbishment of each strainer drum is to ensure debris from the river does not bypass the strainer at the wear ring location and affect the heat transfer characteristics of the components downstream of the strainer which are cooled by the service water system.

Future planned corrective actions as a result of identifying selective leaching in the service water strainer drum include replacing the existing drums with a newly designed strainer drum. The change in design includes sacrificial anodes to reduce the potential for de-alloying of aluminum bronze material. In addition the new selective leaching program will evaluate all long lived passive component types in the scope of license renewal with this material and environment combination for indications of selective leaching.

This example provides objective evidence that Salem is finding indications of selective leaching during inspections of components that are susceptible to selective leaching. In addition this example demonstrates corrective actions are being taken to refurbish material that is susceptible selective leaching prior to the selective leaching program being implemented at the station.

2. Industry operating experience has identified graphitization of gray cast iron submerged pump components from long-term immersion in saltwater and brackish water environments. In December 2003, selective leaching was visually observed in the graphitization of the gray cast iron pump casing components in the Salem circulating water system, which was exposed to the brackish river water conditions for over 25 years. A root cause was performed and the corrective actions were implemented. As a result of the root cause, inspections or refurbishment of these components are currently performed on a 3-year frequency. This inspection frequency is specified and implemented through the preventive maintenance program. The circulating water system is not within the scope of license renewal. There are no components with a gray cast iron material in a brackish water environment in the scope of license renewal at Salem.

   This example provides objective evidence that Salem has identified selective leaching and is taking corrective actions to monitor and refurbish material that is susceptible to selective leaching.

Once implemented, the Salem Selective Leaching of Materials aging management program will manage loss of material such that intended function(s) of components susceptible to selective leaching will be maintained consistent with the current licensing basis for the period of extended operation.

No other occurrences of selective leaching have been identified at Salem. Occurrence identified to date did not cause significant impact to safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Selective Leaching of Materials program will effectively identify degradation prior to loss of intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Selective Leaching of Materials program will be performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Selective Leaching of Materials aging management program inspections will provide reasonable assurance that loss of material aging effects due to selective leaching will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.22 Buried Piping Inspection

Program Description

The Buried Piping Inspection aging management program is an existing program that includes preventive measures such as coating and wrapping to mitigate corrosion and periodic inspection of external surfaces for loss of material to detect and monitor the effects of corrosion on the external surface of buried steel piping and components in a soil or groundwater (external) environment. The program provides for managing loss of material due to general corrosion, pitting, crevice corrosion and microbiologically-influenced corrosion (MIC). Preventive measures are in accordance with standard industry practices for maintaining external coatings and wrappings.

Salem does not have any buried tanks in the scope of license renewal.

External inspections of buried components using visual techniques will occur opportunistically when they are excavated during maintenance. Inspection of at least one carbon steel, one ductile cast iron and one gray cast iron piping and components will be performed in the ten years prior to the period of extended operation. Upon entering the period of extended operation, a focused excavation and inspection of each of the above materials shall be performed within the first ten years, unless an opportunistic inspection occurs within this ten-year period.

Any coating and wrapping degradation is reported and evaluated according to site corrective actions procedures. External component degradation is reported and evaluated whenever buried commodities are uncovered during yard excavation activities, which includes bolting. The Bolting Integrity program addresses the aging management of buried bolting. In addition, evidence of metal surface corrosion and any leakage detected through periodic testing and visual inspections will be evaluated and used to confirm the system and components ability to perform their intended functions. Any leakage identified is evaluated and appropriate corrective actions are implemented.

The program will be enhanced as described below to provide reasonable assurance that buried piping and components of all steel materials that are in scope of the Buried Piping Inspection program, including carbon steel, ductile cast iron, and gray cast iron at Salem will perform their intended function during the period of extended operation.

NUREG-1801 Consistency

There are no buried tanks at Salem units that are in scope for license renewal. The Buried Piping Inspection aging management program is consistent with the ten elements of aging management program XI.M34, "Buried Piping and Tanks Inspection," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented:

1. The Buried Piping Inspection aging management program will be enhanced to include at least one opportunistic or focused excavation and inspection of carbon steel, gray cast iron, and ductile cast iron piping and components within ten years prior to entering the period of extended operation. Upon entering the period of extended operation, a focused inspection of each of the above materials shall be performed within the first ten years, unless an opportunistic inspection occurs within this ten-year period. **Program Elements Affected: Detection of Aging Effects (Element 4)**

Operating Experience

Operating experience shows that the program described is effective in managing corrosion of external surfaces of buried steel piping. As the inspection frequency is plant-specific and depends on the plant operating experience, the Salem plant-specific operating experience is further evaluated for the extended period of operation. Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion are being adequately managed. The following examples of operating experience provide objective evidence that the Buried Piping Inspection program will be effective in assuring that intended function(s) would be maintained consistent with the CLB for the period of extended operation:

1. In 2004, buried carbon steel piping in the Salem Unit 1 Fuel Oil System was excavated to repair leakage at a welded joint. The socket-welded joint was not properly wrapped with a protective tape. The wrap for this joint was originally missing altogether and the leakage was caused by direct exposure to groundwater and subsequent corrosion, not by aging. The joint was repaired and proper wrapping was applied. No further problem has been identified with this or any other portions of the buried carbon steel piping of the Fuel Oil System. The affected portion of the Fuel Oil System was not in scope for license renewal. This example provides objective evidence that buried piping is opportunistically inspected whenever they are excavated for maintenance, and that corrective actions are taken prior to loss of intended function.

2. In 2001, a section of the buried No. 12 service water piping at Salem Unit 1 was excavated to determine the cause of leakage. The cause of leakage was a break in the steel bell ring, which is installed over one pipe joint section of the service water piping. The apparent cause of this break was due to external loads from the road surface, and not caused by age-related degradation. The break was repaired and the external concrete coating was reapplied. Additionally, a Ram-Neck sealant was reapplied over the entire section of the bell, to prevent water intrusion. This sealant had to be replaced because of being displaced at the leak site. Additionally, the Ram-Neck sealant was top-coated with a flexible paint. Also, a WEKO seal was installed (internally) over the steel bell ring. An extent of condition study, as well as internal corrosion of some other bell-and-spigot joints, resulted in installation of WEKO seals on bell-and-spigot joints for all service water headers internally. With the exception of No. 11 service water header, all service water header joints now incorporate WEKO seals. Work on No. 11 service water header joints is planned for 2010.

   During this excavation, a section of coated carbon steel piping that discharges the backwash of the service water strainers was excavated and no deficiencies were identified.

   This provides objective evidence that excavation and inspection of piping and components have been occurring opportunistically at Salem.

3. In 2008, risk ranking of buried piping at Salem revealed that portions of the carbon steel Service Water piping were determined to be high risk. As a result, a plan was developed to conduct inspection of the external coated carbon steel through-wall penetrations of the 24-inch service water underground spools at the Service Water Intake Structure, entrance and exit of the pipe tunnel, entrance to the Auxiliary Building and entrance to the Diesel Building. Further evaluation is underway to determine if this inspection can be performed using non-destructive examination of piping (from the inside diameter) or if excavation will be required.

   This inspection, which is scheduled to take place during a refueling outage in October of 2009, provides objective evidence that an appropriate risk ranking methodology is in place and that focused inspection of the outer coating of the buried steel piping was planned as part of this aging management program.

A review of plant operating experience showed that excavation of buried piping has occurred, and no instances of significant age related deficiencies were documented. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Buried Piping Inspection program will effectively identify degradation prior to failure. The work planning process provides instructions to do exterior surface inspections when excavations occur. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Buried Piping Inspection program are planned, to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Buried Piping Inspection aging management program will provide reasonable assurance that loss of material aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.23 One-Time Inspection of ASME Code Class 1 Small Bore-Piping

Program Description

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program is a new program that manages the aging effect of cracking in stainless steel ASME Code Class 1 piping, piping elements and piping components less than 4 inches nominal pipe size (NPS 4) and greater than or equal to NPS 1 (Table IWB-2500-1, Examination Category B-J, Item No. B9.21) in reactor coolant and treated water environments. The One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program is a new program that Salem will implement prior to the period of extended operation and within the last ten years of the current operating period. Salem has not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal and mechanical loading. Should evidence of significant aging be revealed by the one-time inspection, periodic inspection will be proposed.

Since the publication of NUREG-1801 Revision 1, the interim guidance contained in EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)," has been supplemented by a more complete set of guidelines on thermal fatigue issues for lines connecting to the reactor coolant system (RCS); those guidelines are contained in EPRI Report 1011955, "Materials Reliability Program Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146)." The program uses the more recent revision.

The Salem One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program is included in the Risk Informed Inservice Inspection (RI-ISI) program, which is based on the EPRI RI-ISI Topical Report, EPRI TR-112657, and ASME Code Case N-578-1. Because the use of RI-ISI, in lieu of ASME Code Section XI, must be approved pursuant to 10 CFR 50.55a(a)(3), it is not considered an exception to NUREG-1801. The alternative RI-ISI program is substituted for the 1998 Edition through the 2000 Addenda of ASME Section XI Code Edition for Class 1 Examination Category B-J, Item No. B9.21 circumferential welds in accordance with 10 CFR 50.55a(a)(3)(i) by alternatively providing an acceptable level of quality and safety.

The program includes one-time volumetric examinations of a sample of Class 1 small-bore butt welds. In lieu of performing one-time volumetric inspections of socket welds for pipe size less than 4 inches NPS and greater than or equal to NPS 1, the examination method and frequency will be VT-2, as allowed per the code, each refueling outage as defined in Code Case N-578-1, Table 1. Any cracking identified in small-bore Class 1 piping resulting from stress corrosion or thermal and mechanical loading will result in periodic inspections. This sample includes locations that are susceptible to cracking. The program includes measures to verify that unacceptable degradation is not occurring in Class 1 small-bore piping, thereby validating the effectiveness of the Water

Chemistry Program, B2.1.2, to mitigate aging-related degradation and confirming that no additional aging management programs are needed for the period of extended operation.

NUREG-1801 Consistency

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program is consistent with the ten elements of aging management XI.M35, One-Time Inspection of ASME Code Class 1 Small-Bore Piping, specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. The NUREG-1801 program references the interim guidance contained in EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)." Salem uses a more recent revision to the MRP issue regarding Thermal Fatigue. **Program Elements Affected: Scope of Program (Element 1)**

Justification for Exception

Since the publication of NUREG-1801 Revision 1, the interim guidance contained in EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)," has been supplemented by a more complete set of guidelines on thermal fatigue issues for lines connecting to the reactor coolant system (RCS). Salem uses these more recent guidelines, contained in EPRI Report 1011955, "Materials Reliability Program Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146)."

Enhancements

None.

Operating Experience

The evaluations use a combination of volumetric and visual inspection techniques with demonstrated capability to detect cracking in piping weld and base material. The application of the specific technique to ASME Code Class 1 small-bore piping is qualified to detect cracking before the examination.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the One-Time Inspection of ASME Code Class 1 Small Bore-Piping program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In September 2008, Salem-1 had no unacceptable small bore piping welds exam inspection results. The Owner's Activity Report had no ASME category B-J welds (Risk Informed R-A welds) listed in Tables 2 or 3.

Table 2 is ISI exam items found with flaws or relevant conditions that require evaluation for continued service. Table 3 is a list of repairs, replacements, or corrective measures required for continued service. Therefore, out of 11 category B-J welds < 4" NPS small bore inspections under the Risk Informed ISI program during this refueling outage, all small bore examined welds met the ASME acceptance criteria.

2. In July 2008, Salem-2 there were no unacceptable small bore piping welds exam inspection results. The Owner's Activity Report had no ASME category B-J welds (Risk Informed R-A welds) listed in Tables 2 or 3. Table 2 is ISI exam items found with flaws or relevant conditions that require evaluation for continued service. Table 3 is a list of repairs, replacements, or corrective measures required for continued service. Therefore, out of 5 category B-J welds < 4" NPS small bore inspections under the Risk Informed ISI program during this refueling outage, all small bore examined welds met the ASME acceptance criteria.

3. Salem Units 1 & 2 from 2003-2008 examined 54 category B-J welds (Risk Informed R-A welds) < 4" NPS small bore inspections under the Risk Informed ISI program. All small bore examined welds met the ASME acceptance criteria.

4. In October 2003, Salem-2 identified a 0.1" Curvilinear Indication on a 4" pipe as a result of scheduled outage ISI inspections. During the ISI program scope activity a liquid penetrant examination observed this 0.1" indication on the 4" pipe adjacent to a hanger. Per ASME XI IWB 3514-2 the length of the indication was acceptable but was repaired by maintenance. The surface imperfection was blended out. This area is scheduled for re-inspection during Salem-2 Fall 2009 (S2RF017) refuel outage.

The above examples provide objective evidence that the new One-Time Inspection of ASME Code Class 1 Small Bore-Piping aging management program is capable of both monitoring and detecting the aging effects of cracking. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the One-Time Inspection of ASME Code Class 1 Small Bore-Piping program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the One-Time Inspection of ASME Code Class 1 Small Bore-Piping program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new One-Time Inspection of ASME Code Class 1 Small Bore-Piping aging management program will provide reasonable assurance that the cracking aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.24 External Surfaces Monitoring

Program Description:

The External Surfaces Monitoring aging management program is a new program that directs visual inspections that are performed during system walkdowns. The program consists of periodic visual inspection of components such as piping, piping components, ducting, and other components within the scope of license renewal exposed to an air environment. The program provides for management of aging effects through visual inspection of external surfaces for evidence of loss of material.

Materials of construction inspected under this program include galvanized steel, carbon steel, gray cast iron and ductile cast iron. For steel components, visual inspections will identify loss of material. General corrosion will manifest itself as visible rust or rust byproducts (e.g., discoloration or coating degradation) and be detectable prior to any loss of intended function.

Examples of components this program inspects are piping and piping elements, ducting, heat exchangers, and tanks. The inspection parameters include material condition of the components, which consists of evidence of unusual rust, corrosion, overheating, blistering, and discoloration; evidence of insulation damage or wetting; degradation, blistering, and pealing of protective coatings; unusual leakage from piping or component bolted joints. Coatings degradation is used as an indicator of possible underlying degradation of the component.

The External Surfaces Monitoring Program is a visual condition monitoring program that does not include preventive or mitigating actions.

Typically, system walkdowns of accessible areas are performed at least quarterly and walkdowns of inaccessible areas are performed at least once per refueling outage. Surfaces that are inaccessible or not readily visible during both plant operations and refueling outages are inspected at such intervals that would provide reasonable assurance that the effects of aging will be managed such that applicable components will perform their intended function during the period of extended operation.

Engineering personnel will determine the acceptance criteria based upon component, material, and environment combinations. Visual inspection activities are performed by qualified personnel in accordance with site controlled procedures and processes. Deficiencies are documented using the corrective action process to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the problem is determined and an action plan is developed to prevent recurrence.

Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion program. The external surfaces of components that are buried are inspected via the Buried Piping Inspection and Buried Non-Steel Piping Inspection programs. The external surfaces of above ground tanks are inspected via the Aboveground Steel Tanks and Aboveground Non-Steel Tanks programs. This program does not provide for managing aging of internal surfaces.

NUREG-1801 Consistency

The Salem External Surfaces Monitoring aging management program is a new program that is consistent with NUREG-1801 aging management program XI.M36, External Surfaces Monitoring.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the External Surfaces Monitoring program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In April 2008, several instances of Containment Fan Cooler Units service water leakage have occurred at Salem Unit 2 causing equipment degradation and or plant transients due to the corrosive effects of the service water. Several carbon steel pipes showed signs of being heavily rusted including pipes that had through wall leaks. The piping in the location is insulated and rust streaks were evident on the containment penetration itself. An apparent cause identified general corrosion due to repeated Service Water leakage onto the insulated carbon steel piping. An extent of condition evaluation was performed and the affected piping was replaced with new piping. Guidance was added to the Service Water Leak Response in Containment document to remove insulation from carbon steel components soaked with service water to dry out the insulation and prevent general corrosion of the carbon steel.

2. During a March 2008 maintenance activity of a Unit 1 containment fan cooler unit the carbon steel bolts were found to have corrosion due to exposure to normal condensation. The bolts were removed and replaced with bolts with a water repellant coating to prevent future degradation.

3. In February 2008, Salem Unit 1 chilled water valves and valve flange nuts were found to have surface rust due to exposure to normal condensation. The areas that were found to have corrosion were cleaned and painted to prevent further degradation.

4. During the October 2006 walkdown of the Salem Unit 2 containment, it was identified that a service water valve body to bonnet had a leak and rust was on the body of the valve. The leak was secured to prevent further degradation and the areas that were found to have corrosion were cleaned to remove rust from the valve body.

5. In June 2005, the Salem Unit 1 #11 Chiller's evaporator cooler was found not to be insulated and was sweating condensation that resulted in surface pitting and corrosion of the evaporator shell. The lack of insulation was determined to be the cause of the corrosion. The other chillers were found to have insulation and not sweating. The exposed surface was prepped, painted and insulated. Follow up walkdowns of the chiller evaporator cooler did not find surface pitting corrosion of the evaporator shell.

The above examples provide objective evidence that surface corrosion will be entered into the corrective action process so that action will be taken to resolve issues. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the External Surfaces Monitoring program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the External Surfaces Monitoring program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new External Surfaces Monitoring aging management program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of structures and components within the scope license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.25 Flux Thimble Tube Inspection

Program Description

The Flux Thimble Tube Inspection Program is a new program that manages the loss of material due to wear of the flux thimble tube materials. It implements the recommendations of NRC Bulletin 88-09. This program utilizes an inspection methodology such as eddy current testing (ECT) to inspect the flux thimble tubes on a periodic frequency to monitor wall thinning and predict when tubes would require repair or replacement. The program implements a wall thickness trending report.

The Flux Thimble Inspection program establishes appropriate acceptance criteria (percent through-wall wear), based on industry guidance and including margin to include allowances for factors such as instrument uncertainty, uncertainties in wear scar geometry, and other potential inaccuracies, as applicable, to the inspection methodology. Where flux thimble tube through wall wear does not meet the established acceptance criteria, the tube must be isolated, capped, plugged, withdrawn, replaced, or otherwise removed from service in a manner that ensures the integrity of the reactor coolant system pressure boundary is maintained.

The monitoring methods employed by the program are effective in detecting loss of material and the frequency of monitoring will be adequate to prevent significant degradation.

NUREG-1801 Consistency

The Flux Thimble Tube Inspection Program is consistent with the ten elements of aging management program XI.M37, Flux Thimble Tube Inspection, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The Flux Thimble Tube Inspection program was in effect from 1985 to 1993. It was discontinued in 1993 after the replacement of the flux thimble tubes with an alternative design and follow-up inspections not finding significant wear. Demonstration that the effects of aging will be effectively managed is achieved through objective evidence that shows that aging effects and mechanisms were being adequately managed in past implementation. The following examples of operating experience provide objective evidence that the Flux Thimble Tube Inspection program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. Salem Unit 1 replaced in-kind all of their flux thimble tubes in 1981 after experiencing three at-power thimble leaks. In 1985, Salem Unit 1 performed eddy current testing (ECT) on all of the new flux thimble tubes and found wall losses of over 50% for ten (10) flux thimble tubes. These ten tubes were isolated. The wall loss on the thimble tubes is at the location where the tube passes through the fuel assembly nozzle block. The possible mechanism was believed to be flow induced vibration at the lower core support. New flux thimble tubes of an improved design were installed during 1RF7 (1990) to replace all of the existing tubes and inserts for the lower internals to prevent flow-induced vibration wear. This example provides objective evidence that the Flux Thimble Tube Inspection program will be capable of both monitoring and detecting the aging effects associated with flux thimble tubes, and that site corrective actions are taken to prevent unacceptable wall thinning.

2. During 2RF2 (1984) at Salem Unit 2, ECT was used to inspect the flux thimble tubes. Possible external damage/wall losses were observed on sixteen (16) tubes where they pass through the lower core support. In the subsequent outage (1986), ECT was used and the results indicated wall losses of over 40% for three (3) flux thimble tubes. These three tubes were isolated. During 2RF4 (1990), Salem Unit 2 replaced all of the flux thimble tubes with tubes of an improved design. This example provides objective evidence that the Flux Thimble Tube Inspection program will be capable of both monitoring and detecting the aging effects associated with flux thimble tubes, and that site corrective actions are taken to prevent unacceptable wall thinning.

3. Salem replaced all of the flux thimble tubes during the 1RF7 (1990) and 2RF4 (1990) outages with an improved design (chrome-plated stainless steel). 1RF10 (1993) activities for Salem Unit 1 involved ECT of eleven (11) of the improved design flux thimble tubes removed and stored in the spent fuel pit. The results indicated that there was no significant wear on any of the eleven inspected flux thimble tubes. Indications found were attributed to incomplete tube cut scar and a partial tube cut. Also, the examinations indicated that there was no cladding bulging or ovality detected. As a result of the examinations, Salem notified the NRC that it would discontinue future periodic inspections of the flux thimble tubes. This example demonstrates the effectiveness of the program where improved design changes were made to replace the flux thimble tube materials with those of an improved design and later inspected to prove that there was minimal wear.

Based on past implementation experience, there is sufficient confidence that the re-implementation of the Flux Thimble Tube Inspection program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found.

Conclusion

The new Flux Thimble Tube Inspection aging management program will provide reasonable assurance that loss of material due to wear will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.26 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

Program Description

The Salem Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is a new program that manages the aging of the internal surfaces of steel piping, piping components, piping elements, ducting components, tanks and heat exchanger components. This program will manage the aging effect of loss of material for components exposed to air/gas wetted, diesel exhaust or raw water. The program includes provisions for visual inspections of the internal surfaces of components not managed under other aging management programs.

Inspections will be performed when the internal surfaces are accessible during the performance of periodic surveillances, during maintenance activities, and during scheduled outages.

For painted or coated surfaces, degradation of surfaces cannot occur without the degradation of the paint or coating. Confirmation of the integrity of the paint or coating is an effective method for managing the effects of corrosion on the steel surface. Paint or coating degradation may be identified by the presence of blistering, cracking, rusting, loss of adhesion, and mechanical damage. For uncoated surfaces, visual inspections will directly monitor for surface degradation including indications of general corrosion.

Inspection locations will be chosen to be a representative sample of the material and environment combinations. Visual inspections will detect indication of borated water leakage on internal surfaces where applicable.

Inspection intervals take into consideration component material and environment and industry and plant-specific operating experience. Results of the periodic inspections are monitored for indications of various corrosion mechanisms and fouling. The extent and schedule of inspections and testing are based on industry and plant specific operating experience, and assure detection of component degradation prior to loss of intended functions.

Indications of degradation that would impact component intended function, including degradation that could result in loss of material or fouling, are reported and will require further evaluation. The acceptance criteria are established in the maintenance and surveillance procedures or are established during engineering evaluation of the degraded condition. If the inspection results are not acceptable, the Corrective Action Program is implemented to assess the material condition and determine whether the component intended function is affected.

NUREG-1801 Consistency

The Salem Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is a new program that is consistent with the ten elements of NUREG-1801 aging management program XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry operating experience indicates that internal environmental conditions can cause age-related degradation to susceptible plant components. Existing plant procedures for visual inspections of internal surfaces of piping and ducting have identified minimal instances of internal degradation. Continued implementation of these procedures additional procedures to expand the scope of systems and components inspected will be adequate to manage degradation during the period of extended operation. Examples of past degradation identified by the existing procedures include:

1. Extensive maintenance history searches were performed on the ventilation systems in the scope of this program to identify plant operating experience with loss of material or other age related degradation on the internal surfaces of galvanized and carbon steel components. These ventilation systems contain and process air drawn directly from outdoors or air drawn from various plant areas. In system locations where condensation is expected, it is contained by collection and drain systems. Plant operating experience indicates that the ventilation system air environment is a passive environment and its degradation properties on the galvanized and carbon steel materials are not aggressive. No age related degradation issues associated with ventilation system internal surfaces could be found. The results from periodic internal inspections performed since 2003 indicate component conditions are satisfactory and did not indicate internal surface corrosion or degradation. Interviews with ventilation system managers at the station confirmed that ventilation systems have not experience loss a material or other aging degradation on the internal surfaces for the galvanized and carbon steel components in the scope of this program. This operating experience example provides objective evidence that existing maintenance activities will identify internal degradation prior to loss of ventilation system components intended functions.

2. The emergency diesel generator turbo boost air receiver tanks and starting air receiver tanks are periodically opened for maintenance inspection. The tank internal surfaces are visually inspected, and ultrasonic tests are performed to measure tank wall thickness. The results of these inspections performed from June 2003 through 2008 were reviewed. In some instances minor rust or scaling was found by visual inspection, and the affected areas were cleaned. Otherwise, the tanks were generally found clear of rust and loose aging debris. The UT wall thickness measurement results confirm that significant loss of material is not occurring. This operating experience example provides objective evidence that existing maintenance activities identify internal corrosion of carbon steel components, and that identified degradation is evaluated and appropriate monitoring activities are established to detect further degradation prior to loss of the component intended function.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program will provide reasonable assurance that the aging effect of loss of material will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.27 Lubricating Oil Analysis

Program Description

The Lubricating Oil Analysis aging management program is an existing program that provides oil condition monitoring activities to manage loss of material and reduction of heat transfer in piping, piping components, piping elements, heat exchangers, and tanks within the scope of license renewal exposed to a lubricating oil environment. Sampling, analysis, and condition monitoring activities identify specific wear products and contamination and determine the physical properties of lubricating oil within operating machinery. These activities are used to verify that the wear product and contamination levels and the physical properties of the lubricating oil are maintained within acceptable limits to ensure that intended functions are maintained.

The program directs the condition monitoring activities (sampling, analyses, and trending), thereby preserving an environment that is not conducive to loss of material, cracking or reduction of heat transfer. The lubricating oil testing (sampling and analysis) and condition monitoring activities identify detrimental contaminants such as water, sediments, specific wear elements, and elements from an outside source. The contaminant levels (e.g., water and particulates) are trended in the program's database, and recommendations are made when adverse trends are observed, which could include inleakage and corrosion product buildup.

