3.4 AGING MANAGEMENT OF 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.

- Condensate Storage and Transfer System (2.3.4.1)
- Feedwater System (2.3.4.2)
- Main Condenser (2.3.4.3)
- Main Steam System (2.3.4.4)

3.4.2 RESULTS

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

Table 3.4.2-1 Summary of Aging Management Evaluation – Condensate Storage and Transfer System

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

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

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

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

3.4.2.1.1 Condensate Storage and Transfer System

Materials

The materials of construction for the Condensate Storage and Transfer System components are:

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

Environments

The Condensate Storage and Transfer System components are exposed to the following environments:

- Air - Indoor
- Air – Outdoor
- Air/Gas Wetted
- Soil
- Treated Water

Aging Effects/Mechanisms Requiring Management

The following aging effects associated with the Condensate Storage and Transfer System components require management:

- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material/Galvanic 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 Condensate Storage and Transfer System components:

- Aboveground Non-Steel Tanks (B.2.2.3)
- Bolting Integrity (B.2.1.12)
- Buried Non-Steel Piping Inspection (B.2.2.4)
- Buried Piping Inspection (B.2.1.24)
- External Surfaces Monitoring (B.2.1.25)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.26)
- One-Time Inspection (B.2.1.22)
- Periodic Inspection (B.2.2.2)
- Water Chemistry (B.2.1.2)

Table 3.4.2-1, Summary of Aging Management Evaluation – Condensate Storage and Transfer System summarizes the results of the aging management review for the Condensate Storage and Transfer System.

3.4.2.1.2 Feedwater System

Materials

The materials of construction for the Feedwater System components are:

- Carbon and Low Alloy Steel Bolting
- Carbon Steel

Environments

The Feedwater System components are exposed to the following environments:

- Air - Indoor
- Treated Water

Aging Effects/Mechanisms Requiring Management

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

- Cracking/Thermal and Mechanical Loading
- Cumulative Fatigue Damage/Fatigue
- 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 Feedwater System components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.12)
- External Surfaces Monitoring (B.2.1.25)
- Flow-Accelerated Corrosion (B.2.1.11)
- One-Time Inspection (B.2.1.22)
- Small-Bore Class 1 Piping Inspection (B.2.2.6)
- TLAA
- Water Chemistry (B.2.1.2)

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

3.4.2.1.3 Main Condenser System

Materials

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

- Aluminum Bronze
- Carbon Steel
- Titanium Alloy

Environments

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

- Air - Indoor
- Raw Water
- Steam

Aging Effects/Mechanisms Requiring Management

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

- None

Aging Management Programs

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

- None

Table 3.4.2-3, Summary of Aging Management Evaluation – Main Condenser System summarizes the results of the aging management review for the Main Condenser 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
- Cast Austenitic Stainless Steel
- Stainless Steel

Environments

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

- Air - Indoor
- Air/Gas – Wetted
- Steam
- Treated Water
- Treated Water > 140 °F
- Treated Water > 482 °F

Aging Effects Requiring Management

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

- Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading
- Cumulative Fatigue Damage/Fatigue
- Loss of Material/Galvanic 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:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.12)
- External Surfaces Monitoring (B.2.1.25)
- Flow-Accelerated Corrosion (B.2.1.11)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.26)
- One-Time Inspection (B.2.1.22)
- Periodic Inspection (B.2.2.2)
- Small-bore Class 1 Piping Inspection (B.2.2.6)
- 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.

3.4.2.2 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 Feedwater, Main Steam System, and Reactor Water Cleanup 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.*

   Hope Creek will implement a One-Time Inspection program, B.2.1.22, 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, and turbine casings exposed to treated water or steam in the Condensate Storage and Transfer System, Feedwater System, and Main Steam System. 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.

Item Number 3.4.1-7 is not applicable to Hope Creek. There are no steel piping, piping components, or piping elements exposed to lubricating oil environment in the Steam and Power Conversion System.

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 Hope Creek. There are no steel piping, piping components, and piping elements exposed to raw water environment 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.*

   Hope Creek will implement a One-Time Inspection program, B.2.1.22, for susceptible locations to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage the reduction of heat transfer due to fouling in copper alloy heat exchanger tubes exposed to treated water in the High Pressure Coolant Injection System and Reactor Core Isolation 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.

Item Number 3.4.1-10 is not applicable to Hope Creek. There are no steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil environment in the Steam and Power Conversion System.

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.*

   Hope Creek will implement the Buried Piping Inspection program, B.2.1.24, to manage Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion in buried steel piping, piping components, and piping elements exposed to soil in the Condensate Storage and Transfer System. The Buried Piping Inspection Program is described in Appendix B.

   There are no steel tanks exposed to soil in the Steam and Power Conversion System.

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.

Item Number 3.4.1-12 is not applicable to Hope Creek. There are no steel heat exchanger components exposed to lubricating oil in the Steam and Power Conversion System.

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.

Hope Creek will implement a One-Time Inspection program, B.2.1.22, 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, and heat exchanger components exposed to steam and treated water greater than 60 deg C (140 deg F) in the Control Rod Drive System, High Pressure Cooling Injection System, Main Steam System, Reactor Core Isolation Cooling System, and Reactor Water Cleanup System. 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.*

   Hope Creek will implement a One-Time Inspection program, B.2.1.22, 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 copper alloy heat exchanger components exposed to treated

water in the High Pressure Injection and Reactor Core Isolation Cooling System. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

Hope Creek will implement a One-Time Inspection program, B.2.1.22, 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 stainless steel piping, piping components, piping elements, and tanks exposed to treated water in the Condensate Storage and Transfer System and Main Steam System. 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 Hope Creek. The AMR methodology for stainless steel piping, piping components, and piping elements exposed to soil predicts microbiologically influenced corrosion in addition to pitting, and crevice corrosion. There are no NUREG-1801 AMR lines available for stainless steel components exposed to soil that include all of these mechanisms.

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 Hope Creek. 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.

Item Number 3.4.1-19 is not applicable to Hope Creek. There are no stainless steel piping, piping components, piping elements, or heat exchanger components exposed to lubricating oil in the Steam and Power Conversion System.

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.