Typical parameters analyzed by the Lubricating Oil Analysis program include; viscosity, total acid number (TAN), total water, wear particle count (WPC), wear metals such as iron, chromium, and lead, and contaminants/additives such as silicon, calcium, and zinc.

The Lubricating Oil Analysis program is a condition monitoring program and the monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

NUREG-1801 Consistency

The Lubricating Oil Analysis aging management program is consistent with the ten elements of aging management program XI.M39, "Lubricating Oil Analysis Program," specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 aging management program XI.M39, "Lubricating Oil Analysis Program" recommends the determination of flash point. Flash point is measured for all new lubricating oil and for in-service Emergency Diesel Generator (EDG) lubricating oil, however, it is not measured for in-service lubricating oil for the remaining components in the scope of the program. **Program Element Affected: Parameters Monitored or Inspected (Element 3)**

Justification for Exception

The determination of flash point in lubricating oil is used to indicate the presence of highly volatile or flammable materials in a relatively nonvolatile or nonflammable material, such as found with fuel contamination in lubricating oil. The existing Lubricating Oil Analysis program includes flash point analysis for the EDG in service lubricating oil, which is the only potential application for the introduction of highly volatile or flammable materials, e.g., diesel fuel, into the lubricating oil.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects/mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Lubricating Oil Analysis aging management program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In April 2004, a lubricating oil sample was taken from the Salem Unit 3 gas turbine in accordance with the Predictive Maintenance Program. The analysis indicated moisture content and total acid number (TAN) at their Alert Levels. It was recognized that the conditions could result in bearing damage. The condition was entered into the corrective action program. Prompt actions were initiated to change the lubricating oil and filter. These actions were completed in June 2004. Data since June 2004 shows moisture content and TAN returned to their normal ranges. Therefore, this example provides objective evidence that the Lubricating Oil Analysis program is capable of sampling lubricating oils, analyzing the samples for critical lubricating oil parameters, recognizing a condition adverse to quality, and implementing corrective actions to restore the critical parameters to the normal ranges.

2. In January 2004, a lubricating oil sample was taken from the lower bearing assembly of a circulating water pump motor in accordance with the Predictive Maintenance Program. The analysis indicated an increase in wear metal particles and a higher than normal total acid number (TAN). The levels of the wear metals iron, copper, and lead did not indicate a bearing problem. The condition was entered into the corrective action program. The vibration data was reviewed and it also did not indicate a bearing problem. The elevated TAN was an indication of possible increased oxidation of the oil. The sample results were verified and discussed with System Engineering. Although there was no indication of a significant problem with the lubricating oil, the recommendation was made to replace the lubricating oil at the next available window as a prudent action to protect the bearing. Prior to this replacement, additional sampling and analysis was performed in March 2004 and June 2004 to

monitor the condition of the lubricating oil and to ensure that the results of the January 2004 sample were accurate. These two additional samples indicated acceptable wear metal particle counts and TAN numbers. The sample from January 2004 was deemed to have been taken using a bad sampling technique. This apparent bad sampling technique was discussed with the personnel performing sampling. Replacement of the lubricating oil was canceled. Therefore, this example provides objective evidence that the Lubricating Oil Analysis program is capable of making prudent recommendations based on sample results, performing additional sampling to monitor critical lubricating oil parameters and to verify the validity of earlier samples, and adjusting corrective actions based on all of the analytical information.

3. In 2004, decreasing trends were noted for oxidation stability for the Salem Units 1 and 2 Main Turbine lubricating oils. This observation prompted a detailed historical review. It was noted that the test data was not always consistent and the sampling might be too infrequent to establish a strong baseline. Consequently, samples were taken in January 2004 with split samples sent to three independent laboratories for testing in accordance with ASTM D2272. The results from Laboratory #1 (the normal laboratory) were shown to be inconsistent with physical processes (i.e. oxidation stability does not improve without action) and inconsistent with the results from the other two laboratories. The cause of the inconsistent results was traced to a previously undetected temperature control problem with the testing apparatus, which was addressed by the vendor. The results from Laboratories #2 and #3 met the reproducibility criteria of ASTM D2272. The results were not at the Alert Level but they did indicate a degradation of the oxidation stability, specifically, the depletion of the additive package. The recommendation was made to increase the frequency of sampling from every 12 months to every 3 months to more closely monitor the trend and to establish a more accurate baseline. The additional sampling showed to the need for additive additions in the subsequent refueling outages. These additions were completed and oxidation stability returned to normal values. Following the creation of a strong baseline, the sampling frequency was set at every 12 months. The recent test data is consistent and strong baselines are maintained. Therefore, this example provides objective evidence that the Lubricating Oil Analysis program is capable of detecting unexpected behavior of critical lubricating oil parameters, initiating actions to understand the behavior, and implementing correction actions to fix the cause of the unexpected results.

There is sufficient confidence that the implementation of the Lubricating Oil Analysis program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Lubricating Oil Analysis program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Lubricating Oil Analysis aging management program provides reasonable assurance that the loss of material and the reduction of heat transfer aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.28 ASME Section XI, Subsection IWE

Program Description

The Salem ASME Section XI, Subsection IWE aging management program is an existing condition monitoring program that provides for inspection of Containment Structure liner plate, including its integral attachments, penetration sleeves, pressure retaining bolting, personnel airlock and equipment hatches, moisture barrier, and other pressure retaining components. The scope of the Salem ASME Section XI, Subsection IWE aging management program is consistent with the scope identified in Subsection IWE-1000. The scope of the program includes the containment *moisture barrier; but does not include containment seals and gaskets.* Containment seals and gaskets are included in the scope of the B.2.1.31, 10 CFR 50 Appendix J aging management program. The program complies with Subsection IWE for Class MC and metallic shell and penetration liners of Class CC pressure retaining components and their integral attachments of ASME Section XI, 1998 Edition including 1998 Addenda in accordance with the provisions of 10 CFR 50.55a. The monitoring methods have been demonstrated effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant aging. The concrete portions of containments are inspected in accordance with Subsection IWL.

The program is implemented through procedures that implement ASME Section XI, Subsection IWE requirements for detecting loss of material, loss of preload, and loss of sealing (of the moisture barrier). The containment environments addressed are: air-indoor, air with borated water leakage and air with steam or water leakage.

The program utilizes inspections that detect degradation before loss of intended function. No preventive attributes are associated with these activities. The program implements the requirements of IWE by providing general visual examinations, detailed visual examinations and augmented inspections as approved by 10 CFR 50.55a(a)(3)(i) for evidence of aging effects that could affect structural integrity or leak tightness of the containment structure. Areas subject to augmented inspection are subject to detailed visual inspection and volumetric (ultrasonic) examination techniques as required by engineering. The program addresses the E-A and E-C Examination Categories described in Table IWE-2500-1 in the ASME Code 1998 Edition with 1998 Addenda, as approved per 10 CFR 50.55a. The ASME 1998 and later ASME Codes do not contain categories E-B, E-D, E-F, E-G and E-P. The program specifies examinations of accessible surfaces to detect the aging effects of loss of material, loss of preload, and loss of sealing (of the moisture barrier) consistent with IWE-3500. The frequency and scope of examinations specified is in accordance with 10 CFR 50.55a and ASME Section XI, Subsection IWE-2400.

The moisture barrier at Salem has been partially covered by the liner insulation stainless steel lagging causing portions of the moisture barrier to be inaccessible for examination. The moisture barrier is a sealant installed at the junction of the Containment concrete floor and the carbon steel Containment liner. The portion of the moisture barrier that is accessible has been inspected by general visual examination in accordance with IWE. Insulation lagging and insulation have been removed for examination of the liner and moisture barrier when indications of degradation were observed. The program will be enhanced to require that visual inspection of 100% of the moisture barrier, at the junction between the containment concrete floor and the containment liner, will be performed in accordance with ASME Section XI, Subsection IWE program requirements, to the extent practical within the limitation of design, geometry and materials of construction of the components. The bottom edge of the stainless steel insulation lagging will be trimmed, if necessary, to perform the moisture barrier inspections.

The program provides for periodic inspections for the presence of age related degradation on all accessible surfaces of the containment on a scheduled basis. When examination results require an evaluation or the component is repaired and is found to be acceptable for continued service, the areas containing such flaws, degradation, or repair are reexamined during the next inspection period, in accordance with Examination Category E-C.

The program was developed based on the 1998 Edition with the 1998 Addenda of the ASME Code as authorized in accordance with 10 CFR 50.55a(a)(3)(i). The requirements of IWE-2430 were removed from this Code year and are not applicable to Salem.

The acceptance criteria for the ASME Section XI, Subsection IWE aging management program are in accordance with the requirements of the 1998 Edition with 1998 Addenda of the ASME Code, Subsections IWE-3000 and IWE-3500. In this Code year, Table IWE-3410-1 was replaced with a reference to Subsection IWE-3500.

The program implementing procedures and references contain the acceptance criteria for containment surface examinations. Category E-A examinations are conducted by a Certified VT-3 examiner or engineer; and Category E-C examinations are conducted by a Certified VT-1 examiner or engineer. Indications are evaluated and compared to acceptance standards in implementing procedures. The IWE Responsible Individual is responsible for evaluation of examination results. Unacceptable conditions are recorded and documented in accordance with the corrective action process and supplemental examinations are performed in accordance with IWE- 3200. Conditions which do not meet the acceptance criteria are accepted by an engineering evaluation or corrected by repair or replacement in accordance with IWE-3122.

Repairs and reexaminations, when required, are performed in accordance with IWA-4000 as required by IWE-3124 and the components are repaired or replaced to the extent necessary to meet the acceptance standards of IWE-3500. Component reexaminations are conducted in accordance with the requirements of IWA-2200 and the results are recorded to demonstrate that the repair meets the owner defined acceptance standards per IWE-3500.

The ASME Section XI, Subsection IWE program will be enhanced, as noted below, to provide reasonable assurance that the aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWE aging management program is consistent with the ten elements of aging management program XI.S1, "ASME Section XI, Subsection IWE," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented:

1. Inspection of a sample of the inaccessible liner covered by insulation and lagging prior to the period of extended operation and every 10 years thereafter. Should unacceptable degradation be found additional insulation will be removed as necessary to determine extent of condition in accordance with the corrective action process. **Program Elements Affected: Scope of Program (Element 1)**
2. Visual inspection of 100% of the moisture barrier, at the junction between the containment concrete floor and the containment liner, will be performed in accordance with ASME Section XI, Subsection IWE program requirements, to the extent practical within the limitation of design, geometry and materials of construction of the components. The bottom edge of the stainless steel insulation lagging will be trimmed, if necessary, to perform the moisture barrier inspections. This inspection will be performed prior to the period of extended operation, and on a frequency consistent with IWE inspection requirements thereafter. Should unacceptable degradation be found, corrective actions, including extent of condition, will be addressed in accordance with the corrective action process. **Program Elements Affected: Scope of Program (Element 1)**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWE program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 1995, corrosion products were identified below the Salem Unit 1 containment liner insulation. The insulation panel was removed to allow

examination of the inaccessible liner. Visual examinations found the liner to be in acceptable condition. UT inspections were also performed with satisfactory results and all thickness readings were greater than nominal wall thickness. The source of the corrosion product debris observed was not identified. This example provides evidence that inaccessible areas of the liner are examined and evaluated for acceptance when degradations are observed in accessible areas of the liner.

2. In 2005, borated water was noted leaking down the inside of the Unit 2 containment wall. The area was inspected and the liner insulation was removed in the area. No visible degradation was noted on the containment liner. To confirm visual inspection results, UT measurements of the containment liner were obtained and all thickness readings were greater than nominal wall thickness. This example provides objective evidence that inaccessible areas of the liner that are suspect of degradations are subject to visual and volumetric examination to ensure the required liner plate thickness is maintained.

3. In 2007, borated water was found leaking near the Unit 1 containment sump and corrosion of the galvanized elevator panels was found. The galvanized elevator panels are not subject to IWE examination. A gap of between 1.5 and 2.5 inches between the concrete floor and the stainless steel insulation lagging exists in the affected area. An examination was performed and no corrosion of the containment liner or degradation of the moisture barrier was found during these inspections. Monitoring activities were initiated to perform monthly inspections and cleaning of the boric acid leakage from around the containment sump enclosure and elevator until the sump leakage issue was resolved. This example provides objective evidence that the Salem ASME Section XI, Subsection IWE aging management program is capable of monitoring the liner plate for loss of material due to corrosion.

4. In 2008, a sampling inspection of the normally inaccessible containment liner and moisture barrier behind the insulation panels was conducted during the Unit 1 refueling outage. These areas were exposed for inspection due to industry experience as noted in USNRC Information Notice 2004-09 and experience at Robinson and Indian Point which have a similar insulated liner configuration. Four stainless steel panels and the associated insulation (one in each quadrant) were removed just above the floor elevation and inspected. The moisture barrier and the liner condition were found acceptable in all areas inspected. A similar inspection is planned for the Unit 2 containment liner. This example provides objective evidence that the Salem ASME Section XI, Subsection IWE aging management program is capable of both monitoring and detection of the aging effects associated with the containment liner and the moisture barrier, and that industry operating experience is used to improve the program and prevent degradation that has occurred at other plants.

The Containment Structure liner plate, including its integral attachments, penetration sleeves, pressure retaining bolting, personnel airlock and equipment hatches, moisture barrier, and other pressure retaining components have been found during inspections performed in accordance with ASME Section XI, Subsection IWE to be in good condition. Although minor corrosion has been identified in various locations, it is not significant, and the aging management program will provide reasonable assurance that significant degradation of the Containment liner and associated pressure retaining components will not occur during the period of extended operation. Problems identified did not cause any impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. The condition of the containment, and the evidence that degraded conditions, such as those described above, can be identified and corrected prior to any significant degradation occurring, provides sufficient confidence that the implementation of the ASME Section XI, Subsection IWE program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the ASME Section XI, Subsection IWE program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced ASME Section XI, Subsection IWE aging management program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained, consistent with the current licensing basis, during the period of extended operation.

B.2.1.29 ASME Section XI, Subsection IWL

Program Description:

The Salem ASME Section XI, Subsection IWL aging management program is an existing program which implements examination requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, Subsection IWL for reinforced and prestressed concrete containments (Class CC), 1998 Edition with the 1998 Addenda, as approved in accordance with 10 CFR 50.55a(a)(3). The program requires periodic inspection of Containment Structure concrete surfaces as specified by ASME Section XI, Subsection IWL and approved alternatives in accordance with 10 CFR 50.55a.

Inspection methods are in accordance with ASME Section XI, Subsection IWL and alternates authorized per 10 CFR 50.55a (a)(3)(i). Accessible concrete surfaces are subject to General Visual examination to detect deterioration and distress such as defined in ACI 201.1, including loss of material, cracks and distortion, and loss of bond. Concrete surfaces that are suspect of deterioration and distress, based on General Visual examination, are subject to Detailed Visual examination to determine the magnitude and extent of deterioration and distress. Qualification of examination personnel for Detailed and General Visual examinations conform to the requirements for VT-1C and VT-3C respectively.

Acceptance criteria specified in the program is consistent IWL-3000 for concrete containment surfaces. The acceptance criteria are qualitative and rely on the Responsible Engineer (RE), as defined by the ASME Code, to determine whether observed degradations warrant further evaluation or repair. Quantitative acceptance criteria, developed based on ACI 349.3R guidance, are included in the program implementing documents to augment qualitative assessment of the RE. Conditions that do not meet acceptance criteria are entered in the corrective action process and evaluated for acceptability or subject to Repair/Replacement, as determined by the RE.

The Salem ASME Section XI, Subsection IWL aging management program utilizes inspections that detect degradation before loss of intended function. No preventive attributes are associated with these activities.

The aging management program compiles with ASME Section XI, Subsection IWL, 1998 Edition including 1998 Addenda, as approved by 10 CFR 50.55a. In accordance with 10 CFR 50.55a(g)(4)(ii), the Salem ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWL aging management program is consistent with the ten elements of aging management program XI.S2, "ASME Section XI, Subsection IWL," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects are being adequately managed. The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWL program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In November 2000, Salem completed baseline visual examination of unit 2 containment structure concrete surfaces as mandated in 10 CFR 50.55a. Examination were conducted in accordance with ASME Section XI, Subsection IWL 1998 Edition, 1998 Addenda, approved in accordance with 10 CFR 50.55a. The examinations consist of general visual examinations to assess the general structural condition of the containment as required by IWL-2310. Minor surface scaling and spalling (< 2" deep) of concrete on exterior surfaces of the containment were observed; but in no case was rebar exposed. Rust stains were observed on the outside of the containment concrete wall (shell). The stains were attributed to carbon steel form-ties, and other original construction aid abandoned in place without cover since they no longer perform a function. Examiners qualified as specified in IWL-2310 identified no degradation that required evaluation, or Repair/Replacement in accordance with IWL-4000. Examinations results were documented in corrective action reports in accordance with the corrective action process. The RE evaluated the degradations and determined they have no impact on structural integrity of the containment thus acceptable without Repair/Replacement. This example demonstrates that loss of concrete material (scaling and spalling) and potential rebar corrosion (rust stains) are detected and evaluated before they have an impact on the containment reinforced concrete structural integrity.
2. In April 2001 Salem completed baseline examination of unit 1 containment structure accessible concrete surfaces in accordance with Salem ASME Section XI, Subsection IWL aging management program. The visual examinations were performed to assess the general structural condition of unit 1 containment in accordance with IWL-2310. Scaling (< 3" deep) and other minor degradations were observed by personnel qualified in accordance with IWL-2310. The Examiners identified no recordable

indications or suspect areas that require Detailed Visual examination. The Responsible Engineer (RE), who meets the requirements of IWL-2320, conducted a separate walkdown to evaluate the condition of the containment. The RE determined that the degradations were superficial/cosmetic in nature and found no evidence of damage or degradations that could impact the structural integrity of the containment structure. The RE concluded the identified degradations do not warrant further evaluation or performance of Repair/Replacement in accordance with IWL-4000. This example illustrates that examinations conducted in accordance with Salem ASME Section XI, Subsection IWL detect concrete degradations before they have impact on the containment structural integrity.

3. In May 2005 Salem completed second examination of unit 2 containment structure accessible concrete surfaces in accordance with Salem ASME Section XI, Subsection IWL aging management program. The examinations consist of General Visual examinations to assess the general structural condition of the containment as required by IWL-2310. The observed degradations were consistent with those documented in baseline inspection reports. The degradations consist of minor local surface scaling and spalling (< 2" deep) of concrete on exterior surfaces of the containment, rust stains attributed to embedded concrete inserts, localized efflorescent (leaching), and normal shrinkage cracks. The Examiners also noted several non-age related items such as concrete forms left in place, non-adhering concrete coating, and abandoned protruding anchors in the adjacent Auxiliary Building floors. Examiners qualified as specified in IWL-2310 conducted the examinations and documented the results in a corrective action report. The degradations were evaluated and accepted by the RE. The RE determined the degradations were superficial in nature and have no impact on structural integrity of the containment structure. This example demonstrates that loss of material (scaling and spalling) and potential rebar corrosion (rust stains) are detected and evaluated before they have impact on containment reinforced concrete structural integrity.

4. In October 2005 Salem completed a second examination of unit 1 containment structure accessible concrete surfaces in accordance with Salem ASME Section XI, Subsection IWL aging management program. The examinations consist of General Visual examinations conducted by certified personnel to assess the general condition of the containment as required by IWL-2310. The observed degradations were consistent with those identified in baseline inspection reports. The degradations consist of non-recordable findings and minor local surface scaling and spalling (< 3" deep) of concrete on exterior surfaces of the containment. Additionally, the Examiners noted degradation that are outside the scope of IWL such as water intrusion into the Fuel Handling Building, and light to medium rust on the seismic gap seal cover hold down bolts. These degradations were documented and assigned for corrective action. The Examiners identified no recordable indications or suspect areas that require Detailed Visual examination. The RE evaluated IWL related degradations and determined they have no impact of containment structural integrity and thus acceptable without further corrective actions. This example illustrates that

loss of material (scaling and spalling) and potential rebar corrosion (rust stains) are detected and evaluated before they have impact on containment reinforced concrete structural integrity. This example demonstrates that minor concrete degradations observed during the current inspection are compared with previous inspections to establish if a change in their condition warrants further evaluation.

The Containment Structure concrete has been found during inspections performed in accordance with ASME Section XI, Subsection IWL to be in good condition. Although conditions including minor surface scaling and spalling, as well as, normal shrinkage cracking have been identified in various locations, they are not significant, and the aging management program will provide reasonable assurance that significant degradation of the Containment Structure concrete will not occur during the period of extended operation. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken in accordance with the corrective action program. There is sufficient confidence that the implementation of the ASME Section XI, Subsection IWL program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of ASME Section XI, Subsection IWL program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing ASME Section XI, Subsection IWL aging management program provides reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.30 ASME Section XI, Subsection IWF

Program Description:

The ASME Section XI, Subsection IWF aging management program is an existing program that consists of periodic visual examination of ASME Section XI Class 1, 2, and 3 piping and component support members for loss of material and loss of mechanical function in the following environments: air-indoor, air-outdoor, air with steam or water leakage, and treated borated water. Bolting for supports is also included with these components and inspected for loss of material and for loss of bolting preload by inspecting for missing, detached, or loosened bolts and nuts in the following environments: air indoor, air outdoor and air with steam or water leakage. Metal Containment (MC) piping and components and their associated supports are not included in the scope of the program because they are not applicable to Salem reinforced concrete containments. The program also relies on the design change procedures that are based on EPRI TR-104213 guidance to ensure proper specification of bolting material, lubricant, and installation torque. Identified degradations are entered in the corrective action process for evaluation or correction to ensure the intended function of the component support is maintained.

The program is implemented through corporate and station procedures, which provide inspection and acceptance criteria consistent with the requirements of the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section XI, Subsection IWF 1998 Edition with 2000 Addenda approved by10 CFR 50.55(a). The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

The ASME Section XI, Subsection IWF aging management program utilizes inspections that detect degradation before loss of intended function. No preventive or mitigating attributes are associated with these activities.

In accordance with 10 CFR 50.55a(g)(4)(ii), the Salem ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval.

NUREG-1801 Consistency:

The ASME Section XI, Subsection IWF Program is consistent with the ten elements of aging management program XI.S3, "ASME Section XI, Subsection IWF", specified in NUREG-1801.

Exceptions to NUREG-1801:

None.

Enhancements:

None.

Operating Experience:

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material, loss of mechanical function, and loss of bolting preload are being adequately managed. The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWF program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2005, Salem Unit 1 conducted visual examination (VT-3) of 125 ASME Class 1, 2, and 3 component supports in accordance with ASME Section XI, Subsection IWF. The supports consist of a sample of Salem Unit 1 support types (i.e., anchor, guide, support, etc.) selected from Auxiliary Feedwater, Chemical Volume Control, Component Cooling, Containment Spray, Reactor Coolant, Residual Heat Removal, Main Steam, Safety Injection, and Service Water systems. VT-3 qualified examiners observed no unacceptable indications on 113 out of the 125 supports. The examiners identified 12 supports with indications that required further evaluation. The indications on 11 supports were related to spring can hanger settings that were outside acceptable tolerances. The indication on the 12th support was related to concrete cracks observed on Component Cooling Heater Exchanger (11 CCHX) concrete pedestal support. A corrective action report was issued to document and evaluate the observed indications.

   Evaluation of the as-found condition of the spring can hangers prompted inspection scope increase in accordance IWF-2430. The scope increase resulted in additional unacceptable spring can hangers. All identified spring cans with out-of-tolerance settings were adjusted to meet design requirements and re-examined in accordance with IWF-3122.2. The concrete cracks on the 11 CCHX support pedestal were evaluated by engineering, determined not to impact structural integrity of the pedestal support and accepted for continued service without repair. This example demonstrates that examinations conducted in accordance with ASME Section XI, Subsection IWF identify aging effects that could impact structural integrity of component supports. The example also illustrates that identified degradations are evaluated for extent of condition, and accepted for continued service, or repaired as required by ASME Code.

2. In 2007, Salem Unit 1 conducted visual examination (VT-3) of 21 ASME Class 1, 2, and 3 component supports in accordance with ASME Section XI, Subsection IWF. The supports consist of a sample of Salem Unit 1 support types (i.e., anchor, guide, support, etc.) selected from Auxiliary Feedwater, Chemical volume, Component Cooling, Containment Spray, Reactor Coolant, Residual Heat Removal, Main Steam, Safety Injection, and Service Water systems. The supports were inspected for degradations including corrosion, distortion, spring can functionality and

settings, loose bolts and nuts, debris, foreign material, etc. VT-3 qualified examiners observed no unacceptable indications as documented in inspection data sheet. This example demonstrates that the condition of Salem Unit 1 ASME Class 1, 2, and 3 piping and component supports are acceptable. Parameters monitored and activities conducted in accordance with ASME Section XI, Subsection IWF provide reasonable assurance that aging effects will be adequately managed during the period of extended operation.

3. In 2006, Salem Unit 2 conducted visual examination (VT-3) of 5 ASME Class 1, 2, and 3 component supports in accordance with ASME Section XI, Subsection IWF. The supports consist of a sample of Salem Unit 2 support types (i.e. anchor, hanger, variable support, etc.) selected from Component Cooling, Residual Heat Removal, Safety Injection, and Main Steam systems. The supports were inspected for degradations including corrosion, distortion, spring can functionality and settings, loose bolts and nuts, debris, foreign material, etc. VT-3 qualified examiners observed no unacceptable indications. This example demonstrates that the condition of Salem Unit 2 ASME Class 1, 2, and 3 piping and component supports are acceptable. Parameters monitored and activities conducted in accordance with ASME Section XI, Subsection IWF provide reasonable assurance that aging effects will be adequately managed during the period of extended operation.

4. In 2007, during the replacement of the Salem Unit 2 No. 22 steam generator, two (2) cap screws (bolts) on one of four (4) support base plates of the steam generator support were found broken. Each support base plate has six (6) 1-1/2 inch diameter non-tensioned high strength bolts (min. yield 200 ksi). The base plate design incorporates slotted holes and Lubrite plates to allow for thermal movement. The bolts had not been previously inspected because they were not accessible. A corrective action report was initiated to document and evaluate the extent and cause of the condition.

   Evaluation of the condition concluded that failure was caused by improper installation and was not due to age or stress corrosion cracking. The bolts were not aligned as required by design to allow sliding surfaces to move without loading the bolts. The improper installation introduced high thermal loads that overstressed the two bolts causing a shear failure.

   As a part of extent of condition determination, the remaining bolts of both Salem Unit 2 steam generator support base plates were inspected. No additional broken bolts were found. All the bolts on the four (4) base plates of each Unit 2 steam generator support were replaced and installed as required by design. Past operability review determined the No. 22 steam generator was operable with the two broken bolts. Additionally applicability of the condition to Unit 1 steam generators supports was also reviewed. The review determined the condition was not applicable to Unit 1 because of design differences between Unit 1 and Unit 2. This example demonstrates that when degradations are identified on component supports exempt from examination by the ASME Code, because they are inaccessible, these degradations are investigated to determine their cause and extent, and evaluated for acceptance or repair and replacement.

The piping and component supports inspections performed in accordance with the ASME Section XI, Subsection IWF program have been found to be generally in good condition. Although a limited number of supports were identified with problems, such as spring can hanger settings outside acceptable tolerances, and concrete cracks on a heat exchanger concrete pedestal support, these problems are not significant and the aging management program will provide reasonable assurance that significant degradation of piping and component supports will not occur during the period of extended operation. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the ASME Section XI, Subsection IWF program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of ASME Section XI, Subsection IWF program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion:

The existing ASME Section XI, Subsection IWF program provides reasonable assurance that the loss of material, loss of mechanical function, and loss of bolting preload aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.31 10 CFR 50, Appendix J

Program Description

The 10 CFR Part 50, Appendix J aging management program is an existing program that provides for detection of age related pressure boundary degradation of components exposed to air environments due to aging effects such as loss of leaktightness, loss of material or loss of preload in various systems penetrating containment. The program also provides for detection of age related degradation in material properties of gaskets, o-rings, and packing materials for the primary containment pressure boundary access points.

The 10 CFR Part 50, Appendix J program consists of tests performed in accordance with the regulations and guidance provided in 10 CFR 50 Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," Option B; Regulatory Guide 1.163, "Performance-Based Containment Leak-Testing Program;" NEI 94-01, "Industry Guideline for Implementing Performance-Based Options of 10 CFR Part 50, Appendix J;" and ANSI/ANS 56.8, "Containment System Leakage Testing Requirements."

Containment leakage rate tests are performed to assure that leakage through the containment and systems and components penetrating primary containment does not exceed allowable leakage limits specified in the plant technical specifications. An Integrated Leakage Rate Test (ILRT) is performed during a period of reactor shutdown at the frequency specified in 10 CFR Part 50, Appendix J, Option B. Performance of the Integrated Leakage Rate Test (ILRT) per 10 CFR Part 50, Appendix J demonstrates the leak-tightness and structural integrity of the containment. Local leakage rate tests (LLRT) are performed on isolation valves and containment access penetrations at frequencies that comply with the requirements of 10 CFR Part 50 Appendix J, Option B.

The ILRT measures overall containment leakage and the LLRTs measure the pressure retaining integrity and leakage rates of individual containment penetrations. The parameters monitored are leakage rates of the containment shells; containment liners; and associated welds, penetrations, fittings and other access openings. The leakage rate acceptance criteria meet the requirements of 10 CFR Part 50, Appendix J, and are part of the current licensing basis (CLB).

The 10 CFR Part 50, Appendix J does not prevent degradation due to aging effects but provides measures for condition monitoring to detect the degradation prior to loss of intended function. The 10 CFR Part 50, Appendix J program detects degradation of the containment shell and liner and components that may compromise the containment pressure boundary, including seals and gaskets. The use of pressure tests verify the pressure retaining integrity of the containment. The leak rate tests demonstrate the leak-tightness of containment isolation barriers.

The Leak Rate Test (LRT) program documents and trends test results in accordance with the requirements and guidance provided in 10 CFR Part 50 Appendix J. The LRT program demonstrates that the test results meet the requirements contained in the acceptance criteria. Tests results that fail to meet the acceptance criteria defined in the plant technical specifications are reported in accordance with approved procedures that meet the requirements of 10 CFR 50.72 and 10 CFR 50.73.

Evaluations are performed for test or inspection results that do not satisfy established criteria and a Notification is initiated to document the issue in accordance with plant administrative procedures.

The 10 CFR Part 50 Appendix B corrective actions program (CAP) ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to prevent recurrence. Corrective actions are performed in accordance with applicable procedures that meet the requirements of 10 CFR Part 50 Appendix J and NEI 94-01.

The monitoring methods established in the 10 CFR Part 50 Appendix J Program are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

NUREG-1801 Consistency

The 10 CFR Part 50, Appendix J aging management program is consistent with the ten elements of aging management program XI.S4, 10 CFR Part 50, Appendix J, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The 10 CFR Part 50, Appendix J, LRT program has been effective in preventing unacceptable leakage through the containment pressure boundary. In addition, the implementation of Option B for testing frequency is consistent the plant-specific operating experience. The station operating experienced and assessments described below show the Appendix J program has been effective in preventing unacceptable leakage and has maintained compliance with regulatory driven test frequencies prescribed in Regulatory Guide 1.163, that are governed by the Appendix J program.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Appendix J LRT program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The cumulative maximum leakage test results at Salem-1 in 2008 was approximately 26,730 standard cubic centimeters per minute (sccm) and Salem-2 in 2008 was approximately 29,120 sccm, or 21% and 22%, respectively, of the total allowable technical specification limit of 129,756 sccm. The historic data shows not only that equipment is being adequately maintained but also that the equipment maintenance has been capable of creating a significant safety margin between the technical specification allowable limits and the as-tested values. The test results show the effects of aging are effectively being managed for primary containment.

2. A Nuclear Oversight Audit (NOSA) was performed to independently review the 10 CFR Part 50, Appendix J Program at Salem Nuclear Generating Station in October 2006. The NOS Audit consist of comprehensive reviews of the Appendix J program to verify 10 CFR50 Appendices, Quality Assurance Topical Report (QATR) requirements, and applicable ASME and ANSI codes are acceptably implemented at Salem. The NOS audit also included an Operating Experience (OPEX) assessment. The audit demonstrated that industry and plant operating experience is reviewed and incorporated as required on a regular basis and that required parameters are effectively monitored and trended by the program.

3. At Salem 2 a Local Leakage Rate Test was performed in October 2003 for the XA-21 Series Air Operated Valve, which is an outboard isolation valve. The valve exceeded the allowable administrative technical specification limits when the test was performed. The valve was investigated and repaired to resolve the condition. The apparent cause of the leakage rate failure was due to inadequate seat load from high packing friction. The valve was repacked and other similar valves were reworked as well based on the results of the investigation performed on this valve. This example shows that corrective actions are taken to repair a condition that causes excessive leakage and appropriate corrective actions are taken to address the degraded conditions. Furthermore, this demonstrates that investigation results are documented and corrective actions are generically implemented where other conditions may exist.

4. At Salem 1 in April 2001, the Primary Water Supply to the Pressurizer Relief Tank (PRT) isolation valve, was leakage rate tested and found to exceed the allowable technical specification limits. The valve was investigated in accordance with the Corrective Action Process (CAP) and an Apparent Cause Evaluation was performed to determine the cause of the leakage rate failure. The cause of the failure was due to the leak-through of an adjacent valve resulting in the test failure. The adjacent valve was re-worked and the re-test was performed satisfactorily. Furthermore, the extent of condition was reviewed to determine if other failures could result from similar failures. This example provides objective evidence that failures are investigated, documented and corrective actions taken when LLRT results show the leakage rates exceed the allowable technical specification limits.

The data from the most recent running summary totals in 2008 show the total leakage has adequate margin at 21% and 22% for the allowable technical specification limit at Salem 1 and 2, respectively. In addition, problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the 10 CFR Part 50 Appendix J Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the 10 CFR Part 50 Appendix J Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing 10 CFR Part 50, Appendix J aging management program provides reasonable assurance that the aging effects are adequately managed so that containment components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis during the period of extended operation.

B.2.1.32 Masonry Wall Program

Program Description

The Masonry Wall Program is an existing program that is part of the Structures Monitoring Program. It is based on the guidance provided in IE Bulletin 80-11, "Masonry Wall Design," and Information Notice 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11," and is implemented through station procedures.

The Masonry Wall aging management program addresses loss of material, and cracking due to age-related degradation of concrete for masonry walls. The program relies on periodic visual inspections to monitor and maintain the condition of masonry walls within the scope of license renewal, so that the established design basis for each masonry wall remains valid during the period of extended operation.

Masonry walls are inspected for cracking by qualified, experienced engineers, who are qualified per the requirements of the Structures Monitoring Program. The scope of the program will be enhanced to include structures that are not monitored under the current term but require monitoring during the period of extended operation. Details of the enhancements are discussed below.

Inspection frequency is every 5 years maximum, with provisions for more frequent inspections to ensure that observed conditions that have the potential for impacting an intended function are evaluated or corrected with the corrective action process in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the problem is determined and an action plan is developed to prevent recurrence.

NUREG-1801 Consistency

The Masonry Wall Program is consistent with the ten elements of aging management program XI.S5, "Masonry Wall Program," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the program elements:

1. Add buildings, and masonry walls that have been determined to be in the scope of License Renewal.
   a. Fire Pump House

b. Masonry Wall Fire Barriers

c. Office Buildings (The clean and controlled facilities buildings)

d. SBO Compressor Building

e. Service Building

f. Turbine Building

Program Elements Affected: Scope of Program (Element 1)

2. Add an Examination Checklist for masonry wall inspection requirements. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

3. Specify an inspection frequency of not greater than 5 years for masonry walls. **Program Elements Affected: Detection of Aging Effects (Element 4)**

Operating Experience

The Masonry Wall Program has provided for detection of cracks, and other aging effects in masonry walls. In response to I.E. Bulletin 80-11, "Masonry Wall Design," and Information Notice 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to I.E. Bulletin 80-11," various actions were taken. Actions included program enhancements, follow-up inspections to substantiate masonry wall analyses and classifications, and modification to various walls. These actions addressed all concerns raised by I.E. Bulletin 80-11 and Information Notice 87-67, namely unanalyzed conditions, improper assumptions, improper classification, and lack of procedural controls.

The Masonry Wall Program as implemented by the Structures Monitoring Program inspections at Salem Units 1 and 2 have confirmed that the masonry walls at Salem are in good condition and showed insignificant aging or degradation. Deficiencies that have been identified have been evaluated and corrected, as appropriate. Operating experience review concluded that the program is effective for managing aging effects of masonry walls. The following examples of operating experience provide objective evidence that the Masonry Wall Program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The most recent structural monitoring inspections were performed on August 2008 for Salem 1 masonry walls. None of the walls showed any signs of significant degradation, such as, efflorescence or cracking. The above example provides objective evidence that the periodic structural inspections are thorough and effectively monitor for age related degradations of masonry walls.

2. In 2006, a corrective action report was issued to document, evaluate and repair degraded masonry wall tie rod (missing nut) on the controlled facilities building wall. The condition was evaluated by a qualified

structural engineer. The structural engineer concluded the masonry wall still had acceptable seismic margin and recommended prompt repair of tie rod to restore design margin. An expedited repair restored the masonry wall tie rod nut in accordance with design drawings. This example provides objective evidence that the station's Corrective Action and Structures Monitoring Programs are documenting, evaluating, and correcting structural conditions to maintain the masonry wall design basis.

3. In 2006, a corrective action report was issued to document, evaluate and repair a degraded masonry blocks on a seismic radiation shielding masonry wall in the mechanical penetration room. The condition was evaluated by a qualified structural engineer. The structural engineer concluded that the condition does not adversely impact the masonry wall design basis and concluded the cause was equipment movement damage. A work order was generated to repair the masonry wall and restore it to its design condition. This is another example that provides objective evidence that the station's Corrective Action and Structures Monitoring Programs are documenting, evaluating, and correcting structural conditions to maintain the masonry wall design basis.

The above examples provides objective evidence that the periodic structural inspections and corrective action report are thorough and effectively monitor for age related degradations of masonry walls in the scope of the Masonry Wall Program. The program is effective in monitoring and detecting the various aging effects and mechanisms for the structural components, and environments such that there is no loss of component intended function.

As demonstrated in the operating experience examples above, the Masonry Wall Program is effectively managing the aging effects of masonry walls. Based on these examples, station procedures are utilized to identify and document conditions adverse to quality in accordance with the corrective action program. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Masonry Wall Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Masonry Wall Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Masonry Wall Program as implemented by the Structures Monitoring Program will provide reasonable assurance that cracking of masonry walls will be adequately managed so that the intended functions of masonry walls within the scope of license renewal will be maintained consistent with the current licensing basis for the period of extended operation.

B.2.1.33 Structures Monitoring Program

Program Description

The Structures Monitoring Program is an existing program that provides for aging management of structures and structural components, including structural bolting, within the scope of license renewal. The program was developed based on guidance in Regulatory Guide 1.160 Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and NUMARC 93-01 Revision 2, "Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," to satisfy the requirement of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants."

The program requires monitoring of structures and components in accordance with 10 CFR50.65 and RG 1.160 Rev. 2, Regulatory Position 1.5.

The scope of the program also includes condition monitoring of masonry walls and water control structures as described in the Masonry Wall Program and in the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, aging management program. As a result, the program elements incorporate the requirements of NRC IEB 80-11, "Masonry Wall Design", the guidance in NRC IN 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11", and the requirements of NRC Regulatory Guide 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants."

The structures and structural components are inspected by qualified personnel having a B.S. Engineering degree and/or Professional Engineer license, and a minimum of four years experience working on building structures. Concrete structures are inspected for indications of deterioration and distress including evidence of leaching, loss of material, cracking, and a loss of bond, as defined in ACI 201.1R, "Guide for Making a Condition Survey of Existing Buildings". Steel components are inspected for loss of material due to corrosion. Masonry walls are inspected for cracking. Elastomers will be monitored for hardening, shrinkage and a loss of sealing. Earthen structures associated with water control structures will be inspected for loss of material and loss of form. Component supports will be inspected for loss of material, reduction or loss of isolation function, and reduction in anchor capacity due to local concrete degradation. Exposed surfaces of bolting are monitored for loss of material, due to corrosion, loose nuts, missing bolts, or other indications of loss of preload. The program also relies on plant procedures that are based on the guidance contained in EPRI TR-104213, "Bolted Joint Maintenance and Applications Guide" to ensure proper specification of bolting material, lubricant, and installation torque.

A de-watering system is not relied upon to control settlement and porous concrete is not used in the design of sub-foundations.

The program contains provisions for increased inspection frequency and trending of structures and components in accordance with 10 CFR 50.65 (a)(1), if the extent of degradation is such that the structure or component may not meet its design basis or, if allowed to continue uncorrected until the next normally scheduled assessment, may not meet its design basis. As an example, enhancements have been developed due to spent fuel pool leakage. The implementation of effective corrective actions resulted in enhancements to the Structures Monitoring Program for detecting parameters to aid in identifying and minimizing potential aging effects for the Fuel Handling Building.

Underground concrete structures and structures in contact with river water are subject to an aggressive environment. Ground water and river water samples show pH > 5.5 and sulfates <1500 ppm indicating a non-aggressive environment; but chlorides exceed the threshold limit chlorides > 500 ppm which indicates an aggressive environment. The program will be enhanced to perform periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates on a frequency of 5 years. Periodic inspections of the submerged portions of the intake structure will be used as a leading indicator for the condition of below-grade structures, because the groundwater chemistry is bounded by the river water chemistry. This provides reasonable assurance that degradation of inaccessible structures will be detected before a loss of an intended function.

The scope of the program will be enhanced to include structures that are not monitored under the current term but require monitoring during the period of extended operation. Details of the enhancements are discussed below.

Inspection frequency is every 5 years maximum, with provisions for more frequent inspections to ensure that observed conditions that have the potential for impacting an intended function are evaluated or corrected in accordance with the corrective action process.

Evaluations are performed for test or inspection results that do not satisfy established criteria and a corrective action report is issued in accordance with the corrective action process to document the concern in accordance with the 10 CFR 50, Appendix B Corrective Action Program. The corrective action program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the problem is determined and an action plan is developed to prevent recurrence.

NUREG-1801 Consistency

The Structures Monitoring Program is consistent with the ten elements of aging management program XI.S6,"Structures Monitoring Program," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The scope of the program will be enhanced to include the following structures and components:

    a. Fire Pump House

    b. Office Buildings (The clean and controlled facilities buildings)

    c. SBO Compressor Building

    d. Service Building

    e. Switchyard

    f. Turbine Building

    g. Transmission towers

    h. Yard Structures (Foundations for fire water and demineralized water tanks, the plant vent radiation monitoring enclosures, the turbine crane runway extensions, and manholes)

    i. Building penetrations and pipe encapsulations that perform flood barrier, pressure boundary, shelter and protection intended functions

    j. Pipe whip restraints and jet impingement/spray shields

    k. Trench covers and sump liners

    l. Masonry walls, including Fire Barriers

    m. Miscellaneous steel (catwalks, vents, louvers, platforms, etc.)

    n. Vortex Suppressor, Ice Barrier, Marine Dock Bumper (Service Water Intake Structure)

    o. Panels, Racks, Cabinets, and Other Enclosures

    p. Metal-enclosed Bus

    q. Components supports including, electrical cable trays, electrical conduit, tubing, HVAC ducts, instrument racks, battery racks, and supports for piping and components that are not within the scope of ASME Section XI, Subsection IWF

    r. Duct banks that contain safety-related cables, and cables credited for SBO or ATWS

Program Elements Affected: Scope of Program (Element 1)

2. Concrete structures will be observed for a reduction in equipment anchor capacity due to local concrete degradation. This will be accomplished by visual inspection of concrete surfaces around anchors for cracking and spalling. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

3. Clarify that inspections are performed for loss of material due to corrosion and pitting of additional steel components, such as embedments, panels and enclosures, doors, siding, metal deck, and anchors. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

4. Require inspection of penetration seals, structural seals, and elastomers, for degradations that will lead to a loss of sealing by visual inspection of the seal for hardening, shrinkage and loss of strength. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

5. Require the following actions related to the spent fuel pool liner:

    a. Perform periodic structural examination of the Fuel Handling Building per ACI 349.3R to ensure structural condition is in agreement with the analysis.

    b. Monitor telltale leakage and inspect the leak chase system to ensure no blockage.

    c. Test water drained from the seismic gap for boron concentration.

    Program Elements Affected: Parameters Monitored or Inspected (Element 3)

6. Require monitoring of vibration isolators, associated with component supports other than those covered by ASME XI, Subsection IWF. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

7. Add an Examination Checklist for masonry wall inspection requirements. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

8. Parameters monitored for wooden components will be enhanced to include: Change in Material Properties, Loss of Material due to Insect Damage and Moisture Damage. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

9. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the service water intake structure. **Program Elements Affected: Detection of Aging Effects (Element 4)**

10. Require individuals responsible for inspections and assessments for structures to have a B.S. Engineering degree and/or Professional Engineer license, and a minimum of four years experience working on building structures. **Program Elements Affected: Detection of Aging Effects (Element 4)**
11. Perform periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates on a frequency of 5 years. Groundwater samples in the areas adjacent to Unit 1 containment structure and Unit 1 auxiliary building will also be tested for boron concentration. **Program Elements Affected: Detection of Aging Effects (Element 4)**
12. Require supplemental inspections of the affected in scope structures within 30 days following extreme environmental or natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes). **Program Elements Affected: Detection of Aging Effects (Element 4)**
13. Perform a chemical analysis of ground or surface water in-leakage when there is significant in-leakage or there is reason to believe that the in-leakage may be damaging concrete elements or reinforcing steel. **Program Elements Affected: Detection of Aging Effects (Element 4)**
14. Implementing procedures will be enhanced to include additional acceptance criteria details specified in ACI 349.3R-96. **Program Elements Affected: Acceptance Criteria. (Element 6)**

Operating Experience

The Structures Monitoring Program inspections show that aging effects and mechanisms are being adequately managed. The inspection history revealed minor degradation of structural components, but none that could impact their intended function. The Structures Monitoring Program inspections at Salem have confirmed that the structures are in good condition and showed insignificant aging or degradation. Deficiencies that have been identified have been evaluated and corrected, as appropriate. The following examples of operating experience provide objective evidence that the Structures Monitoring Program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The Structures Monitoring Program was implemented on the schedule as required by 10 CFR 50.65(a). Baseline inspections of all structures in the scope of Maintenance Rule were completed in 1997. Additional inspections were completed consistent with the program frequency. The following examples of findings were extracted from inspection reports for the following structures and components.

   Masonry Walls:

   The most recent structural monitoring inspections were performed on August 2008 for Salem 1 masonry walls. None of the walls showed any signs of significant degradation, such as, efflorescence or cracking.

Auxiliary Building:

Condition monitoring inspections were performed in accordance with the Structures Monitoring Program on March 2007.

Auxiliary Feedwater Enclosure – All the steel members are in good shape and there is no evidence of distortion, misalignment or deflection. There is no visible corrosion, pitting or oxidation, and the coating was in good condition. There is no fireproofing material inside the enclosure. Connection inspection showed bolt and weld connections are in good condition. There are no missing, broken, or loose bolts, nuts or washers or evidence of weld cracks.

Main Steam Enclosure – The enclosure steel is in good structural condition. All the connections are intact. There is no evidence of coating degradation. Fireproofing material is not used on or inside the enclosure. There is no structural integrity concern in the Main Steam Enclosure.

Pipe Tunnel Enclosures and Pipe Tunnel Hatch:

Condition monitoring inspections were performed in accordance with the Structures Monitoring Program on October 2006. Structural steel for the entrance and doors to the pipe tunnel is in good condition. The inside the pipe tunnel is dry and clean. There is no evidence of steel member damage, mis-alignment, or deflection. No loose or missing bolts were found. There is no fire proofing material used inside the pipe tunnel. The top of the pipe tunnel hatch is in good condition.

Outer Penetration Structure:

Condition monitoring inspections were performed in accordance with Structures Monitoring Program on March 2004. The condition of the structural steel (i.e., Platforms, ladders, Pipe Whip Restraint Structures, and Blowout Panels) inside the Outer Penetration structure, were found to be in good condition with no apparent degrading conditions, except for one finding. Two sections of a Blow Out Panel, have loose and missing supporting bolts. A corrective action report was issued to document and repair this degraded condition. The work order report indicated supporting bolts were replaced and tightened in accordance with station procedure.

Service Water Intake Structure:

All accessible portions of the Service Water Intake Structure submerged concrete walls were inspected per the Structures Monitoring Program, on June 2005, during low tide. There was no evidence of any deficiency or degradation. There was some erosion from water flow at the corners of the concrete wall. The erosion was minimal and negligible.

Shoreline Protection and Dike:

The Shoreline Protection and Dike was inspected both by boat and from the dike itself. This inspection was per the Structures Monitoring Program and documents the results for 2008. The Shoreline Protection and Dike were found to be in conformance with design drawings with no notable defects. There were no noticeable changes, based on pictures from last year's inspection report.

The above examples provide objective evidence that the periodic structural inspections are thorough and effectively monitor for age related degradations of structural component types in the scope of the Structures Monitoring Program. The program is effective in monitoring and detecting the various aging effects and mechanisms for the structures, components, and environments such that there is no loss of structure or component intended function.

2. Salem Unit 1 operating experience shows that the spent fuel pool (SFP) liner plate leaks allowing fuel pool water to migrate through small cracks in concrete structures and reaches the seismic gap between the containment structure and the fuel handling building. In 2002, tests identified evidence of SFP water leakage through an exterior wall of the Unit 1 Auxiliary Building mechanical penetration room. Further investigations revealed that the SFP leak chase and drainage system were blocked. As a result of this blockage, leakage through the seam welds and the plug welds accumulated in small gaps between the stainless steel liner and concrete. As water level in the gap increased, hydrostatic pressure forced the water outside through construction joints and small cracks in the SFP concrete. The escaped water reached the groundwater within the controlled restricted area of the plant. The release of SFP water prompted Salem to notify the NRC.

   Structural evaluation of the Fuel Handling Building (FHB) was conducted using projected degradation rates derived from tests conducted by Salem. The evaluation concluded that structural integrity of the building would not be impacted for 70 years (from start of operation). Repair of the leaks is determined to be impractical considering the pool is nearing capacity of stored spent fuel making access challenging. Also locating the cracks may not be possible as evidenced by unsuccessful efforts in 1995 to find existing leaks via vacuum box testing, suggesting multiple very small leaks below the sensitivity of test. Thus, the current direction is to clean out the leak detection drainage system and maintain them free flowing for the remainder of plant life, minimizing hydrostatic pressure buildup and resultant leakage through concrete.

   The following corrective actions were initiated to ensure both the environment and the FHB/SFP structural integrity are protected.

   - Inspected and repaired seam welds suspected as leak path in early 1980's.