Hope Creek will implement a One-Time Inspection program, B.2.1.22, 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, piping, piping components, piping elements, exposed to treated water in the Closed Cycle Cooling Water System, Condensate Storage and Transfer System, Containment Hydrogen Recombiner System, Control Rod Drive System, Core Spray System, Fuel Pool Cooling and Cleanup System, High Pressure Coolant Injection System, Main Steam System, Nuclear Boiler Instrumentation, Reactor Core Isolation Cooling (RCIC) System, Reactor Recirculation System, Reactor Water Cleanup System, Residual Heat Removal System, Standby Diesel Generators and Auxiliary Systems, and Torus Water Cleanup 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 NonSafety Related Components

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

3.4.2.3 Time-Limited Aging Analysis

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

- Section 4.3, Metal Fatigue of the Reactor Pressure Vessel, Internals, and Reactor Coolant Pressure Boundary 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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 steam. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See Subsection 3.4.2.2.2.1.
3.4.1-3	PWR 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
3.4.1-4	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 with exceptions. The One-Time Inspection program, B.2.1.22, 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. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. 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
3.4.1-5	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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 (when applicable) corrosion in steel heat exchanger components, piping, piping components, and piping elements exposed to treated water. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See Subsection 3.4.2.2.9.
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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 stainless steel tanks exposed to treated water.

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
					Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See Subsection 3.4.2.2.7.1.
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	Not Applicable. 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.

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
3.4.1-9	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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 copper alloy heat exchanger components exposed to treated water. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See Subsection 3.4.2.2.4.1.
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	Not Applicable. See Subsection 3.4.2.2.4.2.

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
3.4.1-11	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.2.1.24, will be used to manage the loss of material due to general, pitting, crevice, and microbiologically influenced corrosion in steel piping, piping components, and piping elements exposed to soil. See Subsection 3.4.2.2.5.1.
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	Not Applicable. See Subsection 3.4.2.2.5.2.

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
3.4.1-13	Stainless steel piping, piping components, piping elements exposed to steam	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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 exposed to steam. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See subsection 3.4.2.2.6.

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 with exceptions. The One-Time Inspection program, B.2.1.22, 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, and heat exchanger components exposed to treated water > 60 deg C (> 140 deg F). Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. See Subsection 3.4.2.2.6.

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
3.4.1-15	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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 exposed to treated water. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. 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 with exceptions. The One-Time Inspection program, B.2.1.22, 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 piping, piping components, and piping elements exposed to treated water. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation. 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.

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
3.4.1-18	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.
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	Not Applicable. 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.

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
3.4.1-21	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 is no high-strength steel closure bolting exposed to air with steam or water leakage in the Steam and Power Conversion System.
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.2.1.12, 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 air and outdoor air in the Condensate Storage and Transfer System, Feedwater System, and Main Steam System. Exceptions apply to the NUREG-1801 recommendations for the Bolting Integrity 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
3.4.1-23	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	Not applicable. There are no stainless steel piping, piping components, or piping elements exposed to closed-cycle cooling water >60°C in the Steam and Power Conversion System.
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	Not applicable. There are no stainless steel piping, piping components, piping elements, or heat exchanger components 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
3.4.1-26	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.
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 steel, stainless 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.2.1.25, will be used to manage the loss of material due to general corrosion on the external surfaces of steel piping, piping components, piping elements, and turbine casings exposed to indoor air in the Condensate Storage and Transfer System, 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
3.4.1-29	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.2.1.11 will be used to manage wall thinning due to flow-accelerated corrosion in steel piping, piping components, piping elements, and heat exchanger elements exposed to steam or treated water in the Feedwater System, Main Steam System, and Reactor Water Cleanup System. Exceptions apply to the NUREG-1801 recommendations for Flow-Accelerated Corrosion 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
3.4.1-30	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, and piping elements, exposed to Air/Gas wetted in the Condensate Storage and Transfer System and the Main Steam System.
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.

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
3.4.1-32	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 or copper alloy piping, piping components, and piping elements exposed to raw water in the Steam and Power Conversion System.
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.2.1.13, will be used to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling in stainless steel piping, piping components, piping elements, and tanks exposed to raw water in the Service Water System. Components in the Fresh Water Supply System 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, and fouling in stainless piping and piping components for this 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
3.4.1-34	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, or copper alloy heat exchanger tubes exposed to raw water 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	Not applicable. There are no copper alloy >15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water, raw water, or treated water in the Steam and Power Conversion 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 with exceptions. 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 and treated water > 140 °F in the Main Steam System. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation.
3.4.1-38	PWR Only				
3.4.1-39	PWR Only				
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, or treated 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
3.4.1-41	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 Hope Creek 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, or copper alloy piping, piping components, and piping elements exposed to gas in the Steam and Power Conversion System.

Table 3.4.2-1
Condensate Storage and Transfer System
Summary of Aging Management Evaluation

Table 3.4.2-1 Condensate Storage and Transfer 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 - Outdoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	IV.C1-10	3.1.1-52	B
Expansion Joints	Structural Support	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 2
Expansion Joints	Structural Support	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Expansion Joints	Structural Support	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	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	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D

Table 3.4.2-1 Condensate Storage and Transfer 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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-33	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.E-33	3.4.1-4	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	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
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	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-33	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.E-33	3.4.1-4	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, 2
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A

Table 3.4.2-1 Condensate Storage and Transfer 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	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
Piping and Fittings	Structural Support	Stainless Steel	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 2
Piping and Fittings	Structural Support	Stainless Steel	Soil (External)	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Non-Steel Piping Inspection			H, 4
Piping and Fittings	Structural Support	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Piping and Fittings	Structural Support	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
Piping and Fittings (Pipe Sleeve)	Shelter, Protection	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.B1-7	3.4.1-30	A
Piping and Fittings (Pipe Sleeve)	Shelter, Protection	Carbon Steel	Soil (External)	Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion	Buried Piping Inspection	VIII.E-1	3.4.1-11	A
Tanks (CST)	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 (CST)	Pressure Boundary	Stainless Steel	Soil (External)	Loss of Material/Pitting, Crevice, and Microbiologically Influenced Corrosion	Aboveground Non-Steel Tanks			G, 3
Tanks (CST)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-40	3.4.1-6	A
Tanks (CST)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-40	3.4.1-6	B
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, 2
Thermowell	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A

Table 3.4.2-1 Condensate Storage and Transfer System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Thermowell	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-33	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.E-33	3.4.1-4	B
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	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Valve Body	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B
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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-33	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.E-33	3.4.1-4	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	Air - Outdoor (External)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 2
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.E-29	3.4.1-16	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.E-29	3.4.1-16	B

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 Periodic Inspection program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

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

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

Table 3.4.2-2
Feedwater System
Summary of Aging Management Evaluation

Table 3.4.2-2 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 (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-11	3.1.1-4	A, 1
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting and Crevice Corrosion	Bolting Integrity	V.E-4	3.2.1-23	B
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	IV.C1-10	3.1.1-52	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cracking/Thermal and Mechanical Loading	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cracking/Thermal and Mechanical Loading	Small-Bore Class 1 Piping Inspection	IV.C1-1	3.1.1-48	E, 2