- Cleared Unit 1 and Unit 2 leak chase system to restore proper drainage.
- Future preventive maintenance activities issued to maintain the leak chase system clear for proper drainage.
- Implemented the tritium reclamation project to prevent adverse impact on the environment.
- Initiated a test program to quantify degradation of concrete and rebar submerged in borated water equivalent to SFP water so the aging effects could be used in an analysis to determine structural integrity.
- Performed a detailed structural analysis of the FHB/SFP considering the results of the test program. The analysis projected that, based on available margin, structural integrity will not be adversely impacted for at least 70 years.
- Performed a structural examination of the FHB/SFP per ACI 349.3R to ensure FHB/SFP structural condition is in agreement with the analysis.
- Monitor telltale leakage and clear the leak chase system every 18 months to ensure proper drainage and minimize any leakage to the environment.
- Test water drained from the seismic gap for boron concentration. Based upon the findings in the test results, the effects of the presence of treated borated water on adjacent structures were evaluated and determined to be bounded by the effects on the Fuel Handling Building. This also provides another indication of proper drainage in the leak chase system.
- Plant operating experience reveals that similar leaks have occurred in the Salem Unit 1 and Unit 2 reactor cavities, during refueling outages. These leaks were retained inside of the Containment Structures. The effects of the treated borated water on the Containment Structures were evaluated and determined to be bounded by the effects on the Fuel Handling building.

This example provides objective evidence that the station's Corrective Action and Structures Monitoring Programs are documenting, evaluating, and correcting conditions adverse to quality. The implementation of effective corrective actions resulted in enhancements to the Structures Monitoring Program for detecting parameters to aid in identifying potential aging effects.

3. Salem operating experience shows that the Groundwater intrusion is observed in below grade areas of Salem Structures (Auxiliary building, Turbine building, Penetration Areas, Fuel Handling building, and the Pipe Tunnel). The groundwater in leakage is through seismic expansion joints,

concrete construction joints, and through expansion and shrinkage cracks in the concrete. The ground water level is approximately 5 feet below site grade level, therefore this provides to a 20 to 40 feet head of water pressure on underground leakage paths. Groundwater samples and a sample of water drained from the seismic gap were tested for pH, chlorides, and sulfates to determine the potential for concrete degradation due to aggressive chemical attack. A qualified structural engineer evaluated the condition. The structural engineer concluded that the condition does not adversely impact the structural design basis, and there were no current significant leaks that would impact a safety function. Continuing corrective and preventive maintenance was listed as the best solution. Corrective actions include cracks found in concrete to be grouted and sealed, deteriorated seismic joints, and concrete construction joints repaired per station procedures. Proper housekeeping is used to eliminate standing water to insure the condition does not provide an environment that will promote deterioration. The Structures Monitoring Program is used to insure the effects of groundwater intrusion do not result in corrosion of rebar, embedded steel, and floor mounted component support members and anchors with the potential of adverse impact on their structural integrity. The program monitors for water in-leakage such as moisture, standing water, discoloration or concrete staining, evidence of joint or seal separation or deterioration of joint or seal material. Steel is inspected for corrosion of exposed surfaces of embedment and base plates and anchorage and for corrosion stains on surrounding concrete surfaces. This example provides objective evidence that the station's Corrective Action and Structures Monitoring Programs are documenting, evaluating, and correcting conditions adverse to quality.

As demonstrated in the operating experience examples above, the Structures Monitoring Program is effectively managing the aging effects of structures. Based on these examples, station procedures are utilized to identify and document conditions adverse to quality in accordance with the corrective action program. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Structures Monitoring Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Structures Monitoring Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Structures Monitoring Program will provide reasonable assurance that aging effects and mechanisms will be adequately managed so that the intended functions of structures within the scope of license renewal will be maintained consistent with the current licensing basis for the period of extended operation.

B.2.1.34 RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants

Program Description

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants aging management program is an existing condition monitoring program that will be enhanced to require inspection of water-control structures that are in scope for license renewal consistent with the requirements of NRC RG 1.127. These structures include the Service Water Intake structure and Shoreline Protection and Dike structures (including outer walls of the Circulating Water Intake Structure). Structural components and commodities of the structures that are monitored under the program include reinforced concrete members, structural steel and earthen water control structures (embankments, dikes). The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants aging management program addresses age-related deterioration, degradation due to extreme environmental conditions, and the effects of natural phenomena that may affect the safety function of the water-control structures. The program manages loss of material, cracking, and change in material properties for concrete components; loss of material and loss of preload for steel and metal components; loss of material and change in material properties for wooden components; hardening and loss of strength for elastomers, and loss of material and loss of form for earthen water control structures in the following environments: air-indoor, air-outdoor, groundwater/soil, raw water and water-flowing. Elements of the program are designed to detect degradations and take corrective actions to prevent a loss of an intended function.

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants is implemented through the Structures Monitoring Program (10 CFR 50.65), and is based on the guidance provided in NRC RG 1.127 and ACI 349.3R. Inspections of water-control structures are conducted by or under the direction of experienced engineers, who are qualified per the requirements of the Structures Monitoring Program, and are conducted systematically using checklists and other documents as required to minimize the possibility of overlooking significant features. Technical evaluations are performed if observed degradations have the potential for impacting the intended function of the water-control structures.

Accessible structures are monitored on a frequency of 5 years consistent with the frequency for implementing the requirements of the 10 CFR 50.65, Maintenance Rule. The program will be enhanced to include an inspection frequency of 5 years for structures/components submerged in water. The Shoreline Protection Structures are inspected annually.

The program will be enhanced, as noted below, to provide reasonable assurance that water-control structures aging effects will be adequately managed during the period of extended operation.

Safety and performance instrumentation such as seismic instrumentation, horizontal and vertical movement instrumentation, uplift instrumentation, and other instrumentation described in RG 1.127 are not incorporated in the design of Salem water control structures. Thus inspection activities related to safety and performance instrumentation are not applicable, and are not specified in the implementing documents.

The existing program contains no requirements for monitoring the adequacy and quality of maintenance and operating procedures. According to RG 1.127, this requirement applies to the maintenance and operating procedures that pertain to the safety of dams and is not applicable to the station program.

Salem is not committed to the requirements in NRC RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, but Salem has been implementing the guidance of RG 1.127 to the structures in scope for license renewal.

NUREG-1801 Consistency

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program is consistent with the ten elements of aging management program XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Parameters monitored for wooden components will be enhanced to include change in material properties and loss of material due to insect damage and moisture damage. **Program Element Affected: Parameters Monitored or Inspected (Element 3)**

2. Parameters monitored for elastomers will be enhanced to include hardening, shrinkage and loss of strength due to weathering and elastomer degradation. **Program Element Affected: Parameters Monitored or Inspected (Element 3)**

3. The inspection requirement for submerged concrete structural components will be enhanced to require that inspections be performed by dewatering a pump bay or by a diver if the pump bay is not dewatered. **Program Element Affected: Detection of Aging Effects (Element 4)**

4. Specify an inspection frequency of not greater than 5 years for structures including submerged portions of the Service Water Intake structure. **Program Element Affected: Detection of Aging Effects (Element 4)**

5. Require supplemental inspections of the in scope structures within 30 days following extreme environmental or natural phenomena (large floods, significant earthquakes, hurricanes, and tornadoes). **Program Element Affected: Detection of Aging Effects (Element 4)**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2004, industry OE18658 was evaluated for potential generic implication at Salem. The OE subject was that the plant's intake structure was experiencing significant concrete spalling of the floors and walls inside the structure. The cause of the spalling was chloride induced reinforcement corrosion. The interior portion of the plant's intake structure was exposed to significant saltwater leakage from various plant components. The Salem service water intake structure can be exposed to a similar environment therefore there is a potential for this condition to occur. The disposition of the operating experience review stated all Salem safety-related structures are subject to condition monitoring in accordance with the structures monitoring program, and the reported aging effects included in the OE are included in current inspections. Additionally, this type of industry OE would be considered in the evaluation of other water control structures in scope for license renewal. This example provides objective evidence that industry OE is reviewed for applicability to the station and consideration is given for process enhancements if it was deemed necessary to capture these industry events.

2. In 2004, degradations were observed at both ends of the exterior ends of the service water intake structure. The area includes the interface of the shoreline cofferdams and service water intake structure exterior walls. There was a 2" separation between the concrete deck slab of the cofferdam and the exterior wall of the service water intake structure due to differential settlement of the cofferdam concrete deck slab and the service water intake structure foundation wall. The base plate of the support post for the security fencing located on the cofferdam slab was severely corroded due to ponding of water on the concrete deck slab. The exterior concrete masonry wall that is part of the security barrier exhibited cracking of the blocks. There was no structural degradation noted on the service water intake structure reinforced concrete exterior wall except that the concrete coating was separating from the wall. Immediate action was to provide temporary support of the security fencing and power washing of the area and document conditions. The condition was evaluated by site engineering and determined not to affect the intended function of any safety-related systems or structures. This area of the facility was subject to an aggressive environment (i.e., river water), which contributed to these

degradations. The corrective action was to repair the degraded conditions in accordance with plant specifications and procedures. The concrete deck slab was repaired to fill in the separation gap and eliminate ponding of water so that the base plates would not be subject to standing water. The coating on the service water intake structure reinforced concrete exterior wall was reapplied. Follow up inspections were to be performed during the scheduled preventive maintenance (PMs) for condition monitoring of structures under the Maintenance Rule. There were no corrective action reports or notifications found as result of the inspections performed during the Maintenance Rule PMs of the structure. This example provides objective evidence that the site corrective program and the Maintenance Rule PMs will detect aging affects associated with systems and structures.

3. In 2002, during the performance of preventive maintenance walkdowns to support condition monitoring of the Service Water Intake Structure, it was noted that spalling had occurred on the exterior concrete wall by watertight doors SW-1 and SW-5. There was exposure of the rebar as result of the spalling and corrosion on the rebar was noted. The corrective action was to have design engineering inspect the area and evaluate the condition. The condition was evaluated by design engineering and repaired in accordance with station specifications. As a follow up to this condition report, a walkdown inspection of the area was performed in 2004. It was noted that the spalling condition had been repaired and no indication of degradation in the structure was present. This example provides objective evidence that the existing station procedures are effective in monitoring and detecting aging affects associated with the condition monitoring program for structures.

An overview of inspection results shows that water-control structures are in good condition, except for a few minor issues that are documented and repaired as noted in examples 2 and 3 above. As discussed in the operating experience examples above, the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program has not shown any adverse trend in performance. Based on these examples, station procedures are utilized to identify conditions adverse to quality and documented in accordance with the corrective action program. Problems that are identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced RG 1.127, Inspection of Water-Control Structures Associated With Nuclear Power Plants program will provide reasonable assurance that the loss of material, cracking, loss of preload, change in material properties, hardening, loss of strength, and loss of form aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.35 Protective Coating Monitoring and Maintenance Program

Program Description

The Protective Coating Monitoring and Maintenance program is an existing program that manages cracking, blistering, flaking, peeling, and delamination of Service Level I coatings subjected to indoor air in the containment structure. Although Salem is committed to Regulatory Guide 1.54, Rev. 0, the Protective Coating Monitoring and Maintenance Program defines Service Level I coating as "a coating system used in areas in reactor containment where the coating failure could adversely affect the operation of post-accident fluid systems and thereby impair safe shutdown", which is consistent with the definition of Service Level I coatings in Regulatory Guide 1.54, Rev. 1. Since the 1998 response to GL 98-04, the Protective Coating Monitoring and Maintenance Program has been updated to be consistent with ASTM D 5163-05(a) guidelines.

The Salem Protective Coating Monitoring and Maintenance Program is consistent with the guidance in ASTM D 5163-05(a) by establishing a program that monitors the conditions of the Service Level I coatings during refueling outages and uses the corrective action program to resolve non-conforming coatings and those experiencing degradation. The scope of the existing Protective Coating Monitoring and Maintenance program has been expanded beyond the program described in the Salem response to GL 98-04, which was based on Regulatory Guide 1.54, Rev. 0 and its referenced ANSI standards (since withdrawn) by including monitoring and trending activities.

The Protective Coating Monitoring and Maintenance Program requires individuals responsible for inspecting, coordinating, and evaluating the conditions of the coatings as having a minimum of 2 years of experience in assessing the conditions of Service Level I coatings. The program identifies instruments and equipment to be used for inspections.

The Protective Coating Monitoring and Maintenance Program requires that that all accessible areas of containment are planned for inspection. During every refueling outage, a walkdown is performed by qualified individuals knowledgeable in nuclear coatings to conduct visual examinations and perform physical testing as necessary on the coatings to monitor their condition over time.

The Protective Coating Monitoring and Maintenance Program requires that an initial walk-though is conducted, followed by more thorough inspections on previously designated areas, and in areas noted during the initial walk-though as being deficient and requiring repair.

Guidance is provided in the program for the characterization of defects including blistering, cracking, flaking, peeling, delamination, and rusting. When appropriate, additional testing (e.g., adhesion and dry film thickness) may be specified in order to characterize the severity of observed deficiencies. The coatings evaluator dispositions all coating deficiencies in accordance with the program in the written inspection report that describes the size and number of visible defects, their locations, and a disposition as whether to repair the defects in the current outage, or to continue to monitor the defects.

The Protective Coating Monitoring and Maintenance program is a condition monitoring program and the monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation. The program is consistent with the coating monitoring requirements of Regulatory Guide 1.54, Rev. 1, and GL 98-04, and follows the guidelines contained in ASTM D 5163-05(a).

NUREG-1801 Consistency

The Protective Coating Monitoring and Maintenance Program is consistent with the ten elements of aging management program XI.S8, "Protective Coating Monitoring and Maintenance Program," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Salem responded to GL 98-04 providing information on their protective coatings program, and an assessment of their emergency core cooling systems (ECCS) operations. More recently, Salem has met the requirements of Generic Safety Issue 191 (GSI-191), which required the design and installation of new sump strainers. The design incorporated the amount of unqualified coatings in containment, as well as an allotment for qualified coatings subjected to jet spray due to a postulated pipe break in containment. Salem is committed to GSI-191 to implement a coatings condition monitoring program consistent with ASTM D 5163, which is consistent with that described in Regulatory Position C4 in Regulatory Guide 1.54, Rev. 1. The coatings condition monitoring program is an effective program for managing degradation of Service Level I coatings, and consequently an effective means to manage loss of material due to corrosion of carbon steel structural elements inside containment.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Protective Coating Monitoring and Maintenance Program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2002, a containment coatings inspection was performed during the refueling outage for Salem Unit 2. The inspection used the guidance contained in ASTM D 5163. The areas covered by the inspection were the containment outer annulus on elevations 78-ft, 100-ft, and 130-ft; the inner bioshield on elevations 81-ft and 103-ft; the upper containment liner and polar crane, and the reactor sump. The inspection consisted of visual examinations on the various metal and concrete surfaces in the selected areas. The summary of findings indicated that the coatings applied to metal and concrete surfaces were in satisfactory to good condition, but there were areas of chipped and mechanically damaged coatings. There were specific areas of delaminated coatings identified within the bioshield for future maintenance work. The corrective action program was used to identify the recommended repairs, evaluate the conditions of the coatings for one cycle, and perform the repairs during the following refueling outage. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in identifying, assessing the condition of the containment coatings, and using the corrective action program to evaluate and perform repairs documented in the inspection report.

2. In 2008, an inspection of the Salem Unit 1 containment coatings was conducted during the refueling outage. The inspection was conducted in accordance with the Protective Coating Monitoring and Maintenance Program. Pre-walkdown research was completed per the program requirements. While the inspections covered the accessible areas of the 78-ft, 100-ft, and 130-ft elevations of the containment structure outer annulus and in the bioshield, the first focused inspections were performed at areas inspected in the previous outage, and identified for continued monitoring. These areas consisted of missing coatings on the outer bioshield wall from previous efforts of removing delaminations to sound coatings, missing coatings on structural steel due to mechanical damage, and missing coatings on the concrete floor due to mechanical damage. Missing coatings are not required to be repaired, unless they are on the containment liner and exhibiting rusting, or exhibiting disbondment from the surface that would create debris during a design basis accident. The missing coatings identified in the previous outage and re-inspected in the 2008 outage did not exhibit any further degradation and were considered satisfactory for the next cycle. The 2008 inspection findings indicated that the coatings applied to metal and concrete surfaces were in satisfactory condition except for two specific areas that required immediate attention in the current outage. These two areas were documented in the corrective action program and after discussions with station management on the priority for immediate corrective action, repairs were made to these areas within the current outage. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in monitoring the conditions of coatings, identifying areas of degraded conditions, recommending and communicating appropriate corrective actions, and restoring the degraded coatings to a satisfactory condition.

3. In 2008, the Salem Unit 2 containment coating inspection findings were reported under the Protective Coating Monitoring and Maintenance Program. Pre-walkdown research was completed per the program requirements. The first focused inspections were performed at areas inspected in the previous outage and identified for continued monitoring. The 2008 inspection findings noted that there was no further degradation, i.e., additional delamination of missing coatings from the concrete walls. The inspection findings also indicated that the coatings applied to metal and concrete surfaces were in satisfactory condition and there were no areas that required immediate attention in the current outage. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in monitoring and trending the conditions of coatings in containment.

There is sufficient confidence that the implementation of the Protective Coating Monitoring and Maintenance Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Protective Coating Monitoring and Maintenance Program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Protective Coating Monitoring and Maintenance Program provides reasonable assurance that the cracking, blistering, flaking, peeling, and delamination aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.36 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new condition monitoring program that will be used to manage accessible non-EQ cables and connections within the scope of license renewal that are subject to adverse localized environments caused by heat, radiation, or moisture.

Cables and connections subject to an adverse localized environment are managed by visual inspection of the insulation or jacket. A representative sample of accessible electrical cables and connections installed in adverse localized environments or ambient conditions in excess of 60-year service limiting environments will be visually inspected for signs of accelerated age-related degradation such as embrittlement, discoloration, cracking, swelling, or surface contamination. The representative sample of accessible cables and connections will be inspected prior to the period of extended operation, with an inspection frequency of at least once every 10 years. If an unacceptable condition or situation is identified for a cable or connection, a determination will be made as to whether the same condition or situation is applicable to other accessible or inaccessible cables or connections. Additional inspections, repair or replacement are initiated as appropriate under the Corrective Action Process. Trending actions are not included as part of this program.

This program considers the technical information and guidance provided in NUREG/CR-5643, IEEE Std. P1205, SAND96-0344, and EPRI TR-109619. Connections included in the scope of this program are splices, terminal blocks, connectors, containment electrical penetration assembly connections, and the insulation portion of fuse blocks. Non-EQ cables used in low-level signal applications that are sensitive to reduction in insulation resistance such as radiation monitoring and nuclear instrumentation are included in the Electrical Cables and Connections Not Subject to 10 CFR 50.49 "Environmental Qualification Requirements Used in Instrumentation Circuits Aging Management Program"; therefore, they are not included in the scope of this program.

NUREG-1801 Consistency

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is consistent with the ten elements of aging management program XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements", specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

As noted in NUREG-1801, industry operating experience has shown that adverse environments caused by heat or radiation for electrical cables and connections may exist next to or above steam generators, pressurizers or hot process pipes, such as feedwater lines. These adverse environments have been found to cause degradation of the insulating materials on electrical cables and connections that is visually observable, such as color changes or surface cracking. These visual indications can be used as indications of degradation.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cable and connection age related degradation due to adverse environmental conditions are being adequately managed. Operating experience has demonstrated that Salem personnel have successfully identified degraded cable insulation through visual observations made during unrelated maintenance activities. The following examples of operating experience provide objective evidence that the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be effective in assuring that intended function(s) would be maintained consistent with the current licensing basis for the period of extended operation:

1. In June 1997, OE 8425, Heat Damage to Cables in Cable Trays was written describing an event at the Farley Nuclear Plant. An evaluation and assessment of the Salem cable tray configuration against the experience at Farley Station was performed. Actions were taken by the station staff to visually inspect the field for similar conditions at Salem. The field inspections validated that a similar adverse condition did not exist at Salem as described in the Farley Nuclear Plant report. This example illustrates that the Salem electrical cables and connections aging management program will be effective in utilizing industry OE in visually assessing cables and connections in local adverse environments.

2. In April 1980, the Westinghouse Nuclear Service Division (NSD) issued NSD Data Letter 80-2, Rev 1 that shared industry OE regarding a phase-to-phase fault on a Reactor Coolant Pump (RCP) motor cable at an operating nuclear plant due to long-term vibration. The letter recommended that an explicit check of the RCP motor cable be performed during routine maintenance to detect cable damage. This check was formally added to the RCP motor preventive maintenance procedure. Since then, reports have been made regarding RCP cable jacket degradation near the RCP motor terminals due to localized heat. Engineering personnel have evaluated the RCP cable jackets and

appropriate actions were taken. Additional actions are planned to replace the RCP power cables. This example illustrates that the Salem electrical cables and connections aging management program will be effective in utilizing industry OE in determining where likely local adverse environments are to be found in order to assess cables and connections. In addition, this example illustrates that the Salem electrical cables and connections aging management program will be effective in detecting the aging effects of cable, and the effectiveness of implementing the corrective action program in response to finding unacceptable visual indications.

3. On October 31, 2003, mechanical technicians (working an unrelated job in the vicinity) observed deteriorated insulation on the 230V cable that powers the Salem containment sump pumps. The degradation was local to the sump lid penetration and appeared to be caused by jacket embrittlement and excessive stress on the cable. The repairs to the cable insulation and jacket were made before any loss of function of the containment sump pumps. This example illustrates that the Salem electrical cables and connections aging management program will be effective in detecting the aging effects of cable, and the effectiveness of implementing the corrective action program in response to finding unacceptable visual indications.

4. On September 24, 2007, oil soaked control wiring within the 23 control room area chiller control panel was visually discovered. The control wiring jacket soaked up the oil and the wire swelled up with the oil. The extent of condition review revealed that the damage was limited to just one control panel. The damaged wiring was replaced with new control wiring that is resistant to oil. In addition, the control-panel wiring in the other two chillers in Unit 2 and in the other three chillers in Unit 1 was replaced pro-actively with oil resistant wiring to preclude a similar event in the future. This example illustrates that the Salem electrical cables and connections aging management program will be effective in detecting the aging effects of cable, and the effectiveness of implementing the corrective action program in response to finding unacceptable visual indications.

These examples demonstrate that Salem maintenance technicians and engineering staff are responsive to industry OE and demonstrate a history of visually assessing cable and connections installed in the field for similar situations as described in industry operating experience notices. Moreover, these operating experience examples demonstrate that the Salem maintenance technicians are knowledgeable and demonstrate a history of reporting degraded cable conditions when discovered during unrelated routine maintenance activities.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to resolve the conditions. There is sufficient confidence that the implementation of the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of these components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.37 Electrical Cables and Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Used In Instrumentation Circuits

Program Description

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program is a new condition monitoring program that will be implemented to manage the in-scope portions of the Radiation Monitoring System and the Reactor Protection System (i.e., the nuclear instrumentation system) not included in the Salem EQ Program. This program applies to sensitive instrumentation cable and connection circuits with low-level signals that are in scope for license renewal and are located in areas where the cables and connections could be exposed to adverse localized environments caused by heat, radiation, or moisture. These adverse localized environments can result in reduced insulation resistance causing increases in leakage currents.

The high voltage low-level signal instrumentation circuits from the Radiation *Monitoring System, Reactor Protection System and other Salem* License Renewal systems, which are not part of the scope of this aging management program, have been excluded because they either do not perform an intended function, are included in the Salem EQ program, or are not subject to adverse localized environments.

Calibration results and findings of surveillance programs for the in-scope portions of the Radiation Monitoring System and the Reactor Protection System will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards.

This new aging management program will be implemented prior to the period of extended operation.

This program considers the technical information and guidance provided in NUREG/CR-5643, IEEE Std. P1205, SAND96-0344, and EPRI TR-0109619.

NUREG-1801 Consistency

The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program is consistent with the ten elements of aging management program XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits" specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry operating experience has identified occurrences of cable and connection insulation degradation in high voltage, low-level instrumentation circuits performing radiation monitoring and nuclear instrumentation functions. The majority of occurrences are related to cable and connection insulation degradation inside of containment near the reactor vessel or to a change in an instrument readout associated with a proximate change in temperature inside the containment.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In December 2006, a routine surveillance was performed on the Salem Unit 1 Plant Vent Noble Gas Radiation Monitor. The surveillance result was unacceptable. Further troubleshooting revealed the cable for the background detector connector was broken. The entire detector was replaced (including the cable and connector assemblies). The problem was appropriately resolved and the system was retested satisfactorily. The extent of condition review revealed no other problems with the Plant Vent Noble Gas Radiation Monitoring System. This example provides objective evidence that the existing surveillances apply the appropriate acceptance criteria when testing instrumentation circuits and will detect cable and connector problems when the acceptance criterion is not met. This example also demonstrates that the corrective action program is effective in resolving the abnormal conditions.

2. In August 2006, operation personnel noted the Salem Unit 1 12 Steam Generator Blowdown Radiation Monitor background activity increasing above normal expected levels. Although the background activity levels were still well below the alarm setpoint and no alarms were present, an investigation was initiated with subsequent corrective actions. Maintenance technicians performed troubleshooting to diagnose the abnormal readings. The radiation monitor passed its channel source check. Further troubleshooting discovered that the cable connector between the rate meter and the pre-amp had begun to fail. The cable and connector was replaced and the system was retested satisfactorily. This example provides objective evidence that this program will detect and correct degraded cable and cable connections prior to a loss of function.

This example also demonstrates that the corrective action program is effective in resolving the abnormal conditions.

3. In May 2004, a Salem Unit 1 Containment Fan Cooling Unit Radiation Monitor failed low. Maintenance technicians performed troubleshooting in order to diagnose the abnormal condition and discovered that the detector cable for the radiation monitor was wetted from an overhead pipe leak. The pipe leak was repaired. The cable section was unable to be dried out, thus the cable section was replaced with new cable. The Containment Fan Cooling Unit Radiation Monitor was retested satisfactorily. This example provides objective evidence that this program will detect and correct problems with the detector cables when exposed to a localized adverse environment. This example also demonstrates that the corrective action program is effective in resolving the abnormal conditions.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program will be performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrument Circuits program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.38 Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new program that manages inaccessible medium voltage cables that are exposed to significant moisture simultaneously with significant voltage.

Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable in standing water). Periodic exposure to moisture that last less than a few days (i.e., normal rain and drain) is not significant. Significant voltage exposure is defined as being subjected to system voltage for more than twenty-five percent of the time.