Table 3.4.2-2 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
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cracking/Thermal and Mechanical Loading	Water Chemistry	IV.C1-1	3.1.1-48	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B
Flow Element	Structural Support	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Flow Element	Structural Support	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-7	3.4.1-4	A
Flow Element	Structural Support	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-7	3.4.1-4	B
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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-7	3.4.1-4	A

Table 3.4.2-2 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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-7	3.4.1-4	B
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D2-8	3.4.1-29	B
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	Treated Water (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VIII.D2-6	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.D2-7	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.D2-7	3.4.1-4	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D2-8	3.4.1-29	B
Piping and Fittings	Structural Support	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Structural Support	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-7	3.4.1-4	A
Piping and Fittings	Structural Support	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-7	3.4.1-4	B
Piping and Fittings	Structural Support	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D2-8	3.4.1-29	B
Piping and Fittings (Class 1)	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 (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C

Table 3.4.2-2 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 (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B
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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-7	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.D2-7	3.4.1-4	B
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D2-8	3.4.1-29	B
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	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-7	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.D2-7	3.4.1-4	B
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.D2-8	3.4.1-29	B
Valve Body (Class 1)	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 (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C

Table 3.4.2-2 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 (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B

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.

2. The NUREG-1801 "One-Time Inspection of ASME Code Class 1 Small-Bore Piping" aging management program is applicable only to plants that have not experienced cracking of ASME Code Class 1 small-bore piping. Based on previous Hope Creek operating experience with Class 1 small-bore pipe cracking, a new plant-specific periodic inspection program will be used. The "Small-Bore Class 1 Piping Inspection" aging management program is a plant-specific periodic program that will be implemented to manage cracking by periodic volumetric examinations of small-bore Class 1 piping.

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

Table 3.4.2-3 Main Condenser System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Main Condenser Shell	Holdup	Carbon Steel	Air - Indoor (External)	None	None			J, 1
Main Condenser Shell	Holdup	Carbon Steel	Steam (Internal)	None	None			J, 1
Main Condenser Tubes	Holdup	Titanium Alloy	Raw Water (Internal)	None	None			J, 1
Main Condenser Tubes	Holdup	Titanium Alloy	Steam (External)	None	None			J, 1
Main Condenser Tubesheet	Holdup	Aluminum Bronze	Raw Water (Internal)	None	None			J, 1
Main Condenser Tubesheet	Holdup	Aluminum Bronze	Steam (External)	None	None			J, 1

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. Aging management of the main condenser is not based on analysis of materials, environments and aging effects. Condenser integrity required to perform the post accident intended function (holdup) is continuously confirmed by normal plant operation. No traditional aging management review or aging management program is required. The main condenser must perform a significant pressure boundary function (maintain vacuum) to allow continued plant operation. The post-accident intended function of the main condenser is to provide a holdup volume. This intended function does not require the condenser to be leak- tight, and the radiological analysis assumes the condenser is isolated and vacuum is lost, with 1.0 percent per day leakage. These conditions do not challenge the pressure boundary integrity of the condenser. Since normal plant operation assures adequate condenser pressure boundary integrity, the post-accident intended function to provide holdup volume is assured. Based on past precedence (NUREG-1796, Dresden and Quad Cities SER, Section 3.4.2.4.4 and NUREG-1769, Peach Bottom SER, Section 3.4.2.3), the staff concluded that the main condenser integrity is continually verified during normal plant operation and no aging management program is required to assure the post-accident intended function.

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 (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-11	3.1.1-4	A, 1
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Material/General, Pitting and Crevice Corrosion	Bolting Integrity	V.E-4	3.2.1-23	B
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor (External)	Loss of Preload/Thermal Effects, Gasket Creep, and Self-Loosening	Bolting Integrity	IV.C1-10	3.1.1-52	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VII.D-3	3.3.1-57	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Cracking/Thermal and Mechanical Loading	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Cracking/Thermal and Mechanical Loading	Small-Bore Class 1 Piping Inspection	IV.C1-1	3.1.1-48	E, 2

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
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Cracking/Thermal and Mechanical Loading	Water Chemistry	IV.C1-1	3.1.1-48	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	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
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	Small-Bore Class 1 Piping Inspection	IV.C1-1	3.1.1-48	E, 2
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	Water Chemistry	IV.C1-1	3.1.1-48	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	Small-Bore Class 1 Piping Inspection	IV.C1-1	3.1.1-48	E, 2
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking, Thermal and Mechanical Loading	Water Chemistry	IV.C1-1	3.1.1-48	B
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	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
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	A
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	E, 3
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.C1-1	3.1.1-48	E, 3
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	E, 3
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.C1-1	3.1.1-48	E, 3
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Condensing Chamber (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Flow Element (Class 1)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VII.D-3	3.3.1-57	A
Flow Element (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C

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 (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Flow Element (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Flow Element (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Flow Element (Class 1)	Throttle	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Flow Element (Class 1)	Throttle	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Flow Element (Class 1)	Throttle	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Flow Element (Class 1)	Throttle	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Flow Element (Class 1)	Throttle	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 482 F	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.C1-9	3.1.1-41	E, 4
Flow Element (Class 1)	Throttle	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 482 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Flow Element (Class 1)	Throttle	Cast Austenitic Stainless Steel (CASS)	Treated Water (Internal) > 482 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
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	Steam (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Piping and Fittings	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D

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	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	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-15	3.4.1-2	B
Piping and Fittings	Leakage Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B2-4	3.4.1-29	B
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Piping and Fittings	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.B2-6	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.B2-6	3.4.1-4	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	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-4	3.4.1-16	A
Piping and Fittings	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-4	3.4.1-16	B
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/Gas - Wetted (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.B1-7	3.4.1-30	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Air/Gas - Wetted (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.B1-7	3.4.1-30	E, 7
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VIII.B2-5	3.4.1-1	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
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	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-15	3.4.1-2	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B2-4	3.4.1-29	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (External)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.B2-6	3.4.1-4	A
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (External)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-6	3.4.1-4	B
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	One-Time Inspection	VIII.E-7	3.4.1-5	C
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/Galvanic Corrosion	Water Chemistry	VIII.E-7	3.4.1-5	D
Piping and Fittings	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.B2-6	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.B2-6	3.4.1-4	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/Gas - Wetted (Internal)	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	V.D2-35	3.2.1-8	E, 5
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B2-1	3.4.1-13	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B2-1	3.4.1-13	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	VII.E3-14	3.3.1-2	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
Piping and Fittings	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-2	3.4.1-37	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B2-1	3.4.1-13	A
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B2-1	3.4.1-13	B
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cumulative Fatigue Damage/Fatigue	TLAA	VII.E3-14	3.3.1-2	A, 1
Piping and Fittings	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-2	3.4.1-37	B
Piping and Fittings	Structural Support	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Piping and Fittings	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Piping and Fittings	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VII.D-3	3.3.1-57	A
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Piping and Fittings (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B
Piping and Fittings (Head Seal Leak Detection)	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	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 (Head Seal Leak Detection)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.A1-10	3.1.1-19	E, 6
Piping and Fittings (Head Seal Leak Detection)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.A1-10	3.1.1-19	E, 6
Piping and Fittings (Head Seal Leak Detection)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Piping and Fittings (Head Seal Leak Detection)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
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	Steam (Internal)	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B2-1	3.4.1-13	A
Restricting Orifices	Leakage Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B2-1	3.4.1-13	B
Restricting Orifices	Leakage Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-2	3.4.1-37	B
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	Steam (Internal)	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B2-1	3.4.1-13	A
Restricting Orifices	Pressure Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B2-1	3.4.1-13	B
Restricting Orifices	Pressure Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-2	3.4.1-37	B
Restricting Orifices (Class 1)	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	A
Restricting Orifices (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	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
Restricting Orifices (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.C1-1	3.1.1-48	E, 3
Restricting Orifices (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Restricting Orifices (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Restricting Orifices (Class 1)	Throttle	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	A
Restricting Orifices (Class 1)	Throttle	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	IV.C1-1	3.1.1-48	E, 3
Restricting Orifices (Class 1)	Throttle	Stainless Steel	Treated Water (Internal) > 140 F	Cracking/Stress Corrosion Cracking	Water Chemistry	IV.C1-1	3.1.1-48	E, 3
Restricting Orifices (Class 1)	Throttle	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Restricting Orifices (Class 1)	Throttle	Stainless Steel	Treated Water (Internal) > 140 F	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B
Sparger (T-quencher)	Pressure Boundary	Stainless Steel	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-4	3.4.1-16	A
Sparger (T-quencher)	Pressure Boundary	Stainless Steel	Treated Water (External)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-4	3.4.1-16	B
Sparger (T-quencher)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VIII.D2-4	3.4.1-16	A
Sparger (T-quencher)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-4	3.4.1-16	B
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	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Strainer Body	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B

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	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	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Strainer Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
Thermowell	Leakage Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Thermowell	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Thermowell	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
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	Air/Gas - Wetted (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.B1-7	3.4.1-30	A
Thermowell	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Thermowell	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
Turbine Casing	Structural Support	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Turbine Casing	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	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
Turbine Casing	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
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	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Valve Body	Leakage Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
Valve Body	Leakage Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B2-4	3.4.1-29	B
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.B2-6	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.B2-6	3.4.1-4	B
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	Steam (Internal)	Cracking/Stress Corrosion Cracking	One-Time Inspection	VIII.B2-1	3.4.1-13	A
Valve Body	Leakage Boundary	Stainless Steel	Steam (Internal)	Cracking/Stress Corrosion Cracking	Water Chemistry	VIII.B2-1	3.4.1-13	B
Valve Body	Leakage Boundary	Stainless Steel	Steam (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.B2-2	3.4.1-37	B
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/Gas - Wetted (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	VIII.B1-7	3.4.1-30	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	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	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-15	3.4.1-2	B
Valve Body	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	VIII.B2-4	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.D2-4	3.4.1-16	A
Valve Body	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VIII.D2-4	3.4.1-16	B
Valve Body	Structural Support	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VIII.H-7	3.4.1-28	A
Valve Body	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VIII.A-15	3.4.1-2	A
Valve Body	Structural Support	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VIII.A-15	3.4.1-2	B
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Air - Indoor (External)	Loss of Material/General Corrosion	External Surfaces Monitoring	VII.D-3	3.3.1-57	A
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Cumulative Fatigue Damage/Fatigue	TLAA	IV.C1-15	3.1.1-3	A, 1
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-6	3.1.1-13	C
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	IV.C1-6	3.1.1-13	D
Valve Body (Class 1)	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning/Flow Accelerated Corrosion	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	B

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 (Class 1)	Pressure Boundary	Stainless Steel	Air - Indoor (External)	None	None	IV.E-2	3.1.1-86	A
Valve Body (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	IV.C1-14	3.1.1-15	A
Valve Body (Class 1)	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	IV.C1-14	3.1.1-15	B

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.

2. The NUREG-1801 "One-Time Inspection of ASME Code Class 1 Small-Bore Piping" aging management program is applicable only to plants that have not experienced cracking of ASME Code Class 1 small-bore piping. Based on previous Hope Creek operating experience with Class 1 small-bore pipe cracking, a new plant-specific periodic inspection program will be used. The "Small-Bore Class 1 Piping Inspection" aging management

program is a plant-specific periodic program that will be implemented to manage cracking by periodic volumetric examinations of small-bore Class 1 piping.

3. The Water Chemistry and ASME Section XI In-Service Inspection, Subsections IWB, IWC, and IWD aging management programs will be used to manage the aging effect of cracking in condensing chambers, restricting orifices, and valve bodies <NPS 4".

4. The Main Steam flow element consists of a carbon steel venturi inserted inside a section of carbon steel piping. The carbon steel venturi includes a cast austenitic steel (CASS) insert to form the venturi nozzle. The carbon steel venturi and CASS nozzle are located entirely within the pipe and therefore do not perform a Pressure Boundary function. The carbon steel pipe performs the Pressure Boundary function. The venturi and nozzle perform a Throttle intended function. This CASS nozzle is not susceptible to thermal embrittlement because the nozzles were cast by a centrifugal casting method using low molybdenum stainless material (SA 351 CF8). In accordance with the guidance provided in the NUREG-1801, Volume 2, Section XI.M12, the centrifugally-cast, low molybdenum CASS portion of the flow restrictors is not susceptible to thermal embrittlement. The Water Chemistry aging management program will be used to manage the aging effects for the CASS material in this application.

5. NUREG-1801 specifies a plant-specific program. The Periodic Inspection program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

6. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program includes inspection of this component; therefore the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD and Water Chemistry programs are credited here for managing the effects of cracking for this component.

7. One-time inspection will also be used for loss of material for safety relief valve dischage line at point of entry into the torus based upon recent industry operating experience. The line is carbon steel in an air/gas wetted (internal) environment.

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 as being subject to aging management review. The structures or portions of structures and commodities, which are addressed in this section, are described in the indicated sections.