Development of this program will consider the technical information and guidance provided in NUREG/CR-5643, IEEE Standard P1205, SAND 96-0344, and EPRI TR-109619. In scope, non-EQ, inaccessible medium voltage cables subject to significant moisture and voltage will be tested as part of this aging management program. These medium voltage cables will be tested using a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed. Cable testing will be performed at least once every ten years. The first tests will be completed prior to the period of the extended operation.

Manholes and cable vaults associated with the cables included in this aging management program will be inspected for water collection. In scope, non-EQ, inaccessible cables subject to significant moisture and voltage will be evaluated, so that draining or other corrective actions can be taken. The frequency of manhole and cable vault inspections for accumulated water and subsequent pumping will be based on existing practices and adjusted based on inspection results. This adjustment in inspection frequency recognizes that the objective of the inspections, as a preventive action, is to keep the cables infrequently submerged, thereby minimizing their exposure to significant moisture. This adjustment in inspection frequency also recognizes that a recurring inspection, set at the optimum frequency, would result in the cables being submerged only as a result of event driven, rain and drain, type occurrences. The maximum time between inspections will be no more than two years. The first inspections will be completed prior to the period of extended operation.

NUREG-1801 Consistency

The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new aging management program that is consistent with NUREG-1801 aging management program XI.E3, “Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new preventive and condition monitoring program that manages inaccessible medium voltage cable exposed to significant moisture simultaneously with significant voltage. Demonstration that the effects of aging are effectively managed is achieved through objective evidence which shows that the localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion and water trees are being adequately managed. The following examples of operating experience at Salem provide objective evidence that the Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be effective in assuring that intended functions will be maintained consistent with the current licensing basis for the period of extended operation:

1. In response to NRC Generic Letter 2007-01, Inaccessible or Underground Plant Transients, Salem was reported to have no history of failures of inaccessible or underground medium voltage cables. A cable condition-monitoring program has not yet been implemented for medium voltage cable. However, a representative sample of medium voltage cables have been routinely monitored since initial plant operations as part of existing maintenance procedures for periodically megger testing rotating electrical equipment. These tests include the power cables from the electrical switchgear to the equipment motor windings. Polarization Index (PI) testing for rotating equipment is performed with the power feeder cable connected. This example provides objective evidence that in-scope 4 kV cable insulation is in satisfactory condition, and detection methods exist such that if any aging effects of interest for this new program do occur, they would be detected prior to loss of intended function.

2. Manhole SWI-1 for the service water pump 4kV cable pull vaults was opened in 2003 in response to NRC Information Notice 2002-12, and found to be generally dry with some small amount of water on the floor. The cable was found to be in good condition. The cable was not submerged and no repairs were needed. This manhole has a drain

installed, below the cables, which leads to the service water pipe tunnel sump. The medium voltage power cable installed is supplied by Anaconda (Triplex), and connects switchgear to the service water pumps. The material condition inside this manhole, and its effect upon the cable, is therefore understood. This example provides objective evidence that in-scope 4 kV cable insulation is in good condition, industry operating experience will be used to improve the program, and detection methods exist such that if any aging effects of interest for this new program do occur, they would be detected and prevented prior to loss of intended function.

3. In May 2004, groundwater leakage was identified at a cable conduit at the West wall of the Auxiliary Building. The subsequent investigation discovered that the flexible portion of the conduit run buried underground outside of the Auxiliary Building had deteriorated and therefore no longer provided a watertight barrier. The conduit contains 4 kV power cable to the service water pumps. The cable was in good condition. A modification package was prepared and installed to seal the conduit. The ground water leakage into the conduit and the building was stopped. This example provides objective evidence that corrective actions are taken to keep medium voltage cables dry and make repairs prior to loss of intended function.

4. Megger testing was performed in October 2003 just prior to refueling outage 2R13 for the T2-T4 crosstie cable (13.8 kV Okonite) in accordance with procedures. The testing enabled use of the crosstie during the outage. Leakage current was successfully detected - in the switchyard manhole GBT-24 area where the cable was spliced - utilizing an AC high potential (very low frequency) test method. Recommendations included maintaining switchyard manhole GBT-24 dry, in order to keep any leakage current (due to the splice) from tracking to ground. The test demonstrated that the cable can be tested, and that splices (not cable insulation) are the most common problem. The cable splice was repaired after the outage. This example provides objective evidence that 13.8 kV cable insulation is in good condition, and test methods are proven such that if any aging effects of interest for this new program do occur, they would be detected prior to loss of intended function.

5. The 4 kV power cable inside of a conduit for the 12B Circulating Water pump motor was inspected in March 2001. Electromagnetic interference (EMI) analysis/signature indicated a high level of energy in the middle of the flexible conduit, which was also found warm to the touch. Thermography was subsequently used to confirm and pinpoint the problem (a defective splice, not the cable insulation) during a subsequent system outage window. This example demonstrates that the most common cable problems experienced at Salem have been due to bad splices, and not due to cable insulation degradation. This example also provides objective evidence that corrective actions will be taken such that if any aging effects of interest for this new program do occur, they will be addressed through the corrective action process.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will provide reasonable assurance that the inaccessible medium voltage cables exposed to significant moisture and significant voltage will be adequately managed so that the intended functions of these cables will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.39 Metal Enclosed Bus

Program Description

The Metal Enclosed Bus aging management program is a new condition monitoring program that will manage the aging of in-scope metal enclosed busses at Salem.

The internal portions of the in-scope metal enclosed bus enclosures will be visually inspected for cracks, corrosion, foreign debris, excessive dust build-up and evidence of moisture intrusion. The bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The internal bus supports will be visually inspected for structural integrity and signs of cracks. Bolted connections are not accessible, but will be checked (sampled) for loose connection using thermography from outside the metal enclosed bus.

Metal enclosed busses are to be free from unacceptable visual indications of surface anomalies, which suggest that conductor insulation degradation exists. In addition no unacceptable indication of corrosion, cracks, foreign debris, excessive dust buildup or evidence of moisture intrusion is to exist. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of intended function. Bolted connections will be confirmed to be within the acceptance criteria of administrative program procedures.

This new aging management program will be implemented prior to the period of extended operation. In addition, the first inspections will be completed prior to the period of extended operation and every 10-years thereafter.

NUREG-1801 Consistency

The Metal Enclosed Bus program is consistent with the ten elements of aging management program XI.E4, “Metal Enclosed Bus,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry experience has shown that failures have occurred on Metal Enclosed Buses caused by cracked insulation and moisture or debris buildup internal to the metal enclosed bus. Experience has also shown that bus connections in the metal enclosed busses exposed to appreciable ohmic heating during operation may experience loosening due to repeated cycling of connected loads.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that the aging effects of loosening of bolted connections and reduced insulation resistance (of standoff insulators) and the associated aging mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the new Metal Enclosed Bus program will be effective in assuring that intended function will be maintained consistent with the current licensing basis for the period of extended operation:

1. In November 1996 in response to industry experience, work orders were generated to megger and high-potential test the 4 kV non-segregated metal enclosed bus duct and inspect the duct connecting the auxiliary power transformers to the 4 kV group busses. The metal enclosed duct was examined to ensure no loose bolts (including insulator mounting bolts); properly compressed gaskets; and filter/breather drains were clean and free of stoppage. The duct was also evaluated for potential water leakage into the duct and its effects. The duct was inspected, cleaned and in some cases caulked principally at locations where housing bolts may have been loose, on the top horizontal sections of the duct, to prevent moisture intrusion. The corrective actions also included enhancements to existing preventive maintenance procedures and practices to more effectively detect water intrusion and address the lessons learned from industry operating experience. No significant age-related degradation was detected during these inspections, such as insulation surface anomalies and discoloration (signs of overheating). The bus enclosures were found to be clean, with no evidence of water intrusion or signs of overheating, and have not experienced any failures since these measures were established in 1996. These activities demonstrate that the bus is accessible for visual inspection and in good condition, and that effective measures exist to prevent water accumulation in the duct such that if any aging effects of interest for this program do occur, they should be detected during future inspections. This example provides objective evidence that the new Metal Enclosed Bus program will be capable of both monitoring and detection of the aging effects associated with bus insulation and bolted connections, and that industry operating experience will be used to improve the program and prevent events that have occurred at other plants.

2. Preventive maintenance activities and bus overhauls were established at Salem in 1990 in response to NRC Information Notice 89-64, Electrical Bus Bar Failures. An overhaul project was undertaken to replace Noryl sleeving on 4 kV buses, as well as the bolts. The Salem 2H and 2E group buses were overhauled in the Unit 2 1990 refueling outage, replacing the sleeving in question and improving the overall bus conditions. In November 2000, the effectiveness of metal bus inspections and maintenance was evaluated in light of industry experience associated with bolt torque relaxation as described in NRC Information Notice 2000-14. These examples provide objective evidence that industry operating

experience will be used to improve the program and prevent events that have occurred at other plants.

3. Preventive maintenance (PM) activities were performed in April 2007 to inspect and clean the 4 kV non-segregated metal enclosed bus duct on Salem Unit 1. This metal enclosed duct (not in scope for license renewal) was examined to ensure no loose bolts (including insulator mounting bolts); properly compressed gaskets; and filter/breather drains were clean and free of stoppage. The duct was also evaluated for potential water leakage into the duct. The duct was inspected, cleaned and found to be in good condition. This PM activity is performed each outage for two group buses on each unit. These activities demonstrate the bus is accessible for visual inspection and in good condition, and that effective measures exist to prevent water accumulation in the duct, such that if any aging effects of interest for this program do occur, they would be detected during future inspections. This example provides objective evidence that the new Metal Enclosed Bus program will be capable of both monitoring and detection of the aging effects associated with bus insulation and bolted connections.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Since only a small portion of metal bus at Salem is in scope for license renewal and experience has shown that aging degradation is a slow process, a 10-year inspection frequency is an adequate period to preclude failures. There is sufficient confidence that the implementation of the new Metal Enclosed Bus program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Metal Enclosed Bus program will be performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Metal Enclosed Bus program will provide reasonable assurance that the loosening of bolted connections and reduced insulation resistance aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.40 Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new one-time inspection program that will be used to confirm the absence of an aging effect with respect to electrical cable connection stressors. The aging effect and mechanism of concern is the loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation.

A representative sample of cable connections within the scope of license renewal will be selected for one-time testing prior to the period of extended operation to confirm that there is no age related degradation of the electrical connection metallic parts, and if occurring, to determine the extent of any such degradation. The scope of this sampling program will consider application (medium and low voltage), circuit loading (high loading), and location (high temperature, high humidity, vibration, etc). The technical basis for the sample selection will be documented.

The specific type of test performed will be a proven test for detecting loose connections, such as thermography or contact resistance measurement, as appropriate to the application.

NUREG-1801 Consistency

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is consistent with the ten elements of aging management program XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements", specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 describes an aging management program for electrical cable connections in Chapter XI: XI.E6 "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." An NRC and industry effort is in progress, working towards the issuance of a revision to XI.E6, via the Interim Staff Guidance (ISG) process. The latest draft revision of this ISG was presented for public comment in the September 6, 2007, Vol. 72, No. 172 issue of the Federal Register as: Proposed License Renewal Interim Staff Guidance LR-ISG-2007-02: Changes to Generic Aging Lessons Learned (GALL) Report Aging Management Program (AMP) XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements" Solicitation of Public Comment. The exception for this aging management program is that the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management

program is consistent with NUREG-1801 as it is modified by the September 6, 2007 proposed revision of LR-ISG-2007-02. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), and Corrective Actions (Element 7).**

Enhancements

None.

Operating Experience

Operating experience has demonstrated that Salem has successfully identified loose connections through the effective use of thermography. Salem experience is in alignment with the industry in that electrical connections have not experienced a high degree of failures and that existing Salem installation and maintenance practices are effective.

The following examples of operating experience provide objective evidence that the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be effective in confirming the absence of an aging effect with respect to electrical cable connection stressors prior to the period of extended operation:

1. In April 2002, a routine thermography survey discovered a hot electrical connection (40 degree C rise) on a molded case circuit breaker located in the Salem Unit 2 Auxiliary Power Transformer control cabinet. A temperature difference of 75 degrees C or more requires immediate action. This condition required the connection to be monitored more frequently until the control panel could be de-energized for repairs. No other connections were found to be at an abnormal temperature. The molded case breaker was replaced and tested satisfactorily. This example provides objective evidence that thermography will detect loose or dirty electrical connections prior to a loss of function. This also demonstrates that actions are taken to increase the monitoring of electrical connections that are discovered to be hotter than expected. Lastly, this example demonstrates that the thermography acceptance criterion is effective in utilizing the corrective action process to resolve the problem prior to the loss of intended function.

2. In July 2008, the Salem Unit 2 Individual Rod Position Indicator (IRPI) for control rod 2B4-2 began to show signs of degradation. Although the IRPI was still performing within tolerance, an investigation and corrective actions were initiated. Since this is a low power system, thermography is not an appropriate tool for locating loose or dirty electrical connections. Time Domain Reflectometry (TDR) was utilized to detect the location of high impedance on the IRPI cable. Corrective actions were taken to improve the performance of the IRPI circuit and the system was retested satisfactorily. This example provides objective evidence that the appropriate testing techniques are utilized to locate loose or dirty connections prior to a loss of function.

3. In October 2008, a routine thermography survey in Salem Unit 1 discovered a hot spot on an internal bus bar connection inside a lighting panel. The connection was 31 degrees C above the other bus bar temperatures. A temperature difference of 75 degrees C or more requires immediate action. Normally, all associated panel bus bar connections should be about the same temperature. The connection was monitored more frequently until the panel could be de-energized for repairs. The bus bar connection was repaired and tested satisfactorily. This example provides objective evidence that the appropriate use of thermography will detect loose electrical connections prior to a loss of function. This also demonstrates that actions are taken to increase the monitoring of electrical connections that are discovered to be hotter than expected. Finally, this example demonstrates that the thermography acceptance criterion is effective in utilizing the corrective action process to resolve the problem prior to the loss of intended function.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Electrical Cable Connections Not Subject to 10 CR 50.49 Environmental Qualification Requirements program will effectively confirm the absence of aging degradation of metallic cable connections. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found.

Conclusion

The new Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will provide reasonable confirmation of the absence of an aging effect with respect to electrical cable connection stressors prior to the period of extended operation so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.2 Plant Specific Aging Management Programs

This section provides summaries of the plant specific programs credited for managing the effects of aging.

B.2.2.1 High Voltage Insulators

Program Description

The High Voltage Insulators aging management program is a new condition monitoring program that manages the degradation of insulator quality at Salem due to the presence of salt deposits or surface contamination.

The scope of the program includes high voltage insulators in the 500 kV switchyard, and portions of the 13 kV buses. The High Voltage Insulators program includes visual inspections to detect unacceptable indications of insulator surface contamination. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of intended function. Corrective actions include subsequent cleaning (i.e., washing) of a contaminated insulator. The visual inspections will be performed on a twice per year frequency, will be effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

This program will be implemented prior to the period of extended operation so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The High Voltage Insulators program is a new program that manages the aging effect of degradation of insulator quality. The scope of the program includes insulators in the 500 kV switchyard ring bus and portions of the 13.8 kV buses. The high voltage insulators are those credited for supplying power to in-scope components for recovery of offsite power following a station blackout.

Degradation of insulator quality due to presence of any salt deposits and surface contamination could occur in high voltage insulators. NUREG-1801 recommends further evaluation of a plant-specific aging management program for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Various airborne materials such as dust, salt and industrial effluents can contaminate insulator surfaces. A large buildup of surface contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover. The buildup of surface contamination is washed away by rain, as evident in the operating history for Salem. The glazed porcelain insulator surface aids this contamination removal. The High Voltage Insulators program relies upon condition monitoring of the insulator surface to visually identify degradation and manage the aging mechanisms of salt deposits and surface contamination on high voltage insulators.

Preventive Actions – Element 2

The High Voltage Insulators aging management program is not a preventive or mitigation program. The High Voltage Insulators aging management program is a condition monitoring program that relies upon visual inspections of insulator surface in order to manage the degradation of insulator quality due to the presence of salt deposits or surface contamination.

Parameters Monitored or Inspected – Element 3

Walkdowns are periodically conducted to visually inspect material conditions in the switchyards. Inspections of high voltage insulators will be performed visually to determine a threshold for implementing corrective actions. These inspections will detect the presence and extent of any aging degradation due to the presence of salt deposits.

Porcelain insulators typically have a shiny surface; if the surface is dull, then contamination is present. Typically heavy contamination will be apparent by the buildup at the base area of a vertical insulator. Similarly, for insulators in the dead-end horizontal configuration, significant drip marks are an indication that the location should be monitored. The most important area that signifies heavy contamination is when contamination is observed on the inside ridges of the underside of the bells. Evidence of salt deposits or surface contamination will be monitored and inspected to ensure high voltage insulator intended function during the period of extended operation.

No actions are taken as part of this program with respect to performance monitoring, or to prevent or mitigate aging degradation. The High Voltage Insulators aging management program is a condition monitoring program that relies on visual inspections of insulator surface in order to manage the degradation of insulator quality due to the presence of salt deposits or surface contamination.

Detection of Aging Effects – Element 4

System walkdowns in the switchyards are conducted periodically, and include a visual inspection of high-voltage insulator surface conditions in accordance with system engineering walkdown procedures. These walkdowns will continue into the period of extended operation, and will detect any aging degradation due to the presence of salt deposits or surface contamination. These inspections will be performed visually to determine a threshold for implementing corrective actions.

The high-voltage insulators within the scope of this program are to be visually inspected at least twice per year. This is an adequate period to detect aging effects before a loss of component intended function since experience has shown that aging degradation is a slow process. A twice per year inspection interval will provide multiple data points during a 20-year period, which can be used to characterize the degradation rate.

The buildup of surface contamination is typically a slow, gradual process that is even slower for rural areas with generally less suspended particles and contaminant concentrations in the air than urban areas. Salem is located in a rural area, not near heavy industry that would provide a source for contaminants. There has only been one event associated with insulator contamination, which was not age-related or time-dependent. Therefore, operating history and plant location support a twice per year inspection frequency, which in turn provides reasonable assurance that the aging effect of degraded insulator quality will be detected prior to failure and loss of intended function.

Monitoring and Trending – Element 5

Monitoring activities will be prescribed by procedures that contain consistent qualitative criteria for insulator surface contamination levels (e.g. slight, moderate and heavy), and results will be documented providing a predictable extent of degradation. Visual techniques and a twice per year frequency are appropriate for monitoring high voltage insulators and have been employed with success by transmission and distribution organizations. Qualitative criteria for insulator surface contamination levels (e.g. slight, moderate and heavy), will allow a predictable extent and rate of surface contamination degradation. The results will be trended, from inspection to inspection, providing a basis for timely corrective actions such as insulator cleaning/washing, prior to a loss of insulator intended function.

Acceptance Criteria – Element 6

Visual inspection of high voltage insulators will be prescribed by procedures that contain consistent qualitative criteria for insulator surface contamination levels (e.g. slight, moderate and heavy), and the results will be documented providing a predictable extent of degradation. Inspection findings are to be within the acceptance criteria of these procedures, to ensure that high voltage insulator intended function is maintained under all current licensing basis design conditions during the period of extended operation.

Quantitative acceptance criteria are not utilized; qualitative criteria are specified to ensure that high voltage insulator intended function will be maintained. Guidance for insulator surface conditions is in accordance with accepted industry practice. Any acceptance criteria not currently defined in the UFSAR will be defined by engineering and accepted based on procedures, regulatory requirements and accepted industry practices.

Visual inspection of high voltage insulators will be prescribed by site-specific procedures that contain consistent qualitative criteria for insulator surface contamination levels (e.g. slight, moderate and heavy), and the results will be documented providing a predictable extent of degradation.

Corrective Actions – Element 7

Unacceptable high voltage insulator visual inspection results will be subject to an evaluation under the corrective action process. The evaluation will consider the significance of the inspection results, the extent of the concern, the potential causes for not meeting the inspection acceptance criteria, the corrective actions required. Corrective actions will be implemented when inspection results do not meet the acceptance criteria. The corrective action process is governed by 10 CFR 50, Appendix B and is implemented by corporate administrative procedures. The corrective action process generically applies to all station activities, even when not specifically invoked by a procedure line item.

If the deficiency is assessed to be a significant condition adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition. Engineering analysis of identified degradation of high voltage insulators will confirm that the intended function will be maintained consistent with the current licensing basis, or the structure or component will be repaired or replaced.

Confirmation Process – Element 8

The confirmation process is implemented by site quality assurance (QA) procedures. QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The completion and effectiveness of corrective actions are ensured by site quality assurance (QA) procedures. When corrective actions are necessary, the corrective action process assures that the cause of the adverse condition is determined and corrective actions are effective in precluding repetition. This process defines how the effectiveness of corrective actions is monitored to prevent recurrence.

The High Voltage Insulators program relies on condition monitoring activities to detect and correct the presence of salt deposits and surface contaminants on switchyard insulators. The High Voltage Insulators program is a condition monitoring program, and is not a prevention or mitigation program.

Administrative Controls – Element 9

The procedures used to implement the High Voltage Insulators program are included in the quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

The High Voltage Insulators program consists of administratively controlled procedures, which are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The High Voltage Insulator aging management program is included in the license renewal UFSAR supplement.

Operating Experience – Element 10

Industry operating experience illustrates the potential for loss of insulator quality due to salt deposits and surface contamination on switchyard insulators. Demonstration that the new High Voltage Insulator program will be effective is achieved through objective evidence that shows the aging effect of degradation of insulation quality caused by the presence of salt deposits and surface contamination is being adequately managed. The following examples of operating experience provide objective evidence that the new High Voltage Insulators program will be effective in assuring that the intended function will be maintained consistent with the current licensing basis for the period of extended operation:

1. In March 1993, Crystal River Unit 3 experienced a loss of the 230 kV switchyard (normal offsite power to safety-related buses) when a light rain caused arcing across salt-laden 230 kV insulators and opened switchyard breakers. In March 1993, the Brunswick Unit 2 switchyard experienced a flashover of some high-voltage insulators attributed to a winter storm. Since 1982, Pilgrim experienced several losses of offsite power when ocean storms deposited salt on the 345 kV switchyard, causing the insulator to arc to ground. In response to this industry experience, existing 6-month inspections of Salem 13 kV insulators were expanded to include the 500 kV insulators for salt contamination. The switchyard was inspected using thermography and corona detection equipment in the winter and summer of 2002, and no significant contamination buildup was found. The response and actions associated with this industry experience were revisited in 2003 following the effects of Hurricane Isabel. Switchyard insulator inspections were instituted along with contingency planning for an insulator cleaning strategy. Steps for initiating inspection of switchyard insulator surfaces were added to severe weather abnormal operating procedures upon forecast of severe weather. This example provides objective evidence that industry operating experience will be applied towards this new program, and corrective actions will be taken when the quality of insulator surfaces is threatened by storms and contamination.

2. One plant specific event occurred at Salem on September 18-19, 2003, when Hurricane Isabel passed a considerable distance to the south and west of the site. Strong winds with gusts in excess of 60 mph caused

switchyard insulators to become coated with salt. The rain had stopped prior to the strongest winds, leaving the salt spray to dry on switchyard insulators. Both Salem units operated throughout the storm. The combination of salt on the insulator surface and atmospheric moisture subsequently caused a flashover. Circuit breakers opened as designed to isolate the fault on the Salem end of the line, without effect on Salem plant equipment. Another insulator flashover occurred shortly thereafter with no effect on plant operation. In response to the switchyard faults, both Salem units were manually taken off-line on September 20th. The high voltage insulators were subsequently cleaned/washed prior to returning the units to operation. This event demonstrates that corrective actions are taken when high voltage insulator degradation is found and, because this is the only high voltage insulator-related event of record, flashover due to salt contamination of insulators at Salem is considered rare.

3. Visual inspection of Salem switchyard high voltage insulators is performed every twice per year for evidence of salt and contamination. These inspections have been in place since 1996, and have not found or observed degraded insulator quality other than "slight" surface contamination, even during periods of excessively dry weather, which would warrant cleaning or other corrective measures. This component history demonstrates that minor contamination is washed away by rainfall or snow, and cumulative build up has not been experienced and is not expected to occur (with the exception of infrequent storms like Hurricane Isabel). Visual inspection results for high voltage insulators are evaluated as part of transmission and distribution outage inspections as well as switchyard system walkdowns. This example provides objective evidence that the aging effect of degraded insulation quality is capable of being detected, and that the mechanisms of salt deposit and surface contamination on high voltage insulators will be managed prior to loss of intended function.

The Salem operating experience for the High Voltage Insulators program provides sufficient confidence that the implementation of the High Voltage Insulators program will effectively identify degradation prior to failure.

Exceptions to NUREG-1800

None.

Enhancements

None.

Conclusion

The new High Voltage Insulators aging management program will provide reasonable assurance that the aging effect of degradation of insulator quality due to the presence of salt deposits and surface contamination will be adequately managed so that the intended function of high voltage insulators within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.2.2 Periodic Inspection

Program Description

The Periodic Inspection aging management program is a new condition-monitoring program that manages the aging of piping, piping components, piping elements, ducting components, tanks and heat exchanger components. This program will manage the aging effects of loss of material, reduction of heat transfer and hardening and loss of strength. This program will also manage cracking of the stainless steel emergency diesel generator engine exhaust expansion joints. The program includes provisions for visual inspection of stainless steel, aluminum, copper alloy and elastomer components exposed to air-indoor, air-outdoor, air with steam or water leakage, air/gas-wetted, diesel exhaust, raw water and treated borated water not managed under other aging management programs. The program also includes provisions for ultrasonic wall thickness measurements to detect loss of material. Identified deficiencies due to age related degradation are evaluated under the Corrective Action Program.

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The scope of the Periodic Inspection aging management program manages the aging of piping, piping components, piping elements, heat exchanger components, tanks, and ducting components. This aging management program includes stainless steel, aluminum, copper alloy and elastomer components not included in other aging management programs.