- Auxiliary Boiler Building (2.4.1)
- Auxiliary Building Control/Diesel Generator Area (2.4.2)
- Auxiliary Building Service/Radwaste Area (2.4.3)
- Component Supports Commodity Group (2.4.4)
- Fire Water Pump House (2.4.5)
- Piping and Component Insulation Commodity Group (2.4.6)
- Primary Containment (2.4.7)
- Reactor Building (2.4.8)
- Service Water Intake Structures (2.4.9)
- Shoreline Protection and Dike (2.4.10)
- Switchyard (2.4.11)
- Turbine Building (2.4.12)
- Yard Structures (2.4.13)

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 Boiler Building

Table 3.5.2-2 Summary of Aging Management Evaluation - Auxiliary Building Control/ Diesel Generator Area

Table 3.5.2-3 Summary of Aging Management Evaluation - Auxiliary Building Service/ Radwaste Area Auxiliary Building Service/Radwaste Area

Table 3.5.2-4 Summary of Aging Management Evaluation - Component Supports Commodity Group

Table 3.5.2-5 Summary of Aging Management Evaluation - Fire Water Pump House

Table 3.5.2-6 Summary of Aging Management Evaluation - Piping and Component Insulation Commodity Group

Table 3.5.2-7 Summary of Aging Management Evaluation - Primary Containment

Table 3.5.2-8 Summary of Aging Management Evaluation - Reactor Building

Table 3.5.2-9 Summary of Aging Management Evaluation - Service Water Intake Structures

Table 3.5.2-10 Summary of Aging Management Evaluation - Shoreline Protection and Dike

Table 3.5.2-11 Summary of Aging Management Evaluation - Switchyard

Table 3.5.2-12 Summary of Aging Management Evaluation - Turbine Building

Table 3.5.2-13 Summary of Aging Management Evaluation - Yard Structures

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

3.5.2.1.1 Auxiliary Boiler Building

Materials

The materials of construction for the Auxiliary Boiler Building components are:

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

Environments

The Auxiliary Boiler Building 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 Auxiliary Boiler 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
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Auxiliary Boiler Building components:

- Structures Monitoring Program (B.2.1.32)

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

3.5.2.1.2 Auxiliary Building Control/Diesel Generator Area

Materials

The materials of construction for the Auxiliary Building Control/Diesel Generator Area components are:

- Aluminum
- Aluminum Bolting

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

Environments

The Auxiliary Building Control/Diesel Generator Area components are exposed to the following environments:

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

Aging Effects Requiring Management

The following aging effects associated with the Auxiliary Building Control/Diesel Generator Area 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
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Auxiliary Building Control/Diesel Generator Area components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2-2, Summary of Aging Management Evaluation – Auxiliary Building Control/Diesel Generator Area summarizes the results of the aging management review for the Auxiliary Building Control/Diesel Generator Area.

3.5.2.1.3 Auxiliary Building Service/Radwaste Area

Materials

The materials of construction for the Auxiliary Building Service/Radwaste Area components are:

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

Environments

The Auxiliary Building Service/Radwaste Area components are exposed to the following environments:

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

Aging Effects Requiring Management

The following aging effects associated with the Auxiliary Building Service/Radwaste Area 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
- Increased Hardness, Shrinkage and Loss of Strength/Weathering
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Auxiliary Building Service/Radwaste Area components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2-3, Summary of Aging Management Evaluation – Auxiliary Building Service/Radwaste Area summarizes the results of the aging management review for the Auxiliary Building Service/Radwaste Area.

3.5.2.1.4 Component Supports Commodity Group

Materials

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

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

- Grout
- High Strength Low Alloy Steel Bolting with Yield Strength >150 ksi
- Lubrite®
- Nickel Alloy Bolting
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

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

- Air - Indoor
- Air - Outdoor
- Treated Water
- Water - Flowing

Aging Effects Requiring Management

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

- Loss of Material/Galvanic, 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.2.1.29)
- Structures Monitoring Program (B.2.1.32)
- Water Chemistry (B.2.1.2)

Table 3.5.2-4, Summary of Aging Management Evaluation – Component Supports Commodity Group summarizes the results of the aging management review for the Component Supports Commodity Group.

3.5.2.1.5 Fire Water Pump House

Materials

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

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

Environments

The Fire Water 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 Water 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
- 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/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Water Pump House components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2-5, Summary of Aging Management Evaluation – Fire Water Pump House summarizes the results of the aging management review for the Fire Water Pump House.

3.5.2.1.6 Piping and Component Insulation Commodity Group

Materials

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

- Aluminum
- Calcium Silicate
- Cellular glass
- Ceramic Fiber
- Fiberglass
- Fiberglass (Molded)
- Fiberglass cloth
- Galvanized Steel
- "Min-K"
- NUKON
- Stainless Steel
- Stainless Steel (Mirror Insulation)

Environments

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

- Air - Indoor
- Air - Outdoor

Aging Effects Requiring Management

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

- Loss of Material/Pitting and Crevice Corrosion

Aging Management Programs

The following aging management program manages the aging effects for the Piping and Component Insulation Commodity Group components:

- Periodic Inspection (B.2.2.2)

Table 3.5.2-6, 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.

3.5.2.1.7 Primary Containment

Materials

The materials of construction for the Primary Containment components are:

- Boron Concrete
- Carbon Steel
- Carbon Steel; Dissimilar Metal Welds
- Carbon and Low Alloy Steel Bolting
- Concrete
- Concrete (High Density)
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Grout (High Density)
- Lubrite®
- Paint
- Reinforced concrete

- Stainless Steel
- Stainless Steel Bolting
- Stainless Steel; Dissimilar Metal Welds

Environments

The Primary Containment components are exposed to the following environments:

- Air - Indoor
- Concrete
- Encased in Steel
- Raw Water
- Treated Water

Aging Effects Requiring Management

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

- Cracking, Blistering, Flaking, Peeling and Delamination
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel
- Cumulative Fatigue Damage/Fatigue
- Fretting or Lockup/Mechanical Wear
- Lock-up/ wear
- Loss of Leaktightness/ Mechanical Wear of Locks, Hinges and Closure Mechanisms
- 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 Primary Containment components:

- 10 CFR Part 50, Appendix J (B.2.1.30)
- ASME Section XI, Subsection IWE (B.2.1.28)
- One-Time Inspection (B.2.1.22)
- Protective Coating Monitoring and Maintenance Program (B.2.1.34)
- Structures Monitoring Program (B.2.1.32)

- TLAA
- Water Chemistry (B.2.1.2)

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

3.5.2.1.8 Reactor Building

Materials

The materials of construction for the Reactor Building components are:

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

Environments

The Reactor Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Air/Gas - Dry (Internal)
- Concrete
- Encased in Steel
- Groundwater/Soil
- Raw Water
- Treated Water
- Water - Flowing

Aging Effects Requiring Management

The following aging effects associated with the Reactor Building 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
- Cumulative Fatigue Damage/Fatigue
- 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/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Reactor Building components:

- One-Time Inspection (B.2.1.22)
- Structures Monitoring Program (B.2.1.32)
- TLAA
- Water Chemistry (B.2.1.2)

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

3.5.2.1.9 Service Water Intake Structures

Materials

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

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

Environments

The Service Water Intake 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 Service Water Intake Structures components require management:

- Change in Material Properties, Loss of Material/Moisture Damage, Insect 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

- 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/Abrasion; Cavitation
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Structures components:

- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.33)
- Structures Monitoring Program (B.2.1.32)

Table 3.5.2-9, Summary of Aging Management Evaluation – Service Water Intake Structures summarizes the results of the aging management review for the Service Water Intake Structures.