Preventive Actions – Element 2

The Periodic Inspection aging management program is a condition monitoring program and does not include activities for prevention or mitigation of aging effects. The program includes activities to periodically inspect for applicable aging effects. This program includes visual inspections and ultrasonic (UT) wall thickness measurements. The inspection frequencies are established based on plant and industry operating experience, and provide reasonable assurance that significant aging effects will be detected and corrective actions taken prior to loss of component intended function.

Parameters Monitored/Inspected – Element 3

The Periodic Inspection program is a condition monitoring program that performs periodic focused visual inspections or UT wall thickness measurements to detect loss of material aging effects. The Periodic Inspection aging management program will detect loss of material, reduction of heat transfer and hardening and loss of strength aging effects on components in the scope of this program prior to loss of the component intended function. The program includes visual inspections to detect the presence and extent of fouling that could result in reduction of heat transfer. The program also includes visual inspections of elastomer components for hardening and loss of strength. Visual inspection may include physical manipulation to assist in detecting hardening and degradation of elastomer components.

Detection of Aging Effects – Element 4

The Periodic Inspection aging management program will detect loss of material, reduction of heat transfer and hardening and loss of strength aging effects on components in the scope of this program prior to loss of the component intended function. The program will also detect cracking of emergency diesel engine exhaust expansion joints prior to loss of intended function. The aging effects are detected by direct visual inspection of component surfaces and UT wall thickness measurements. The focused visual inspections and UT wall-thickness measurements will detect the presence and extent of loss of material aging effects. The focused visual inspections will also detect the presence and extent of fouling that could result in reduction of heat transfer on heat exchanger coils. Visual inspections of elastomer components will detect the presence and extent of hardening and loss of strength. Visual inspection may include physical manipulation to assist in detecting hardening and degradation of elastomer components.

Focused visual inspections will be performed on a representative sample of components in the scope of this program. Visual inspections will be performed on component surfaces that are either normally accessible or made accessible during periodic component disassembly.

Piping system UT wall thickness measurements will be performed on a representative sample of piping locations selected from systems in the scope of this program that are not normally opened for maintenance. Locations will be selected to include the material and environment combinations applicable to the piping and piping system component internal surfaces in the scope of this program. Piping system UT wall thickness measurements will be evaluated to determine if significant loss of material is occurring for the material and environment combination. Selected UT locations will include systems and areas within systems considered most susceptible to aging effects, based on system operating conditions and plant operating experience.

A ten year inspection frequency is established based on plant and industry operating experience. Most components in the scope of this program are subject to an environment of uncontrolled air, including outdoor air and ventilation system air. Although this environment is assumed to contain moisture, condensation and contaminants, plant operating experience has not indicated significant aging effects for aluminum, stainless steel and copper alloy components in this environment. The elastomer components in this program are located indoor and not subject to significant UV exposure. The program also includes copper alloy and stainless steel components subject to a raw water environment. For stainless steel and copper alloy components in this program and subject to a raw water environment, operating experience indicates that a ten year inspection frequency will be adequate to detect loss of material prior to loss of the component intended function.

Monitoring and Trending – Element 5

The Periodic Inspection program performs focused visual inspections or UT wall thickness measurements to detect loss of material aging effects. The program includes visual inspections of heat transfer surfaces for reduction of heat transfer. The program also includes visual inspections of elastomer components for hardening and loss of strength. Visual inspection may include physical manipulation to assist in detecting hardening and degradation of elastomer components. The program also includes visual inspections of the standby diesel engine exhaust expansion joints for cracking. These periodic inspection activities provide an effective technique to identify the extent of degradation on component surfaces prior to loss of component intended function. The inspections will be performed on a representative sample of component, material and environment combinations. Inspection frequencies are established based on industry and plant specific operating experience. Identified degradation will be entered into the corrective action process to determine the impact on the component intended function, including any required repairs or subsequent monitoring and trending requirements.

Acceptance Criteria – Element 6

This program manages loss of material, cracking, reduction of heat transfer and hardening and loss of strength aging effects on components in the scope of the program. Acceptance criteria for loss of material are based on the original equipment design wall thickness and any corrosion allowance requirements. Identified degradation is evaluated against the minimum wall thickness required for the component to perform its intended function under applicable design basis conditions, to determine if corrective actions are required. Acceptance criteria for reduction of heat transfer are based on identification of fouling on the external heat transfer surfaces of cooling coils. Identified fouling is removed by cleaning as part of the maintenance activity associated with the inspection. Acceptance criteria for emergency diesel engine expansion joint cracking are based on preventing exhaust gas leakage that could impact engine operation. Acceptance criteria for hardening and loss of strength of elastomer components are based on visual indications of degradation such as cracking, tears or perforations in the elastomer material, and may also include physical manipulation to detect hardening and cracking.

Corrective Actions – Element 7

Evaluations are performed for inspection results that do not satisfy acceptance criteria and a notification is initiated to document the concern in accordance with plant administrative procedures that meet the requirements of 10 CFR 50, Appendix B. The corrective action program and specific corrective action steps as specified in procedures ensure that any conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence.

Identified degradation will be evaluated against the requirements for the system and component to perform its intended function under applicable design basis conditions, to determine if corrective actions are required. The minimum system and component requirements are determined by analysis and are based on applicable design basis operating and environmental conditions.

Confirmation Process – Element 8

The confirmation process is implemented by site quality assurance (QA) procedures. The review and approval processes and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

Administrative Controls – Element 9

The procedures used to implement the Periodic Inspection aging management program are included in the quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. This aging management program is included in the Salem license renewal UFSAR supplement.

Operating Experience – Element 10

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Periodic Inspection program will be effective in assuring that the intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. Extensive maintenance history searches were performed on the Salem ventilation systems in the scope of this program to identify plant operating experience with loss of material or other age-related degradation on the surfaces of stainless steel, aluminum and copper alloy ventilation system components. These ventilation systems contain and process air drawn directly from outdoors or air drawn from various plant areas. In system locations where condensation is expected, it is contained by collection and drain systems. Plant operating experience indicates that the ventilation system air environment is not corrosive to stainless steel, aluminum and copper alloy materials. No age-related degradation issues associated with ventilation system internal surfaces were found. The results from periodic internal inspections performed since 2003 indicate component conditions are satisfactory, and did not indicate internal surface corrosion or degradation. Interviews with ventilation system managers at the station confirmed that ventilation systems have not experienced loss a material or other aging degradation on the stainless steel, aluminum and copper alloy components in the scope of this program. This operating experience

example provides objective evidence that existing maintenance activities will identify internal degradation prior to loss of intended functions.

2. In response to industry operating experience (INPO SEN 226, Stress Corrosion Cracking on a Portion of Safety Injection System Piping, December 2001), periodic external visual inspections have been performed on three different sizes of stainless steel piping located outdoors, to confirm that potential external salt contamination from the Delaware River has not resulted in degradation of the piping. Inspections were performed in September 2002, May 2006 and August 2008. All of the inspection results have been satisfactory, with no indication of age related degradation. The piping appeared in new condition. This operating experience provides objective evidence that stainless steel components in the scope of this aging management program and subject to the outdoor air environment at Salem are not experiencing loss of material aging effects.

3. On August 10, 2004 the Salem Unit 2 Number 22 Fuel Handling Building exhaust fan discharge expansion joint was found to have a tear in it during a routine system walk-down. The corrective action process was initiated. The tear was evaluated to have little impact on the operation of the Fuel Handling Building Ventilation System. An extent of condition review found that numerous patches have been made to the joint. As a result, the entire flexible joint was replaced during the October 2005 refueling outage. This operating experience example demonstrates that degraded elastomer flexible connections are identified by visual inspection prior to loss of system or component intended function, and that when deficient conditions are found, they are entered into the corrective action program for evaluation and resolution. This ensures the proper corrective actions are taken to ensure the intended functions of the components are maintained.

Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Periodic Inspection program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Periodic Inspection program are performed to identify areas that need improvement to maintain the quality performance of the program.

Exceptions to NUREG-1800

None.

Enhancements

None.

Conclusion

The new Periodic Inspection aging management program will provide reasonable assurance that loss of material, reduction of heat transfer and hardening and loss of strength aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.2.3 Aboveground Non-Steel Tanks

Program Description

The Aboveground Non-Steel Tanks program is a new program used to manage the aging effects of the external surfaces of aboveground non-steel tanks exposed to air-outdoor or soil environments in the scope of license renewal. The tanks in the scope of this program are supported on concrete foundations.

The Aboveground Non-Steel Tanks program is credited for managing loss of material on the tank external surfaces, including the exterior bottom surface that is not accessible for direct visual inspection. Visual inspection activities are credited for the entire outer surface of the tanks, up to the surface in contact with the concrete foundation. Loss of material on the inaccessible tank bottom external surfaces is detectable by thickness measurements of the tank bottom. The condition of the tank bottom outer surface will be confirmed by performing a UT inspection of the tank bottom from inside the tank.

This program also includes inspection of grout or sealant installed at the interface edge between the tank bottom and the concrete foundation for signs of degradation. Where bird screens are installed on the tank vent, the bird screen will be visually inspected for loss of material.

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The scope of the Aboveground Non-Steel Tanks aging management program includes outdoor non-steel tanks in the scope of license renewal. The program consists of periodic visual inspection of the accessible tank external surfaces. The condition of the tank bottom outer surface will be confirmed by performing a UT inspection of the tank bottom from inside the tank.

This program also includes inspection of grout or sealant installed at the interface edge between the tank bottom and the concrete foundation for signs of degradation. Where bird screens are installed on the tank vent, the bird screen will be visually inspected for loss of material.

Preventive Actions – Element 2

The Aboveground Non-Steel Tanks aging management program is a condition monitoring program and does not include activities for prevention or mitigation of aging effects. The program includes periodic visual inspection activities, including inspection of grout or sealant installed at the interface edge between the tank bottom and the concrete foundation for signs of degradation. The program also includes a UT inspection to confirm the condition of the inaccessible tank bottom outer surface. Where bird screens are installed on the tank vent, the bird screen will be visually inspected for loss of material. The five year visual inspection frequency is established based on plant and industry operating experience, and provides reasonable assurance that significant aging effects will be detected and corrective actions taken prior to loss of component intended function.

Parameters Monitored/Inspected – Element 3

For the accessible outer surface of the tank, up to the surface in contact with the concrete foundation, the condition of the surface is monitored by direct visual inspection to identify loss of material degradation. Focused visual inspections will detect significant loss of material due to pitting and crevice corrosion prior to loss of the tank intended function. Where grout or sealant is installed at the interface edge between the tank bottom and the concrete foundation, the grout or sealant will be periodically inspected for degradation. Where bird screens are installed on the tank vent, the bird screen will be visually inspected for loss of material.

For the inaccessible tank bottom surface, the condition of the surface is confirmed by performing a UT wall-thickness inspection from inside the tank.

The focused visual inspections and UT wall-thickness measurements will detect the presence and extent of loss of material aging effects. Visual inspections will detect grout or sealant degradation that could allow water to get under the tank bottom.

Detection of Aging Effects – Element 4

The Aboveground Non-Steel Tanks aging management program will detect loss of material aging effects on the tank external surfaces before there is a loss of the tank intended function. For the accessible outer surface of the tank, up to the surface in contact with the concrete foundation, the condition of the surface is monitored by direct visual inspection to identify loss of material degradation. Focused visual inspections will detect significant loss of material due to pitting and crevice corrosion prior to loss of the tank intended function. Grout or sealant at the interface edge between the tank bottom and the concrete foundation prevents water and moisture from penetrating the interface. Therefore, where grout or sealant is installed at this interface, the grout or sealant will be periodically inspected for degradation that could allow water to get under the tank bottom. Where bird screens are installed on the tank vent, the bird screen will be visually inspected for loss of material. The five year frequency of the visual inspections will detect degradation prior to loss of intended function, based on industry and plant-specific operating experience.

For the inaccessible tank bottom surface, the condition of the surface is confirmed by performing a UT wall-thickness inspection from inside the tank. UT data will be taken at a sufficient number of locations on the tank bottom to determine if significant loss of material degradation is occurring. The UT inspection will be performed prior to entering the period of extended operation.

Wall-thickness measurement results will be evaluated to confirm that the tank intended function is maintained. If significant degradation is identified, the condition will be monitored and trended, and corrective action taken prior to loss of the tank intended function.

The Aboveground Non-Steel Tanks aging management program is not a sampling program. The program inspection activities are applied to all tanks in the scope of the program.

Monitoring and Trending – Element 5

For the accessible outer surface of the tank, up to the surface in contact with the concrete foundation, the condition of the surface is monitored by direct visual inspection to identify loss of material degradation. Focused visual inspections will detect significant loss of material due to pitting and crevice corrosion prior to loss of the tank intended function. A periodic visual inspection is an effective technique to identify loss of material on component external surfaces prior to loss of component intended function, based on industry and plant-specific operating experience.

For the inaccessible tank bottom surface, the condition of the surface is confirmed by performing a UT wall-thickness inspection from inside the tank. Wall thickness measurements will be compared to design requirements to determine if significant loss of material degradation is occurring. The UT inspection will be performed prior to entering the period of extended operation. Wall-thickness measurement results will be evaluated to confirm that the tank intended function is maintained. A UT wall thickness inspection is an effective technique to identify loss of material on inaccessible tank bottom external surfaces prior to loss of component intended function, based on industry and plant-specific operating experience.

Significant degradation identified by visual inspections or UT wall thickness measurements will be entered into the corrective action process to determine the impact on the tank intended function, including any required repairs or subsequent monitoring and trending requirements.

Acceptance Criteria – Element 6

This program manages loss of material on the external surfaces of outdoor non-steel tanks in the scope of license renewal. Acceptance criteria for the inspections in this program are based on the original equipment design wall thickness and corrosion allowance requirements for the tank pressure boundary components. Results meeting these criteria are considered to be without degradation, and the intended function will therefore be maintained under all CLB conditions. Identified degradation will be evaluated against the minimum wall thickness required for the tank to perform its intended function under applicable design basis conditions, to determine if corrective actions are required. The minimum required material thickness is determined based on consideration of pressure retaining requirements and structural requirements under applicable design basis operating and environmental conditions.

Acceptance criteria for the tank inspections in this program are quantitative, in that the requirement is to maintain a predetermined wall thickness. Visual inspections are qualitative in that they are relied upon to determine if any material loss is occurring based on the visually observable surface conditions. Indications of significant pitting or crevice corrosion, or other significant degradation will require additional evaluation to quantify the material loss and compare it to the applicable design requirements. Visual inspections of grout or sealant are qualitative in assessing the extent of degraded or missing grout or sealant. UT measurements of the tank bottom are quantitative inspections. Visual and UT inspections are performed by qualified personnel in accordance with approved station procedures.

Corrective Actions – Element 7

Evaluations are performed for inspection results that do not satisfy acceptance criteria and a notification is initiated to document the concern in accordance with plant administrative procedures that meet the requirements of 10 CFR 50, Appendix B. The corrective action program and specific corrective action steps as specified in procedures ensure that any conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition.

Identified degradation will be evaluated against the minimum wall thickness required for the tank to perform its intended function under applicable design basis conditions, to determine if corrective actions are required. The minimum required material thickness is determined by analysis based on consideration of pressure retaining requirements and structural requirements under applicable design basis operating and environmental conditions.

Confirmation Process – Element 8

The confirmation process is implemented by site quality assurance (QA) procedures. The review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

Administrative Controls – Element 9

The procedures used to implement the Aboveground Non-Steel Tanks aging management program are included in the quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. This aging management program is included in the Salem license renewal UFSAR supplement.

Operating Experience – Element 10

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects/mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Aboveground Non-Steel Tanks program will be effective in assuring that the intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In October 2000 during a routine walkdown of the demineralized water storage tank, the base of the tank was identified to have several locations that appeared to be saturated with water. The condition was monitored for several months, no active leak was observed, and no actions were taken. In September 2001, water was again observed around the tank base. The tank was drained and an internal inspection was performed. The source of the leakage was determined to be a through-wall hole caused by pitting originating from the external bottom surface of the tank. UT measurements were taken, and it was determined that the deterioration was limited to an area around the identified hole. The initial repair plan was to weld two 15" x 7" plates over the deteriorated area. Post repair testing revealed that the repair was unsuccessful, and the final corrective action implemented was to replace the base of the tank. After the bottom was replaced, the base perimeter was sealed to the cement support slab. In addition, the bottom tank seal on the other demineralized water tank was also replaced to minimize possible water intrusion under the base of the tank. To date, no further leaks have been identified on either demineralized water storage tanks.

2. Extensive maintenance history searches were performed to identify plant operating experience with loss of material or other aging degradation on the external tank surfaces exposed to the outdoor air environment, for the stainless steel and aluminum tanks in the scope of this program. These tanks are not coated. No age related degradation issues were identified associated with these tank external surfaces.

3. In response to industry operating experience (INPO SEN 226, Stress Corrosion Cracking on a Portion of Safety Injection System Piping, December 2001), periodic external visual inspections have been performed on three different sizes of stainless steel piping attached to the Refueling Water Storage Tanks, to confirm that potential external salt contamination from the Delaware River has not resulted in degradation of the piping. Inspections have been performed in September 2002, May 2006 and August 2008. All of the inspection results have been satisfactory, with no indication of age related degradation. The piping was observed to appear in new condition. This operating experience provides objective evidence that stainless steel components subject to the outdoor air environment at Salem, and located in proximity to the stainless steel tanks in the scope of this aging management program, are not experiencing loss of material.

During over 30 years of operation, there has been no degradation of the tank external surfaces exposed to the outdoor air environment. The good physical condition of these tanks supports the conclusion that inspection of the external surfaces every 5 years will be more than adequate to identify any degradation before it could result in loss of intended function. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Aboveground Non-Steel Tanks program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Aboveground Non-Steel Tanks program are performed to identify areas that need improvement to maintain the quality performance of the program.

Exceptions to NUREG-1800

None.

Enhancements

None.

Conclusion

The new Aboveground Non-Steel Tanks aging management program will provide reasonable assurance that the loss of material aging effect will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.2.4 Buried Non-Steel Piping Inspection

Program Description

The Salem Buried Non-Steel Piping Inspection program is an existing condition monitoring program that manages buried reinforced concrete piping and components in the Service Water System and Circulating Water System that are exposed to an external soil or groundwater environment for cracking, loss of bond, increase in porosity and permeability, and loss of material. The Salem Buried Non-Steel Piping Inspection aging management program also inspects the buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, which are exposed to an external soil or groundwater environment. The program relies on inspections of the external surfaces of piping and components to identify cracking, loss of bond, increase in porosity and permeability, and loss of material. Opportunistic and focused inspections are performed to manage the effects of exterior surface and coating degradation on the pressure-retaining capacity of buried piping and components. Buried piping and components are inspected when they are excavated for maintenance or any other reason. Inspection of buried components identifies coating degradation, if coated, or base metal corrosion, if uncoated.

At least one opportunistic or focused excavation and inspection of buried piping and components within the scope of this program will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried piping and components within the scope of this program will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period.

Areas with high susceptibility of exterior surface degradation, consequence of failure and areas with a history of exterior surface degradation problems are identified and prioritized. Probabilistic arguments were not used in the development of the Buried Non-Steel Piping Inspection aging management program. Aging effects are managed by a condition monitoring program.

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The Salem Buried Non-Steel Piping Inspection aging management program is an existing program that manages cracking, loss of bond, loss of material and increase in porosity and permeability, through the use of opportunistic or focused inspections. The program relies on condition monitoring inspections of the external surfaces of piping and components to identify external surface degradation and detect the aging effects listed above. Opportunistic or focused inspections are performed when the components are excavated for maintenance or for any other reason. The program directs engineering to perform inspections of piping and components exposed during excavation. Inspection of buried components identifies coating degradation, if coated, or base metal corrosion, if uncoated.

The Salem Buried Non-Steel Piping Inspection aging management program inspects system piping and components within the scope of license renewal that are buried and included in the Circulating Water System and the Service Water. This includes the reinforced concrete Circulating Water System piping that begins underground leaving the Turbine Building and ending at the discharge in the Delaware River. This also includes the reinforced concrete piping in the Service Water System. At Salem Unit 2 the reinforced concrete piping in the Service Water System continues from the Service Water Intake Structure to the service water pipe tunnel and continuing to the Auxiliary Building. At Salem Unit 1 the buried Service Water piping goes straight from the Service Water Intake Structure to the Auxiliary Building.

Also included in the Salem Buried Non-Steel Piping Inspection aging management program is a small section (less than three feet long) of the fuel transfer tube assembly that is below grade and extends between the reactor cavities (Unit 1 and Unit 2) to the corresponding transfer pool located in each Fuel Handling building. The stainless steel, fuel transfer tube is encapsulated by carbon steel sleeves, with the ends of the carbon steel sleeves exposed (about 4 inches) at each end, and the stainless steel bellows connecting the two carbon steel sleeves. A galvanized sheet metal protective cover covers the stainless steel bellows. The carbon steel penetration sleeves are included in the scope of this program and not in the Buried Piping Inspection program because the inspection of the stainless steel bellows and carbon steel sleeves will be performed at the same time. This program inspects this buried, encapsulated section of carbon and stainless steel piping for loss of material.

The Salem Buried Non-Steel Piping Inspection aging management program will be enhanced to include at least one opportunistic or focused excavation and inspection of the stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, and buried reinforced concrete piping and components within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection the stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, and of buried reinforced concrete piping and components will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten years period.

Areas with high susceptibility of exterior surface degradation, consequence of failure and areas with a history of exterior surface degradation problems are identified and prioritized. Probabilistic arguments were not used in the development of the Buried Non-Steel Piping Inspection aging management program. Aging effects are managed by a condition monitoring program.

Preventive Actions – Element 2

The Salem Buried Non-Steel Piping Inspection aging management program is not a preventive or mitigation program. The Buried Non-Steel Piping Inspection aging management program is a condition monitoring program that relies on opportunistic or focused inspections of the buried reinforced concrete piping and components in the Circulating Water System and Service Water System that are exposed to an external soil or groundwater environment for cracking, loss of bond, increase in porosity and permeability, and loss of material.

The Salem Buried Non-Steel Piping Inspection aging management program also relies on opportunistic inspections of the buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, which are exposed to an external soil or groundwater environment for loss of material.

Parameters Monitored/Inspected – Element 3

The Salem Buried Non-Steel Piping Inspection aging management program is a condition monitoring program that relies on opportunistic or focused inspections of the buried reinforced concrete piping and components in the Circulating Water System and Service Water System that are exposed to an external soil or groundwater environment for cracking, loss of bond, increase in porosity and permeability, and loss of material. The Salem Buried Non-Steel Piping Inspection aging management program also relies on opportunistic or focused inspections of the buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, which are exposed to an external soil or groundwater environment for loss of material. These aging effects will be identified through visual inspections of the external surfaces of the piping and components. Opportunistic and focused inspections are performed when the piping is excavated for maintenance or for any other reason. External surfaces are inspected by visual techniques whenever buried components are uncovered during station excavation activities. Inspection of buried components identifies coating degradation, if coated, or base material degradation, if uncoated. At least one opportunistic or focused excavation and inspection of buried piping and components within the scope of this program will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried piping and components within the scope of this program will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period. These inspection activities provide reasonable assurance that significant aging effect will be detected and corrective actions taken prior to loss of intended function.

The Salem Buried Non-Steel Piping Inspection aging management program is not a performance monitoring program nor is it a preventive or mitigation program.

Detection of Aging Effects – Element 4

The Salem Buried Non-Steel Piping Inspection aging management program is a condition monitoring program that performs opportunistic or focused inspections on the buried piping and components in the scope of this program to detect and inspect for cracking, loss of bond, increase in porosity and permeability, and loss of material and will detect degradation of the component prior to loss of its intended function. Opportunistic or focused inspections to detect cracking, loss of bond, increase in porosity and permeability, and loss of material will be specified by engineering through specific procedures and will be based on accepted industry practices. Inspection for cracking, loss of bond, increase in porosity and permeability, and loss of material will be performed on the buried reinforced concrete piping in the Circulating Water System and Service Water System. Inspection for loss of material will be performed on the buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves. Examination methods include visual inspections of the external surface of buried piping and components. The methods used to inspect for degradation are performed in accordance with accepted industry standards. These inspections are an effective method to ensure that degradation of external surfaces has not occurred and the intended function is maintained. External inspections of buried components will occur opportunistically when they are excavated during maintenance, in addition to focused inspections. The inspections will be performed on all of the areas made accessible to support the maintenance activity.

At least one opportunistic or focused excavation and inspection of buried piping and components within the scope of this program will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried piping and components within the scope of this program will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period.

Areas with high susceptibility of exterior surface degradation, consequence of failure and areas with a history of exterior surface and coating degradation problems are identified and prioritized. If necessary, engineering will determine expanded inspection scope based on technical evaluations if the initial inspection results are unacceptable.

Operating experience supports this frequency of inspection. A review of plant operating experience at Salem shows that there have been no underground leaks that developed as a result of failure of the external surface of buried reinforced concrete piping. Although failure of buried piping has occurred, it was determined that the buried piping leaks were caused by degradation of the inside of the buried piping or non-age related conditions. In 2001, a section of the buried No. 12 service water reinforced concrete piping at Salem Unit 1 was excavated to determine the cause of leakage. The apparent cause of the leakage was determined to be a non-age related break in the steel bell ring.

Focused visual inspections will be performed on a representative sample of components, material and environment combinations. Visual inspections will be performed on external piping and component surfaces that are made accessible during opportunistic or focused excavations and inspections. Visual inspections will be performed on a representative sample of piping and component external surfaces in the scope of this program.

Significant degradation identified during inspection activities are entered into the corrective action program. The degraded condition is evaluated, and corrective actions are established if necessary to preclude recurrence.