3.5.2.1.10 Shoreline Protection and Dike

Materials

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

- Carbon Steel
- Soil, rip-rap, sand, gravel

Environments

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

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

Aging Effects Requiring Management

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

- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material, Loss of Form/Erosion, Settlement, Sedimentation, Frost Action, Waves, Currents, Surface Runoff, Seepage

Aging Management Programs

The following aging management program manages the aging effects for the Shoreline Protection and Dike components:

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

Table 3.5.2-10, Summary of Aging Management Evaluation – Shoreline Protection and Dike summarizes the results of the aging management review for the Shoreline Protection and Dike.

3.5.2.1.11 Switchyard

Materials

The materials of construction for the Switchyard components are:

- Aluminum
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete
- Concrete Block
- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- PVC
- Reinforced concrete

Environments

The Switchyard components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete

- Encased in Steel
- Groundwater/Soil
- Water - Flowing
- Water - Standing

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
- 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
- Increase in Porosity and Permeability, Loss of Strength /Leaching of Calcium Hydroxide
- Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Switchyard components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2.1.11, Summary of Aging Management Evaluation – Switchyard summarizes the results of the aging management review for the Switchyard.

3.5.2.1.12 Turbine Building

Materials

The materials of construction for the Turbine Building components are:

- Aluminum
- Aluminum Bolting
- Carbon Steel

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

Environments

The Turbine Building components are exposed to the following environments:

- Air - Indoor
- Air - Outdoor
- Concrete
- 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
- 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/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Turbine Building components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2-12, Summary of Aging Management Evaluation – Turbine Building summarizes the results of the aging management review for the Turbine Building.

3.5.2.1.13 Yard Structures

Materials

The materials of construction for the Yard Structures components are:

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

Environments

The Yard Structures components are exposed to the following environments:

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

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/General, Pitting, Crevice, and Microbiologically Influenced Corrosion
- Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw
- 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 Yard Structures components:

- Structures Monitoring Program (B.2.1.32)

Table 3.5.2.1.13, 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.

Item Number 3.5.1-1 is not applicable to the Hope Creek Mark I steel containment. The containment is located in the Reactor Building. The indoor environment of the Reactor Building does not subject the containment to an aggressive environment.

The concrete is designed and constructed in accordance with ACI 318-71 and ACI 301-72. Materials used in the design conformed to ASTM specifications that ensure consistent, reliable concrete of the highest quality. The design provides for low permeability and adequate air entrainment (3% - 6%). Air entraining admixtures conform to ASTM C 260, and water reducing and retarding admixtures conform to ASTM C 494 for types A and D. The admixtures do not contain chlorides and mixing water was controlled so as not to contain more than 250 ppm of chlorides nor more than 1000 ppm of sulfates. The cement is Type II, Portland cement conforming to ASTM C-150, with alkali content limited to 0.6 percent by weight. Aggregates conform to the requirements of ASTM C-33 and were tested in accordance with ASTM specifications C 289, and C 295. These requirements meet the intent of ACI 201.2R, Guide to Durable Concrete. 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 are insignificant and require no aging management. This applies to the concrete foundation for the containment structure and the concrete (i.e., floor slab, RPV pedestal) features within the containment structure.

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.

Item Number 3.5.1-2 is not applicable to the Hope Creek Mark I steel containment.

Item Number 3.5.1-3 is not applicable to the Hope Creek Mark I steel containment foundation.

The containment is supported from the Reactor Building foundation and its design does not incorporate porous concrete in the sub-foundation and a de-watering system is not used. The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increase stress level from settlement for the Reactor Building. However this aging mechanism is insignificant for Hope Creek structures because the structures are founded on the Vincetown Formation. Also reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete sub-foundation is not applicable because porous

concrete is not used in the foundation design. The Structures Monitoring Program is 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 the Hope Creek Mark I steel containment. The Technical Specification and UFSAR limit the bulk air temperature inside the drywell during normal plant operation to 135° F, with a maximum local area air temperature of 194 ° F above elevation 162'. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through the Drywell Air Cooling System.

Therefore, concrete structural components located in the drywell are not subject to general area temperature greater than 150°F or local area temperature greater 200° F. Process piping operating at temperatures greater than 200° F are insulated through the penetrations. The insulation, in combination with compartment air circulation, reduces concrete local area temperature to less than 200° F. Plant operating experience has not identified elevated general area and local area temperature as a concern for concrete structural components.

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.

Hope Creek relies on ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50, Appendix J, B.2.1.30, to manage aging of accessible and inaccessible areas of the BWR Mark I Primary Containment pressure retaining elements. Accessible areas are subject to periodic examinations to detect loss of material due to general, pitting and crevice corrosion. Inaccessible areas are examined when they become accessible, or if they are suspected of degradations based on examination of the corresponding accessible areas. As explained below, examinations conducted in accordance with ASME Section XI, Subsection

IWE have not identified significant corrosion in accessible or inaccessible areas of the Hope Creek Primary Containment.

The concrete in contact with the embedded drywell shell and the drywell support skirts meets the specifications of ACI 318-71 and the guidance of ACI 201.2R. Accessible portions of the drywell floor concrete is monitored under the Structures Monitoring Program, B.2.1.32, to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the embedded drywell shell. Water ponding on the containment drywell concrete floor is not common and when detected it is cleaned up in a timely manner.

The current Hope Creek design does not require installation of a moisture barrier at the junction where the inner drywell shell becomes embedded in concrete. Visual inspection of this interface did not identify gaps, cracks, or separation of concrete from the drywell shell that would be a path for potential water leakage intrusion into the embedded shell. Visual examination conducted in accordance with ASME Section XI, Subsection IWE did not identify significant corrosion at the interface. The examiners noted only local surface rust in areas where the drywell shell coating is chipped or damaged as a result of maintenance activities. There were no indications that corrosion is occurring in the drywell shell below the concrete floor.