Monitoring and Trending – Element 5

Opportunistic or focused inspections are appropriate for detecting cracking, loss of bond, increase in porosity and permeability, and loss of material aging effects prior to loss of intended function, based on plant specific and industry operating experience. External piping and component degradation is repaired and evaluated whenever buried commodities are uncovered during excavation and inspection activities. These inspection activities provide an effective technique to identify the extent of degradation on piping and component surfaces prior to loss of component intended function. The inspections will be performed on a representative sample of component, material and environment combinations. Results of the inspection activities will be monitored and indications of significant degradation will be entered into the corrective action process for evaluation. The evaluation will determine the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize system and component intended functions. In addition, the engineering evaluation will either demonstrate acceptability or specify the appropriate repair or replacement.

The data collected will be evaluated and quantified by engineering, and appropriate corrective actions will be taken for any adverse findings. Engineering evaluation requires an assessment of the rate of degradation, such that timing of the next scheduled inspection will occur before a loss of intended function. Significant degradation identified by visual inspections will be entered into the corrective action process. The corrective action process will include a notification and evaluation of the degraded condition against the acceptance criteria. Notifications are trended within the corrective action program. Significant loss of material identified by the external surface inspection will be quantified in terms of remaining wall thickness, and compared to minimum wall thickness design requirements. Subsequent inspection results will be compared to previous results for trending and confirmation of adequate inspection frequency. Follow up examinations will be required if necessary to determine the extent of the degraded condition, thus expanding the sample size and locations of inspections or adjusting the inspection frequency as appropriate.

Acceptance Criteria – Element 6

Acceptance criteria are specified in the implementing procedure or work order in accordance with the applicable regulatory or industry requirements. Inspection data is evaluated to determine wear rate, remaining life and the time to the next inspection or repair/replacement.

External component degradation is reported and evaluated whenever buried piping and components are uncovered during yard excavation activities. In addition, evidence of surface degradation and any leakage detected through periodic testing and visual inspections will be evaluated and used to confirm the system and components ability to perform their intended functions. Any leakage identified is evaluated and appropriate corrective actions are implemented. Guidance for acceptance criteria relating to localized wall thinning is contained in engineering documents and is used in the evaluation methodology.

Acceptance criteria are specified to ensure that the structure and component intended function(s) will be maintained under all CLB design conditions. Guidance for local wall thinning evaluations is in accordance with applicable regulatory or industry codes.

Any acceptance criteria not currently defined in the UFSAR will be defined by engineering and will be accepted based on procedures, regulatory requirements and accepted industry practices to maintain intended functions under CLB loads.

All qualitative inspections will be performed to the same predetermined criteria as quantitative inspections in accordance with approved site procedures. Acceptance criteria for loss of material are quantitative, in that the requirement is to maintain a predetermined wall thickness. Visual inspections are qualitative in that they are relied upon to determine if any wall loss is occurring based on the visually observable surface conditions. Indications of significant degradation will require additional evaluation to quantify the material loss and compare it to the applicable design requirements. Inspections are performed by qualified personnel in accordance with approved station procedures.

Corrective Actions – Element 7

Evaluations will be performed for inspection results that do not meet the acceptance criteria and a Notification is initiated to document the concern in accordance with the requirements of 10 CFR 50, Appendix B and in accordance with plant administrative procedures. The corrective action program ensures that the conditions adverse to quality are promptly corrected, including root cause determination and prevention of recurrence.

If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition. Engineering analysis of identified degradation will confirm that the structure or component intended function will be maintained consistent with the CLB, or the structure or component will be repaired or replaced.

Confirmation Process – Element 8

The confirmation process is implemented by site quality assurance (QA) procedures, review and approval processes, and administrative controls which are implemented in accordance with the requirements of 10 CFR 50,

Appendix B. The completion and effectiveness of the preventive and corrective actions are monitored by the site's quality assurance (QA) procedures.

The Buried Non-Steel Piping Inspection program relies on condition monitoring activities and strategies to ensure long-term operability of buried piping and components. The Buried Non-Steel Piping Inspection program is a condition monitoring program, not a prevention and mitigation program.

Administrative Controls – Element 9

The procedures used to implement the Buried Non-Steel Piping Inspection program are included in the quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

The Buried Non-Steel Piping Inspection program consists of administratively controlled procedures, which are controlled as stated in the item above. This aging management program is included in the Salem license renewal UFSAR supplement.

Operating Experience – Element 10

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects/mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Buried Non-Steel Piping Inspection program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. A review of plant operating experience at Salem shows that there have been no underground leaks that developed as a result of failure of the external surface of buried reinforced concrete piping. Although failure of buried piping has occurred, it has been determined that the buried piping leaks were caused by degradation of the inside of the buried piping. Degradation of inside surfaces of piping is managed through other aging management programs.
2. In 2001, a section of the buried No. 12 service water piping at Salem Unit 1 was excavated to determine the cause of leakage. The source of leakage was a break in the steel bell ring, which is installed over one pipe joint section of the service water piping. The apparent cause of the break was a crack that occurred during the installation of the steel bell ring or an initial flaw in the metal. Additionally, the metal and mortar was cracked in about the same area, which could indicate that this area was cracked at installation. Contributing to the growth of the initial crack and subsequent corrosion of the steel bell ring was improper protection of the carbon steel bell ring on the underground Service Water buried pipe joint. Therefore the apparent cause of the failure was an installation flaw and improper coating protection of the joint and not an age related failure mechanism. The break was repaired and the external concrete coating was reapplied.

Additionally, a Ram-Neck sealant was applied over the entire section of the bell, to prevent water intrusion. Additionally, the Ram-Neck sealant was top coated with a flexible paint. Also, internally a WEKO seal was installed over the steel bell ring. An extent of condition study, as well as internal corrosion of some other bell-and-spigot joints resulted in installation of WEKO seals on all bell-and-spigot joints for all service water headers internally. With the exception of No. 11 service water header, all service water header joints now incorporate WEKO seals. Work on No. 11 service water header joints is planned for 2010.

This provides objective evidence that excavation and inspection of piping and components have been occurring opportunistically when underground pipe is exposed for other maintenance and the external surfaces have been found to be in good condition

A review of plant operating experience showed that excavation of buried non-steel piping has occurred, and no instances of significant age related deficiencies were documented. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Buried Non-Steel Piping Inspection program will effectively identify degradation prior to failure. The work planning process provides instructions to do exterior surface inspections when excavations occur. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Buried Non-Steel Piping Inspection program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Exceptions to NUREG-1800

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented:

1. At least one opportunistic or focused excavation and inspection of buried reinforced concrete piping and components will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried reinforced concrete piping and components will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3) and Detection of Aging Effects (Element 4)**

2. At least one opportunistic or focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within ten years prior to entering the period of extended operation. Upon entering the period of extended operation at least one focused excavation and inspection of buried stainless steel penetration bellows between the Containment Structure and the Fuel Handling Building, including the penetration sleeves, will be performed within the first ten years, unless an opportunistic excavation and inspection occurs within this ten year period. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3) and Detection of Aging Effects (Element 4)**
3. Guidance for inspection of concrete aging effects. Instructions will include inspection for cracking, loss of bond, loss of material and increase in porosity and permeability. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5).**

Conclusion

The enhanced Buried Non-Steel Piping Inspection aging management program will provide reasonable assurance that cracking, loss of bond, increase in porosity and permeability, and loss of material will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

B.2.2.5 Boral Monitoring Program

Program Description

The Boral Monitoring Program is an existing program that manages the aging effects of the Boral neutron-absorbing material used in the Exxon and Holtec spent fuel storage racks assemblies in the units 1 and 2 spent fuel pools at Salem. The aging effects that need to be managed for the Boral neutron-absorbing material during the period of extended operation are reduction of neutron-absorbing capacity and loss of material in a treated borated water environment.

The Boral Monitoring Program performs inspections and/or tests on Boral test coupons. The program monitors changes in physical properties of the Boral by performing measurements on representative Boral test coupons. The Boral test coupons simulate as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the Boral panels in the spent fuel storage rack assemblies. Monitoring of the Boral neutron-absorbing material is accomplished through periodic examination of the Boral test coupons, consisting of visual observations (which may include photography), and may consist of dimensional measurements (length, width, and thickness), weight and density determinations, and neutron attenuation measurements (for B-10 areal density). The results are evaluated against acceptance criteria for determination of any follow-up corrective action activities as appropriate (e.g., removal and examination of additional Boral test coupons, wet chemical analyses, radiography, etc.).

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The Boral Monitoring Program is an existing aging management program that monitors the Boral neutron-absorbing material in the spent fuel storage rack assemblies at Salem units 1 and 2. The Boral Monitoring Program consists of a surveillance program which involves the periodic inspections and/or testing of Boral test coupons that are monitored to ensure against unexpected degradation of the Boral neutron-absorbing material that are contained in the Salem unit 1 and 2 spent fuel storage rack assemblies. The spent fuel pool reracking project implemented in 1994 retained 3 existing high density Exxon Nuclear Corporation spent fuel storage rack assemblies (Region I) and added 9 new maximum density Holtec spent fuel storage rack assemblies (Region II).

There are two types of Boral test coupons utilized in the surveillance program for the Exxon spent fuel storage rack assemblies. One type is a flat plate sandwich coupon. The other type is a short fuel section that is a four sided cube prototype of the actual fuel cell. The flat plate sandwich coupons and short fuel sections are stainless steel clad Boral plate specimens that are of same materials and were produced by using the same manufacturing and Quality Assurance/Quality Control procedures specified for the spent fuel cells within the Exxon spent fuel storage rack assemblies.

The Holtec Boral test coupons are each mounted in a stainless steel jacket simulating as nearly as possible the actual in-service geometry, physical mounting, materials and flow conditions of the Boral in the spent fuel storage rack assemblies. The Boral is from the same production run as the Boral poison panels in the spent fuel storage rack assemblies. Each Boral test coupon is encased in a stainless steel jacket of the same alloy used in the manufacture of the spent fuel storage rack assemblies mounted with tolerances representative of those in the spent fuel storage rack assemblies.

Preventive Actions – Element 2

The Boral Monitoring Program aging management program is a condition monitoring program and does not include activities for prevention or mitigation of aging effects.

The Boral Monitoring Program aging management program is a condition monitoring program that includes activities to periodically inspect for applicable aging effects. Additionally, the Water Chemistry Program will be credited to manage loss of material of the aluminum cladding of the Boral.

Parameters Monitored/Inspected – Element 3

The Boral Monitoring Program performs inspections and/or tests on the Boral test specimens or coupons. The program monitors changes in physical properties of the Boral by performing measurements on representative Boral test coupons so that the intended function "absorb neutrons" will be maintained during the period of extended period of operation. The Boral test coupons simulate as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the Boral in the spent fuel storage rack assemblies. The Boral test coupons are removed in accordance with a prescribed schedule.

The Boral test coupons representative of the Exxon spent fuel storage rack assemblies are removed from the spent fuel pool. These Boral test coupons are dried and weighed. A visual inspection is performed, looking specifically for corrosion, weld cracks or leaks. Physical measurements of the test coupons are not performed as part of the surveillance inspection. Benchmark measurements of the Boral test coupons (i. e., length, width and thickness) are not available from the initial fabrication of the Boral test coupons, prior to their placement in the spent fuel pool. Performing these measurements now would not provide an accurate correlation of test coupon physical changes. However, the inspections for the Boral test coupon for the Exxon spent fuel storage rack assemblies will be enhanced to perform a neutron attenuation measurement. This will provide reasonable assurance that the intended function "absorb neutrons" of the Boral will be maintained during the period of extended period of operation. The results of the inspection are annotated on data sheet Forms and the Boral test coupons are returned to the spent fuel pool. The Boral test coupons are generally out of the spent fuel pool less than a month for inspections. Unsatisfactory results are forwarded to the System Engineer for evaluation and further actions. If applicable, the System Engineer forwards all completed and evaluated Forms to Reactor Engineering for final review and approval.

For the Holtec spent fuel storage rack assemblies, a Boral test coupon representative of the Holtec spent fuel storage rack assemblies is removed from the spent fuel pool. The test coupon is shipped to a Qualified Contractor or measurement laboratory for testing and analysis. The test coupon is inspected and tested to determine changes in physical properties of the Boral in the spent fuel pool. The measurements performed are:

- Visual Observation and Photography
- Dimensional Measurements (length, width, and thickness)
- Weight and Specific Gravity
- Neutron Attenuation

The results of the inspection are annotated on data sheet Forms and forwarded to the System Engineer/Qualified Contractor for evaluation and determination of further actions. The System Engineer/Qualified Contractor forwards all completed and evaluated Forms to Reactor Engineering for final review and approval. If additional testing does not result in a physical change to the test coupon, the test coupon is returned to the Salem spent fuel pool. The Boral test coupon is generally out of the spent fuel pool less than a month for inspections and testing.

The Boral Monitoring Program aging management program is a condition monitoring program and does not include activities for a performance monitoring program.

The Boral Monitoring Program aging management program is a condition monitoring program and does not include activities for a preventative and migration program.

Detection of Aging Effects – Element 4

The Boral Monitoring Program performs inspections on Boral test coupons. The program monitors changes in physical properties of the Boral by performing measurements on representative Boral test coupons. The Boral test coupons simulate as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the spent fuel pool water for the Boral poison panels in the spent fuel storage rack assemblies. There is a specimen assembly or coupon tree for each vendor's spent fuel storage rack assemblies in each spent fuel pool. A specimen assembly or coupon tree provides the mounting structure to suspend the Boral test coupons in a cell of the spent fuel storage rack assemblies. The Exxon spent fuel storage rack assemblies have a specimen assembly with 50 Boral test coupons and the Holtec spent fuel storage rack assemblies have a specimen assembly with 10 Boral test coupons.

Fourteen (14) Exxon Boral test coupons are retrieved from the specimen assembly, which are removed from the spent fuel pool every two years for inspections and examinations. Upon completion of the inspections, the Boral test coupons are returned to the specimen assembly. The specimen assembly location strategy ensures that the specimen assembly is returned to the spent fuel pool following inspections and is placed in an empty cell in the Exxon spent fuel storage rack assemblies next to a high burnup assembly in the most recently discharged batch of spent fuel assemblies.

The Holtec specimen assembly is removed on a frequency as follows: during the first five refueling cycles after the initial placement of the maximum density Holtec spent fuel storage rack assemblies in the pool, a Boral test coupon was removed for inspection during the second, third and fifth refueling cycle. After the first five refueling cycles, a Boral test coupon was removed every fifth refueling cycle going forward. After the fuel is off-loaded from the reactor core during the first five refueling cycles, the specimen assembly was relocated to a cell to ensure it was surrounded with eight recently discharged fuel assemblies. After the fifth refueling cycle going forward, the specimen assembly is returned to the same empty cell location of the spent fuel storage rack assemblies.

The Boral test coupons are generally out of the spent fuel pool less than a month for inspections. There are sufficient Boral test coupons on the assembly specimen to permit the inspection of the Boral test coupons beyond the period of extended operation for the Exxon and Holtec spent fuel storage rack assemblies.

Monitoring of the Boral neutron-absorbing material is accomplished through periodic examination of Boral test coupons, which may consist of visual observations and neutron attenuation measurements. The specimen assembly for the Boral test coupons representative of the Boral poison panels in the Exxon spent fuel storage rack assemblies is removed from the spent fuel pool on a two year cycle. Fourteen (14) Boral test coupons are removed from the specimen assembly to be dried and weighed. A visual inspection is performed, looking specifically for corrosion, weld cracks or leaks. The inspection will be enhanced to perform a neutron attenuation measurement. The acceptance criteria will be enhanced such that the neutron attenuation measurement will be annotated to define neutron absorption acceptance as a Boron-10 content not decreasing by more than 5%. The benchmark Boron-10 content used for comparison will be based on the nominal B-10 areal density in the design basis specification. The results of the inspection are annotated on data sheet Forms and the Boral test coupons are returned to the spent fuel pool. Unsatisfactory results are forwarded to the System Engineer for evaluation and further actions. If applicable, the System Engineer forwards all completed and evaluation Forms to Reactor Engineering for final review and approval.

For the Holtec spent fuel storage rack assemblies, the specimen assembly is removed from the pool. One test coupon representative of the Holtec spent fuel storage rack assemblies is removed from the specimen assembly. The test coupon is shipped to a Qualified Contractor or measurement laboratory for testing and analysis. The test coupon is inspected and tested to determine changes in physical properties of the Boral in the spent fuel pool. The measurements performed are:

- Visual Observation and Photography
- Dimensional Measurements (length, width, and thickness)
- Weight and Specific Gravity
- Neutron Attenuation

The results of the inspection are annotated on data sheet Forms and forwarded to the System Engineer/Qualified Contractor for evaluation and determination of further actions. The System Engineer/Qualified Contractor forwards all completed and evaluation Forms to Reactor Engineering for final review and approval. If testing does not result in a physical change to the Boral test coupon, the Boral test coupon is returned to the Salem spent fuel pool. Acceptance criteria are a decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements, and an increase in thickness at any point should not exceed 10% of the initial thickness. Changes in excess of either of these criteria require investigation and engineering evaluation as directed by Salem Reactor Engineering.

In all cases, except as noted above, the Boral test coupons are returned to the pool in a timely manner to simulate as near as possible the Boral poison panels of the spent fuel storage rack assemblies. These inspections will ensure against unexpected degradation of the Boral neutron-absorbing material.

Monitoring and Trending – Element 5

Monitoring of the Boral neutron-absorbing material is accomplished through periodic examination of the Boral test coupons, which may consist of visual observations (which may include photography), and may include dimensional measurements (length, width, and thickness), weight and density determinations, and neutron attenuation measurements (for B-10 areal density). Results are compared to archive values from pre-irradiated samples when available, and with results from previous Boral test coupon examinations, summarized in reports of the surveillance compiled by the Qualified Contractor or measurement laboratory and forwarded to Salem Reactor Engineering for review. The results are evaluated against acceptance criteria for determination of any follow-up corrective action activities as appropriate (e. g., removal and examination of additional coupons, wet chemical analysis, radiography, etc.). The evaluation reports of the test coupon examinations are maintained to provide a continuing source of data for trend analysis.

Acceptance Criteria – Element 6

Acceptance criteria of the Boral Monitoring Program for the Holtec spent fuel storage rack assemblies are as follows:

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

Acceptance criteria of the Boral Monitoring Program for the Exxon spent fuel storage rack assemblies are as follows:

% Wt. Chg.: Percent Weight Change = [(Specimen Weight – Weight) / (Weight)] x 100%

All. % Chg.: Allowable Percent Change = {4% + [(0.1% / yr) x # of yrs* in Spent Fuel Pool)]} * Initial installation April 1982

Acceptance Criteria:

If % Wt. Chg. < All. % Chg.; the Result is SAT

If % Wt. Chg. > All. % Chg.; the Result is UNSAT and generate a Corrective Action Plan

For the Boral test coupons representative of the Exxon spent fuel storage rack assemblies, the acceptance criteria will be enhanced to include a decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements.

Results are compared to archive values from pre-irradiated samples, and with results from previous test coupon examinations when available, summarized in reports of the surveillance compiled by the qualified contractor or measurement laboratory and forwarded to Salem Reactor Engineering for review. The results are evaluated against acceptance criteria for determination of any follow-up corrective action activities as appropriate (e. g., removal and examination of additional coupons, wet chemical analysis, radiography, etc.). The Boral Monitoring Program is intended to detect the onset of any significant degradation with ample time to take corrective action as may be necessary.

The Boral Monitoring Program was established to monitor the integrity and performance of Boral on a continuing basis and to assure that any slowly developing or long-term effects, if any, do not become significant. The surveillance program is intended to detect the onset of any significant degradation with ample time to take corrective action as may be necessary to ensure that the Boral neutron-absorbing material of the spent fuel storage rack assemblies intended function will be maintained during all current licensing basis (CLB) design conditions.

Corrective Actions – Element 7

Evaluations are performed for inspection results that do not satisfy acceptance criteria and a notification is initiated to document the concern in accordance with plant administrative procedures that meet the requirements of 10 CFR 50, Appendix B. The corrective action program and specific corrective action steps as specified in procedures ensure that any conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. Specifically the corrective actions to be taken when the acceptance criteria are not met require investigation and engineering evaluation as directed by Reactor Engineering. Based on the results of the engineering evaluation, additional activities may be determined to be appropriate. These additional activities may include:

- Early retrieval and measurement of one or more of the remaining Boral test coupons to provide corroborative evidence that the measurements are real.
- Wet chemical analyses (destructive) and radiography (non-destructive) for confirming measurements.

If corroborated results of the Boral test coupon program do not satisfy acceptance criteria, additional actions such as in situ radiography, or "blackness testing" of the spent fuel storage rack assemblies, may be employed to investigate the extent of degradation, if any, in the spent fuel storage rack assemblies. In the event that any degradation of the Boral neutron-absorbing material in the spent fuel storage rack assemblies is detected, neutron radiographs of the suspected locations may be obtained. Positive confirmation of any defects will result in evaluations to assure that required subcriticality margin is maintained. Actions may include restrictions on spent fuel storage rack assemblies' cell use, repair of the cell to restore neutron absorber effectiveness, or installation of new spent fuel storage rack assemblies.

Confirmation Process – Element 8

The corrective action program and specific corrective action steps as specified in procedures ensure that any conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. The confirmation process is implemented by site quality assurance (QA) procedures. The review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

Administrative Controls – Element 9

The procedures used to implement Boral Monitoring Program aging management program are included in the quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

This aging management program is included in the Salem license renewal UFSAR supplement.

Operating Experience – Element 10

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects/mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Boral Monitoring Program will be effective in assuring that the intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. In 2006, during the performance of the Boral test coupon surveillance of the representative Boral test coupons of the unit 2 Exxon spent fuel storage rack assemblies, a small corrosion mark and washout trail was discovered on specimen 0114. The mark was brownish in color, very small (approximately ¼ inch in diameter) and the washout trail extended approximately 1 inch down the side of the test coupon. This anomaly was documented in a corrective action report. The evaluation concluded that this did not represent a degradation to the intended function of the Boral neutron-absorbing material of the Exxon spent fuel storage rack assemblies. This corrective action report was written to document the as found condition of the Boral test coupon and to provide data for trending of inspection results for the Boral Monitoring Program. This example provides objective evidence that this program will be capable of both monitoring and detecting aging affects associated with the Boral neutron-absorbing material.

2. In 2003, industry operating experience OE21287, was evaluated for potential generic implication at Salem. The OE had occurred at the another nuclear plant. A brief summary of the OE was that during the inspection of a Boral test coupon that had been removed from the plant's spent fuel pool, an abnormality was noted. The Boral test coupons (Boron carbide and aluminum composite material) had been located in the spent fuel pool as monitoring specimens to assess the performance of similar Boral neutron-absorbing material incorporated into the spent fuel pool racks. Visual inspection of the one Boral test coupon indicated bulging of the Boral aluminum, cladding that normally encapsulates, and is adhered to, the internal Boron carbide and aluminum composite layer. The structural integrity of the clad material had been affected but there has been no evidence of loss or redistribution of the boron carbide in the active poison layer of the Boral material at the time. A number of bulges were observed on the periphery of the coupon. The inspection yielded no apparent loss of neutron-absorbing material. Two additional coupons were inspected. The inspection of these coupons resulted in similar bulges being observed.

   The operating experience report and subsequent Part 21 notification concerning bulging and blistering of a Boral test coupon has had no impact on the Salem Boral test coupon surveillance program. The existing Salem surveillance program, Fuel Storage Cell Surveillance Program

[S1(2).RE-PT.SF-0001(Q)], continues as planned, with removal of Boral test coupons for inspections and examinations per the surveillance program. There has been no evidence of bulging or blistering noted during past inspections. This example provides objective evidence that industry OE is reviewed for applicability to the station and consideration is given for process enhancements if it was deemed necessary to capture these industry events.

3. In the late 1970's, swelling of the inner stainless steel shroud had been observed in a number of the Exxon spent fuel storage rack assemblies cells. Currently the cell is not being used as an available spent fuel storage location and there is no fuel in these cells. Each cell is a square cross-section formed from an inner shroud of stainless steel, a center sheet of aluminum clad boron carbide (B_4C), and an outer shroud of stainless steel. This cell acts as storage space and provides sufficient neutron absorption to allow close spacing of spent fuel. The swelling was the result of hydrogen gas buildup from the corrosion of the aluminum in the Boral poison plates. The gas buildup had bowed or swollen the cells, thereby reducing the inner cell dimension. The hydrogen gas will be vented from the swollen cells to allow the shroud to return to some position closer to the original. This may allow the cell to be returned to service as an available spent fuel storage location. The hydrogen gas is radiologically stable and does not present a personnel hazard. The insignificant volume of gas released will not increase the hydrogen concentration in the area into the explosive range.

   This condition was reviewed by the NRC in Supplement 4 of NUREG- 0517, Safety Evaluation Report, Salem Generating Station Unit 2, April 1980. It was concluded that the minor degradation of the Boral poison plates resulting from the corrosion of the aluminum would not preclude the spent fuel storage cells from performing their intended function. An ongoing program to monitor the condition of the spent fuel storage cells is being conducted.