In 2007 and 2009 Hope Creek conducted ultrasonic testing (UT) measurements of the drywell shell thickness at sample locations above the junction of where the shell becomes embedded in concrete. This area was reported in NRC Information Notice (IN) 2004-01 as susceptible to loss of material due to corrosion. Also, measurements in this area would detect significant loss of material that could be occurring in inaccessible exterior surfaces of the drywell shell, specifically in the "sand-pocket region". There is no "sand-pocket region" or sand in the concrete foundation transition zone of the drywell shell and the air gap at Hope Creek. UT measurement results showed that, in each case, the measured thickness was greater than the specified nominal drywell shell thickness. The minimum measured thickness was 1.51 inches as compared to the nominal design thickness of 1.5 inches.

However, during the 2009 refuel outage, water was found trickling out of a Reactor Building concrete wall penetration sleeve from the drywell air gap region and ponded on the torus room floor. Analysis of the ponded water identified it as reactor water/refueling water. A review of past UT reading on the upper region, taken in 2007, of the drywell shell in areas of reported water leakage indicates no loss of material of the drywell shell. The water leakage stopped after the refueling cavity was drained at the end of the refueling outage. The suspected source of the water was the refuel bellow or liner. The air gap drains were inspected; there was no blockage or standing water in the air gap region and the drywell shell showed no signs of corrosion. The water leakage issue was entered into the corrective action process to determine cause of the leakage and corrective actions to prevent reoccurrence.

In 2007, Hope Creek also conducted UT measurements of the drywell shell thickness at sample locations in the upper region of the drywell. Areas subject to UT examination include locations where two plates of different thicknesses are

welded together to form the drywell shell. The condition of the drywell shell at the interface of the two plates has been of interest to the NRC staff because of the likelihood of moisture collection at the ledge that may be formed by the thicker of the two plates. UT measurement results showed that, in each case, the measured thickness was greater than the specified nominal drywell shell thickness. The results of the UT measurements, the nominal design thickness, and the available margins are tabulated below.

Location	Nominal Thick. Inch	Minimum Measured Thick., Inch	Thickness used in ASME Code stress analysis (.063" corrosion allowance)	Maximum Ratio Design Load/Capacity
Lower Cylinder	0.9375	0.982	0.875	0.96
Knuckle	2.875	2.911	2.813	0.60
Upper Sphere	1.50	1.580	1.438	0.75
Lower Sphere	1.50	1.511	1.438	0.75

In summary, loss of material due to corrosion is insignificant for Hope Creek drywell shell. Visual examinations conducted in accordance with ASME Section XI, Subsection IWE have not identified corrosion that reduces the shell thickness in accessible areas of the drywell. UT thickness measurements of the shell, at locations that have been identified in the industry as susceptible to corrosion, show that the measured thicknesses are greater than the nominal thickness. Also the conditions that led to significant loss of material in inaccessible areas of the drywell shell are not applicable to Hope Creek Mark I containment. That is, the containment has no "sand-pocket region". Potential leakage of water from the reactor cavity during refueling is removed by the reactor cavity seal rupture drain lines that are monitored by instrumentation designed to alarm in the Main Control Room in the event of leakage. A review of the alarm log for the past refueling outage showed no recorded initiation of the alarms during the refueling outage. There are also drains at the bottom of the air gap region at the junction of where the shell becomes embedded in concrete. In 2009, these drains were inspected; there was no blockage or standing water in the air gap region and the drywell shell showed no signs of corrosion.

In 2006 the NRC issued its final license renewal interim staff guidance LR-ISG-2006-01. This LR-ISG provides interim guidance to applicants for license renewal for a plant with a BWR Mark I steel containment to provide a plant-specific aging management program that addresses the potential loss of material due to corrosion in the inaccessible areas of their Mark I steel containment drywell shell for the period of extended operation. In conducting the aging management review and developing the plant-specific aging management program for the drywell shell, the LR-ISG-2006-01 requires the applicant to consider six (6) recommended

actions based upon plant design and operating experience. Hope Creek conducted aging review of inaccessible areas of its Mark I containment considering plant design and operating experience, discussed above. Hope Creek concluded that the following plant-specific activities are required to ensure loss of material in inaccessible areas of the drywell shell is adequately managed or mitigated consistent with the LR-ISG-2006-01 guidance. The activities are:

- Implement a plant design change that installs the moisture barrier at the junction of the drywell concrete floor and the embedded drywell shell. The plant design change will be implemented prior to entering the period of extended operation.
- Monitor the moisture barrier for degradations in accordance with ASME Section XI, Subsection IWE during the period of extended operation.
- Verify that the reactor cavity seal rupture drain lines are clear from blockage once prior to the period of extended operation, and again as a one time inspection during the period of extended operation.
- Verify that drains at the bottom of the drywell air gap are clear from blockage once prior to the period of extended operation, and again as a one-time inspection during the period of extended operation.
- Investigate the source of any leakage detected by the reactor cavity seal rupture drain line instrumentation and to investigate and assess its impact on the drywell shell.
- Monitor the drains at the bottom of the drywell air gap for leakage in the event leakage is detected by the reactor cavity seal rupture drain line instrumentation.

The implementation of ASME Section XI, Subsection IWE, B.2.1.28, and 10 CFR Part 50, Appendix J, B.2.1.30, supplemented by the plant-specific activities describe above provide reasonable assurance that loss of material due to corrosion of the drywell shell will be adequately managed during the period of extended operation such that the intended functions of Mark I containment drywell are maintained consistent with the current licensing basis.

Miscellaneous steel components (catwalks, stairs, handrails, ladders, platforms, etc.) inside the Primary Containment suppression chamber aligned to this line item based on material, environment and aging effect do not perform a primary containment intended function. The components are therefore not in scope of ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J. The Structures Monitoring Program, B.2.1.32, will be substituted to manage loss of material due to general, pitting and crevice corrosion of these components.

The ASME Section XI, Subsection IWE Program, 10 CFR Part 50, Appendix J Program, and the Structures Monitoring Program are described in Appendix B.

Item Number 3.5.1-6 is not applicable to the Hope Creek Mark I steel containment. The Item Number is applicable only to the liner for PWR and BWR concrete containments.

3.5.2.2.1.5 Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature

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).

Item Number 3.5.1-7 is not applicable to the Hope Creek Mark I steel containment. The Item Number is applicable only to PWR and BWR prestressed concrete containments.

3.5.2.2.1.6 Cumulative Fatigue Damage

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).