4. Trending inspection and testing results for the past nine years demonstrates that the Boral neutron absorbing material is performing satisfactorily and no significant degradation has been observed or documented. Below is summary of the inspection and testing results for the past nine years:

   a) In 2001, the Salem Generating Station Unit 1 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 1 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

   b) In 2001, the Salem Generating Station Unit 2 performed an inspection and testing of a Boral test coupon representative of the Holtec spent fuel pool rack in accordance with the Salem Unit 2 Boral surveillance program. The examination of the coupon involved visual observations and photography, dimensional measurements (length, width and thickness), weight and density determinations, and neutron attenuation measurements. On the front side of the coupon, a visual inspection of the coupon found some localized pitting with size ranging from approximate 1 mm to 5 mm and varying degrees of light oxidation. A visual inspection of the back side of the coupon showed only varying degrees of light oxidation. Within the accuracy of the measurements, the length, width, and thickness were within acceptable limits of the initial pre-irradiated benchmarked measurements. The neutron attenuation test results showed that there was no loss of Boron-10 from the coupon. The results of these tests are indicative of satisfactory material performance. Comparison of the post-irradiation measurements with pre-irradiation values further confirms acceptable coupon performance.

c) In 2004, the Salem Generating Station Unit 1 submitted a Boral test coupon representative of the Holtec spent fuel pool rack to a Qualified Contractor for inspection and testing in accordance with Salem Generating Station's Boral surveillance program.. The examination of the coupon involved visual observations and photography, dimensional measurements (length, width and thickness), weight and density determinations, and neutron attenuation measurements. In the summary report prepared by the Qualified Contractor, the following is a summary of the inspection and testing results. The visual inspection of the coupon showed six small blisters and varying degrees of light oxidation. Within the accuracy of the measurements, the length, width, and thickness were within acceptable limits of the initial pre-irradiated benchmarked measurements. The coupon showed a slight increase in density that was attributed to formation of oxides on the coupon surface. The neutron attenuation test results showed that there was no loss of Boron-10 from the coupon. The conclusion from the inspection and tests results report was ..."The results of these tests are indicative of satisfactory material performance. Comparison of the post-irradiation measurements with pre-irradiation values further confirms acceptable coupon performance."

d) In 2005, the Salem Generating Station Unit 1 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 1 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

e) In 2005, the Salem Generating Station Unit 2 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 2 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

f) In 2005, the Salem Generating Station Unit 2 submitted a Boral test coupon representative of the Holtec spent fuel pool rack to a Qualified Contractor for inspection and testing in accordance with Salem Generating Station's Boral surveillance program. The examination of the coupon involved visual observations and photography, dimensional measurements (length, width and thickness), weight and density determinations, and neutron attenuation measurements. In the summary report prepared by the Qualified Contractor, the following is a summary of the inspection and testing results. A visual inspection of the coupon found 17 blisters on the front side and 19 blisters on the back side ranging in size from 3/16" to almost 7/8" across. There was no appreciable oxidation on either side of coupon. Within the accuracy of the measurements, the length, width, and thickness were within acceptable limits of the initial pre-irradiated benchmarked measurements. The coupon showed a slight decrease in density that was attributed to the formation of blisters on the coupon surface. The neutron attenuation test results showed that there was no loss of Boron-10 from the coupon. The conclusion from the inspection and tests results report was ..."The results of these tests are indicative of satisfactory material performance although a series of small blisters was noted on both sides of the coupon. Comparison of the post-irradiation measurements with pre-irradiation values further confirms acceptable coupon performance. The blisters appear to influence only the esthetics and do not compromise the function of the material."

g) In 2006, the Salem Generating Station Unit 2 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 2 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. A visual examination noted a ¼" corrosion spot on one coupon that was documented and dispositioned as acceptable in the corrective action program. Visual examinations on the remaining coupons did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

h) In 2007, the Salem Generating Station Unit 1 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 1 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

i) In 2008, the Salem Generating Station Unit 1 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 1 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

j) In 2008, the Salem Generating Station Unit 2 performed an inspection of Boral test coupons representative of the Exxon spent fuel pool rack in accordance with the Salem Unit 2 Boral surveillance program. The examination of the coupons involved visual observations and dry weight measurements. The visual inspection looks for corrosion and weld cracks or leaks. The visual examination did not document any unsatisfactory abnormalities and the weight measurements were within the acceptance criteria. The results of these inspections are indicative of satisfactory material performance.

As discussed in Example 4 above, the plant operating experience of the Boral Monitoring Program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Boral Monitoring Program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Boral Monitoring Program are performed to identify areas that need improvement to maintain the quality performance of the program.

Exceptions to NUREG-1800

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented:

1. The program will be enhanced to perform a neutron attenuation measurement on one each of the three (no vent holes, one vent holes and two vent holes) flat plate sandwich Boral test coupons during the first three two-year inspection frequency periods and every six years thereafter for the Exxon spent fuel storage rack assemblies. **Program Elements Affected: Parameters Monitored and Inspected (Element 3) and Detection of Aging Effects (Element 4)**

2. The program will be enhanced to include acceptance criteria of the neutron attenuation measurement on the Boral test coupons for the Exxon

spent fuel storage rack assemblies: A decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements. The benchmark Boron-10 content used for comparison will be based on the nominal B-10 areal density in the design basis specification. **Program Element Affected: Acceptance Criteria (Element 6)**

Conclusion

The enhanced Boral Monitoring Program will provide reasonable assurance that reduction of neutron-absorbing capacity and loss of material/general corrosion will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

B.2.2.6 Nickel Alloy Aging Management

Program Description

The Salem Nickel Alloy Aging Management program is an existing program that manages cracking for nickel alloy components in reactor coolant environment. The Nickel Alloy Aging Management program implements mitigative and condition monitoring activities. Mitigative actions include replacement of components whose materials are susceptible to cracking with those of less susceptibility to cracking, and Mechanical Stress Improvement Process (MSIP) on the reactor vessel primary nozzle to safe end welds. The condition monitoring portion of the program uses a number of inspection techniques to detect cracking, including surface examinations, volumetric examinations and bare metal visual examinations. The Nickel Alloy Aging Management program implements the inspection of components through an augmented Inservice Inspection (ISI) program. The augmented program administers component evaluations, examination methods, scheduling, and site documentation as required to comply with regulatory, code, and industry commitments related to nickel alloy issues. The Nickel Alloy Aging Management program implements applicable NRC Bulletins, Generic Letters and staff-accepted industry guidelines.

The Nickel Alloy Aging Management program is a mitigative program that will effectively employ mitigative strategies to prevent significant degradation. It is also a condition monitoring program that will effectively detect the applicable aging effects and the frequency of monitoring will be adequate to prevent significant degradation.

Aging Management Program Elements

The results of an evaluation of each element against the 10 elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800, are provided below.

Scope of Program – Element 1

The Salem Nickel Alloy Aging Management program manages the cracking for the systems, components, and environments listed in Attachment 6.1. The components within the scope of the Salem Nickel Alloy Aging Management program are as follows:

- Reactor Vessel Bottom Mounted Instrument Nozzle Welds (total of fifty-eight (58) nozzles and welds)
- Reactor Vessel Primary Inlet and Outlet Nozzle to Safe End Welds (four (4) inlet and four (4) outlet primary nozzles)
- Unit 1 Steam Generator Primary Channel Head Drain, Plug, and Welds (one drain valve with plug and welds)

The Nickel Alloy Aging Management program scope does not include steam generator tubes (included in the Steam Generator Tube Integrity program), reactor vessel internals (included in future program for PWR Vessel Internals), or control rod drive mechanism nozzles and integrated head assembly vent and reactor vessel level indicating system (RVLIS) nozzles (included in the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors program). The specific locations included are described by the Alloy 600 plan for Salem.

Preventive Actions – Element 2

The Nickel Alloy Aging Management program includes mitigation activities and strategies to ensure the long-term operability of nickel alloy components. Some of the currently available mitigation techniques include mechanical stress improvement program (MSIP), and replacement of Alloy 600/82/182 materials with Alloy 690/52/152 or stainless steel materials that have less susceptibility to SCC and PWSCC.

Parameters Monitored/Inspected – Element 3

The parameters monitored by the Nickel Alloy Aging Management program are cracks (flaws) in nickel alloy components. The program maintains a comprehensive component database that lists the components in the plant that are constructed of nickel materials susceptible to cracking and subjected to the reactor coolant environment. These components are either to be mitigated by the program's strategies or inspected on a frequency established by the program consistent with industry guidelines.

The Nickel Alloy Aging Management program includes mitigation activities and strategies to ensure the long-term operability of nickel alloy components. A mitigative technique implemented by Salem is mechanical stress improvement program (MSIP) of the Alloy 182 reactor vessel primary nozzle to safe end welds.

Nickel Alloy components are inspected in accordance with the augmented In-service Inspection (ISI) plan. The Nickel Alloy Aging Management program uses surface examinations, volumetric examinations and bare metal visual examinations. The schedule for the examinations is described in the Salem augmented ISI database.

Detection of Aging Effects – Element 4

The parameters mitigated and monitored by the Nickel Alloy Aging Management program are cracks (flaws) in nickel alloy components caused by cracking.

The inspection frequency of the nickel alloy components is based on the ASME XI requirements, including Code Case N-722.

The inspection techniques include surface examinations, volumetric examinations, and bare metal visual examinations. Data collection (e.g., inspection reports) is incorporated into the program.

Monitoring and Trending – Element 5

Monitoring and trending activities for detection and sizing of cracks in nickel alloy components are part of the Salem Nickel Alloy Aging Management program. The program ranks the nickel alloy components for inspections based on susceptibility to cracking in accordance with MRP guidelines.

Salem uses the guidelines in ASME XI Table IWB-2500-1, Code Case N-722, and MRP-139 for inspection (examination) techniques and frequencies.

Flaws found during the inspections are immediately evaluated against criteria contained in ASME XI IWB-3500 in to predict the extent of degradation and implement timely corrective or mitigative actions. Disposition by analysis is permitted by IWB-3500. Contingencies for repairs/replacement or mitigative actions such as weld overlays are evaluated prior to each inspection outage. Monitoring of industry-operating experience is performed to incorporate any required changes to the Nickel Alloy Aging Management program as a result of industry experience.

Acceptance Criteria – Element 6

The Salem Nickel Alloy Aging Management program tracks and trends cracking (flaws) in the nickel alloy components within the scope of the program. Following inspections, indications are first verified to be flaws, and then the flaws are evaluated in accordance with the procedures in the program.

With the exception of the reactor vessel primary nozzle to safe end welds (Alloy 82/182), the nickel alloy components within the scope of the program are evaluated against the acceptance criteria contained in ASME XI IWB 3640. The reactor vessel primary nozzle to safe end welds are evaluated against the acceptance criteria published in WCAP-15657-P.

Based on the evaluations, the data is dispositioned as acceptable to permit continued operation through the next operating cycle, or corrective action is initiated via the corrective action program to analyze further or repair/replace prior to start-up.

Corrective Actions – Element 7

In the event that the acceptance criteria prescribed in the program are not met, specific corrective actions are implemented such as further analysis, repair, or replacement of the component, in accordance with the plant quality assurance program based on the requirements of 10 CFR 50, Appendix B. A Notification is initiated to document the condition in accordance with the 10 CFR 50, Appendix B corrective action program. This program ensures that conditions adverse to quality are promptly corrected. If the condition is assessed to be significantly adverse to quality, the cause of the condition is determined and action plan is developed to prevent recurrence, both in a timely manner.

Confirmation Process – Element 8

The confirmation process is implemented by Salem's quality assurance (QA) procedures, review and approval processes, and administrative controls which are implemented in accordance with the requirements of 10 CFR 50, Appendix B.

Administrative Controls – Element 9

The procedures used to implement the Nickel Alloy Aging Management program are included in the Salem quality assurance program that provides for formal reviews and approvals. Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. This aging management program is included in the Salem license renewal UFSAR supplement.

Operating Experience – Element 10

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking are being adequately managed. The following examples of operating experience provide objective evidence that the Nickel Alloy Aging Management program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The Salem Nickel Alloy Aging Management program was implemented in late 2003, following the Salem response to NRC Bulletin 2003-02. Inspections initiated at the reactor vessel bottom head include the fifty-eight (58) bottom mounted instrumentation (BMI) penetrations welded with Alloy 82/182 material. In 2004, the program expanded to incorporate the MRP guidance and it included all of the nickel alloy components susceptible to cracking, including the reactor vessel primary nozzle to safe end welds, reactor coolant system thermowells, and the Unit 1 steam generator bowl drain connection. When the reactor heads were replaced in 2004, the associated new control rod drive mechanism nozzles, constructed of nickel alloy, were placed into the program for later inspections.

   In 2008, the Salem Unit 1 replaced all of the reactor coolant system thermowells (Unit 2 is currently scheduled for 2009) with those of a stainless steel material to preclude volumetric examinations of the nickel alloy materials since this technique was not amenable to the configuration of the components. Therefore, the scope of the Nickel Alloy Aging Management program was reduced to the reactor vessel primary nozzles, BMI penetrations, and the Unit 1 steam generator bowl drain valve connection. This example provides objective evidence that the Nickel Alloy Aging Management program implementation addresses the scope of susceptible nickel alloy components subjected to the program.

2. In an effort to reduce the frequency of condition monitoring of a nickel alloy component, the program permits the component to be mitigated and inspected for two successive intervals, where an inspection interval is every other outage. The Salem Unit 1 implemented Mechanical Stress Improvement Program (MSIP), a technique approved by the NRC, for flaw mitigation in the nickel alloy welds of the reactor vessel primary nozzle to safe end welds.

   Prior to implementation of MSIP at Unit 1 in 2008, volumetric examinations were conducted on each of the eight (8) primary nozzle welds, and a single flaw indication was found on the 14 Hot Leg nozzle to safe end weld. The flaw was determined to be in excess of ASME XI IWB 3514-2 acceptance criteria. An analytical evaluation was performed per IWB-3600 standards and it concluded that the flaw size was within the NUREG 0313 limitations to implement MSIP on the weld. MSIP was implemented on all eight (8) primary nozzle welds successfully. It is important to note that this was the first flaw to have been found, due to cracking, in a reactor vessel primary nozzle weld, and prompted Salem to initiate Operating Experience on the matter.

   A post-MSIP volumetric examination was conducted in the same outage and the flaw was mitigated. If this flaw was not mitigated, the Salem would have had to repair or provide further mitigation within 36 months. This example provides objective evidence that the Nickel Alloy Aging Management program provides for implementing mitigative activities and performing follow-up examination to ensure that the corrective actions were completed and effective.

3. The Unit 1 reactor vessel BMI penetrations were originally inspected in 2004 following the Salem response to NRC Bulletin 2003-02. There were no cracks (flaws) found during the 100% inspection (fifty-eight [58] BMI penetrations). The next inspection interval for U-1 was 2008. The penetration weld inspections for U-1 in 2008 consisted of VT-2 examinations (bare metal). The qualified individual observed no indications (cracks) in the welds. This example provides objective evidence that the existing Nickel Alloy Aging Management program is capable of both monitoring and detection of the aging effects associated with cracking (flaws) of nickel alloy components susceptible to cracking.

4. The Unit 2 reactor vessel BMI penetrations were originally inspected in 2003 following the SGS response to NRC Bulletin 2003-02. There were no cracks (flaws) found during the 100% inspection. All fifty-eight (58) BMI penetrations (100% sample population) were re-inspected in 2005 using VT-2 examination techniques. There was no evidence of component degradation or leakage. The comparison of photos from the previous inspection to the 2005 inspection was consistent with no adverse change in conditions. This example provides objective evidence that the existing Nickel Alloy Aging Management program is capable of monitoring for the aging effects associated with cracking (flaws) of nickel alloy components susceptible to stress corrosion cracking (SCC) and primary

water stress corrosion cracking (PWSCC).

The Nickel Alloy Aging Management program has been effective in preventing, mitigating, detecting, and monitoring of cracking (flaws) in the PWSCC-susceptible components at the Salem. Inspection frequencies established by the program are consistent with Code and industry guidance and ensures that sufficient margin exists for components to continue to meet their intended function (pressure boundary). The station operating experiences described above also shows that the Nickel Alloy Aging Management program has been effective maintaining compliance with regulatory driven activities prescribed by NRC Bulletin 2003-02 that are governed by the Nickel Alloy Aging Management program.

There is sufficient confidence that the implementation of the Nickel Alloy Aging Management program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Nickel Alloy Aging Management program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Exceptions to NUREG-1800

None.

Enhancements

None.

Conclusion

The existing Nickel Alloy Aging Management program provides reasonable assurance that cracking is adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.3 NUREG-1801 Chapter X Aging Management Programs

B.3.1 Evaluation of Chapter X Aging Management Programs

Aging Management Programs evaluated in Chapter X of NUREG-1801 are associated with Time-Limited Aging Analysis for metal fatigue of reactor coolant pressure boundary and environmental qualification (EQ) of electric components. These programs are evaluated in this section.

B.3.1.1 Metal Fatigue of Reactor Coolant Pressure Boundary

Program Description

The Metal Fatigue of Reactor Pressure Boundary Program is an existing program that manages cumulative fatigue usage for the reactor vessel, the pressurizer, the steam generators, Class 1 and non-Class 1 piping, and Class 1 components subject to the reactor coolant, treated borated water, and treated water environments. The Metal Fatigue of Reactor Pressure Boundary Program is a preventive program that monitors and tracks the number of critical thermal and pressure transients to ensure that the cumulative usage factors for selected reactor coolant system (RCS) components remain less than 1.00 through the period of extended operation. The program determines the number of transients that occur and updates the 60-year projections as required on an annual basis. A software program, WESTEMS, computes cumulative usage factors for select locations.

The effect of the reactor coolant environment on fatigue usage, known as environmental fatigue, has been evaluated for the period of extended operation using the formulae contained in NUREG/CR-6583 for carbon and low-alloy steels and NUREG/CR-5704 for austenitic stainless steels.

The program requires the generation of a periodic fatigue monitoring report, including a listing of transient events, cycle summary event details, cumulative usage factors, a detailed fatigue analysis report, and a cycle projection report. If the fatigue usage for any location has had an unanticipated increase based on cycle accumulation trends or if the number of cycles is approaching their limit, the corrective action program is used to evaluate the condition and determine the corrective action. Acceptable corrective actions include repair of the component, replacement of the component, and a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded during the period of extended operation. Corrective actions include a review of additional affected reactor coolant pressure boundary locations.

NUREG-1801 Consistency

The Metal Fatigue of Reactor Coolant Pressure Boundary Program is consistent with the ten elements of aging management program X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to include additional transients beyond those defined in the Technical Specifications and the UFSAR, and expanding the fatigue monitoring program to encompass other components identified to have fatigue as an analyzed aging effect, which require monitoring. **Program Elements Affected: (Element 3)**

2. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to use a software program to automatically count transients and calculate cumulative usage on select components. **Program Elements Affected: (Elements 1, 2, 3, 5, and 6)**

3. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to address the effects of the reactor coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant identified in NUREG/CR-6260. **Program Elements Affected: (Element 2, 3, 5, and 6)**

4. The Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to require a review of additional reactor coolant pressure boundary locations if the usage factor for one of the environmental fatigue sample locations approaches its design limit. **Program Elements Affected: (Element 7)**

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Metal Fatigue of Reactor Coolant Pressure Boundary program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The NRC issued NRC Bulletin 88-11 in December 1988. It required licensees to establish and implement a program to confirm pressurizer surge line integrity with the effect of thermal stratification. In 1991, SGS responded to NRC Bulletin No. 88-11 by analyzing and demonstrating the acceptability of the stress fatigue in the pressurizer surge line. The pressurizer surge line was re-evaluated for the period of extended operation, which also included stratification, and the results indicated that the cumulative usage factor met the acceptance criteria of < 1.0. Therefore, this example provides objective evidence that the existing Metal Fatigue of Reactor Coolant Pressure Boundary program is capable of utilizing industry information in preventing cumulative fatigue damage of sample reactor coolant system components.

2. On June 22, 1988, the NRC issued Bulletin 88-08 requiring licensees to review their reactor coolant systems (RCS) to identify any unisolable piping that could be subjected to temperature distributions which would result in unacceptable thermal stresses, and take action where required. SGS evaluated the Units 1 and 2 RCSs and found that the safety injection lines, normal and alternate charging lines, and the auxiliary spray lines were unisolable and would be subjected to temperature differences. Fatigue analyses were provided to assure that the normal and charging lines, and the auxiliary spray lines would not experience a failure. For the safety injection lines, SGS implemented a leakage monitoring program to satisfy the NRC requirements. The NRC accepted the SGS response to NRC Bulletin No. 88-08 that documented the analyses required to demonstrate the cumulative usage factors (CUFs) of the normal and alternate charging lines and the auxiliary spray lines, and for leakage monitoring of the safety injection lines. Therefore, this example provides objective evidence that the existing Metal Fatigue of Reactor Coolant Pressure Boundary program is capable of performing fatigue analyses and implementing corrective actions in preventing cumulative fatigue damage of sample reactor coolant system components.

3. To ensure that the design limits imposed as transient cycles are not exceeded, the SGS Operations Department tracks and reports the cumulative cycles in an annual report. The SGS Operations Department publishes an annual Cycle Counting Report under their cycle counting procedure that details the transients monitored, their respective design and report limits, the current cycle count, and the respective cumulative usage factors. All monitored cycles have been within their respective administrative limit, which has sufficient margin within the 40-year design limit. Therefore, this example provides objective evidence that the existing Metal Fatigue of Reactor Coolant Pressure Boundary program is capable of monitoring the aging effects associated with metal fatigue of sample reactor coolant system components.

4. To support the 60-year TLAAs associated with metal fatigue of the reactor coolant system pressure boundary components, SGS analyzed the projected cumulative usage factor, incorporating the environmental fatigue effects for the six (6) NUREG/CR-6260 locations; Pressurizer Lower Head and Surge Nozzle, the Normal Charging Nozzle, Alternate Charging Nozzle, RCS Hot Leg Surge Nozzle, the Accumulator Nozzles, and the Boron Injection Tank Nozzles. The detailed analyses found the cumulative usage factors, with the environmental factor added, had met the acceptance criteria of < 1.0.

There is sufficient confidence that the implementation of Metal Fatigue of Reactor Coolant Pressure Boundary program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of Metal Fatigue of Reactor Coolant Pressure Boundary program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The enhanced Metal Fatigue of Reactor Coolant Pressure Boundary Program will provide reasonable assurance that the cumulative fatigue damage aging effect will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained consistent with the current licensing basis during the period of extended operation.

B.3.1.2 Environmental Qualification (EQ) of Electric Components

Program Description

The Environmental Qualification (EQ) of Electric Components program is an existing program that manages components' thermal, radiation, and cyclical aging through the use of aging evaluations in adverse localized environments. The Environmental Qualification (EQ) of Electric Components program implements preventive activities to ensure that the qualified life of components within the scope of the program is maintained through the period of extended operation.

The Environmental Qualification (EQ) of Electric Components program implements the requirements of 10 CFR 50.49, NUREG-0588, NRC Regulatory Guide 1.89, Rev. 1, DOR Guidelines, and Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors.

The Environmental Qualification (EQ) of Electric Components program is an existing program implemented through station procedures and preventive maintenance tasks. The Environmental Qualification (EQ) of Electric Components program complies with 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." The program provides for maintenance of the qualified life for electrical equipment within the scope of the Environmental Qualification (EQ) of Electric Components program. Program activities establish, demonstrate, and document the level of qualification, qualified configuration, maintenance, surveillance and replacement requirements necessary to meet 10 CFR 50.49. Reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, corrective actions if acceptance criteria are not met, and the period of time prior to the end of qualified life when the reanalysis will be completed. Qualified life is determined for equipment within the scope of the Environmental Qualification (EQ) of Electric Components program and appropriate actions such as replacement or refurbishment, or reanalysis, are taken prior to or at the end of the qualified life of the equipment so that the aging limit is not exceeded.

NUREG-1801 Consistency

The Environmental Qualification (EQ) of Electric Components aging management program is consistent with the ten elements of aging management program X.E1, "Environmental Qualification (EQ) of Electric Components," specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Environmental Qualification (EQ) of Electric Components program will be effective in assuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

1. In 2002, concerns were raised during an NRC inspection regarding the environmental qualification (EQ) of the Salem Units 1 and 2 centrifugal charging pumps, specifically, the accumulation of additional run-time on the pumps' motors, due to the positive displacement charging pump (PDCP) being out of service during the previous five years. The PDCP was in service prior to 1997 and was used as an alternative to the centrifugal pumps. In response to the concerns, the corrective action program was utilized and the EQ Program revised the applicable EQ calculations to account for the 100% run-time for the 1997-2002 time duration. Additionally, the calculations had taken into consideration plant data from the plant computer system to provide a stronger technical basis for the calculation, and the results indicated that the motors were shown to have a 40-year qualified life plus capability for 120-day accident and post-accident service. This was a unique condition and there were no extent of condition issues. This example provides objective evidence that the existing Environmental Qualification (EQ) of Electric Components program utilizes the corrective action program to evaluate EQ concerns using plant data along with calculations to provide a strong technical justification.

2. As part of implementing corrective action from a Root Cause Analysis, the Environmental Qualification (EQ) of Electric Components program was revised to direct the EQ engineer to look ahead two (2) years for EQ orders to ensure they are properly launched and planned for work, since there may be long lead times for parts, or the work would have to be scheduled into outages, etc. In January 2009, the EQ engineer performed the 2-Year look ahead and found several missing EQ orders for components that would have otherwise missed their dates for maintenance work. The planned EQ work was listed in the SAP files, but the work orders had not been generated from this data. The missing EQ order information was provided from the EQ engineer to the work planners for incorporation into the maintenance plans. This example provides objective evidence that the existing Environmental Qualification (EQ) of Electric Components program has incorporated corrective actions to prevent recurrence, and found opportunities at the site to improve the EQ program.

3. In 2004, the station provided feedback via the corrective action program to the EQ engineer that the frequency of performing pressure checks on calibration gas bottles associated with the containment hydrogen analyzers may be extended from six months to nine months, based on no appreciable loss of pressure in the calibration bottles during the current 6-month inspection. The extension would reduce containment entries, save on manpower and dose since there are two analyzers for each of the two reactor containments. The EQ engineer performed an evaluation and concluded that the frequency could be extended from six months to nine months. The applicable EQ binder was revised accordingly and provided reference to the evaluation. This example provides objective evidence that the existing Environmental Qualification (EQ) of Electric Components program is used to reanalyze a component's inspection frequency using its operating parameters to reduce workscope in the program.

There is sufficient confidence that the implementation of the Environmental Qualification program will effectively identify degradation prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Environmental Qualification program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing Environmental Qualification (EQ) of Electric Components program provides reasonable assurance that aging effects are adequately managed so that the intended functions of components within the scope of 10 CFR 50.49 will be maintained consistent with the current licensing basis during the period of extended operation.

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APPENDIX C Commodity Group Evaluations

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APPENDIX D Technical Specification Changes

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