At Hope Creek, cumulative fatigue damage of the suppression chamber (torus) shell (including welded joints), and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows), vent header, vent line bellows, and downcomers is a TLAA as defined in 10 CFR 54.3. The TLAA is evaluated in accordance with 10 CFR 54.21(c). Evaluation of this TLAA is discussed in Section 4.6.

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 3.5.1-10 and Item Number 3.5.1-11 are not applicable to Hope Creek. Stress corrosion cracking (SCC) is not an applicable aging effect/mechanism for the Primary Containment stainless steel penetration sleeves, penetration bellows, vent line bellows, and dissimilar metal welds. The components are located in an Air-Indoor environment and are not subject to conditions that promote SCC. Aging management reviews concluded SCC of stainless steel is not considered credible because stainless steel SCC requires a concentration of chloride or sulfate contaminants, which is not present in significant quantities in this environment at Hope Creek

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 3.5.1-12 is not applicable to the Hope Creek containment components: steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers. Fatigue analysis exists in the Hope Creek CLB for these components, thus cracking due to cyclic loading is a TLAA addressed by Item Number 3.5.1-9 and evaluated in paragraph 3.5.2.2.1.6 above.

Item Number 3.5.1-13 is not applicable to the Hope Creek containment components: steel, stainless steel elements, dissimilar metal welds: torus; vent line; vent header; vent line bellows; downcomers. A fatigue analysis exists in the Hope Creek CLB for these components, thus cracking due to cyclic loading is a TLAA addressed by Item Number 3.5.1-8 and evaluated in paragraph 3.5.2.2.1.6 above.

Expansion bellows not associated with containment are located in the Reactor Building and Yard Structures. These bellows have a design specification requirement of 2000 normal cycles. Evaluation of fatigue due cyclic loading for these components shows the projected number of cycles for 60 years is approximately 600 cycles. The number of cycles is 10 cycles per year of operation including refueling operations. Thus, significant cracking of the bellows due to cyclic loading is not expected to occur through the period of extended operation. Furthermore plant operating experience has not identified cracking of bellows as a concern.

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.

Item Number 3.5.1-14 is not applicable to the Hope Creek Mark I steel containment. The Item Number is applicable only to PWR and BWR concrete containments. The containment is supported from and located in the Reactor Building. Thus, repeated freeze-thaw is not applicable, and not subject to loss of material and cracking due to freeze-thaw.

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

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.

Item Number 3.5.1-15 is not applicable to the Hope Creek Mark I steel containment. The Item Number is applicable only to PWR and BWR concrete containments. Additionally, the Hope Creek containment reinforced concrete is designed and constructed to meet ACI and ASTM specifications that meet the intent of ACI 201.2R. The containment is also not subject to a flowing water environment, which would be conducive to leaching of calcium hydroxide. Therefore, managing the effects of cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide is not required.

3.5.2.2.2 <u>Safety-Related and Other Structures and Component Supports</u>

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 Hope Creek, the Structures Monitoring Program, B.2.1.32 is used to manage aging affects applicable to Groups 1, 3, and 4 structures as discussed below. Group 5, "Fuel Storage Facility", is included with Group 1 structures. The GALL

Groups 2, 7, 8, and 9 structures do not exist at Hope Creek. The aging management reviews concluded certain concrete aging mechanisms identified in NUREG-1801 are not applicable to some of Group 1, 3, and 4 structures as explained below and require no aging management. However, accessible structures will be monitored for loss of material, cracking, increase in porosity and permeability, and loss of bond through the Structures Monitoring Program, B.2.1.32, regardless of aging mechanisms. 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 Hope Creek, cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1, 3, and 4 structures are monitored by the Structures Monitoring Program, B.2.1.32, and thus 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.*

Item Number 3.5.1-24 is not applicable to Hope Creek interior and above grade exterior concrete of Groups 1, 3, and 4 structures because the structures are not exposed to aggressive chemical attack.

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

At Hope Creek, loss of material due to corrosion for Groups 1, 3, and 4 structures and structural components is managed through the Structures Monitoring Program, B.2.1.32. 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 Hope Creek, loss of material and cracking due to freeze-thaw for Groups 1 and 3 structures are managed through the Structures Monitoring Program, B.2.1.32, and thus a further evaluation is not necessary. 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 to Hope Creek Group 1 and 3 structures. Concrete specifications require the use of Type II, low alkali cement. Alkali content is limited to 0.6 percent total alkali and testing of aggregates was performed in accordance with ASTM C289 and C295 to demonstrate no potential for alkali reactivity with the aggregate. The Structures Monitoring Program, B.2.1.32, will be used to manage cracking of reinforced concrete in accessible areas of structures regardless of aging mechanisms. 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.*

The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increase stress level from settlement for Groups 1 and 3 structures. However this aging mechanism is insignificant for Hope Creek structures because the structures are founded on dense soil or the Vincetown Formation. Evaluation of pre-construction and post-construction soil explorations, predicted no more than 1.5 inches of settlement for safety-related structures and settlement leveled off soon after construction. The building foundations for the safety-related structures consist of reinforced concrete mats, which bear on dense soil or the Vincetown Formation. Nonsafety-related building foundations for structures that meet 10 CFR 54.4(a)(2) or (a)(3) consist of reinforced concrete slabs supported on piles. Since the magnitude of the total settlements is small, the differential settlements are expected to be smaller, thus settlement distortion is insignificant for Hope Creek structures. A de-watering system is not relied upon to control settlement and porous concrete is not used in the design of sub-foundations. The structures are monitored under the Structures Monitoring Program, B.2.1.32, and thus further evaluation is not necessary. 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 Hope Creek, Groups 1 and 3 structures. The structures are not subject to reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation because the structures are not founded on 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.

At Hope Creek, sliding surfaces are provided for supports for radial beam seats in the drywell. The Structures Monitoring Program, B.2.1.32, will be used to manage lock-up due to wear for these sliding surfaces. The Structures Monitoring Program is described in Appendix B.

3.5.2.2.2.2 Aging Management of Inaccessible Areas

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 Hope Creek, Groups 1 and 3 structures are located in a region where weathering conditions are considered severe as shown in ASTM C33-90, Figure 1. The GALL Groups 2, 5, 7, 8, and 9 structures do not exist at Hope Creek. The loss of material (spalling, scaling) and cracking due to freeze-thaw is applicable to Hope Creek structures. However, these concrete structures are designed and constructed in accordance with ACI 318-71 and ACI 301-72. The design provides for low permeability and adequate air entrainment (3% - 6%) such that the concrete is not susceptible to freeze-thaw aging effects. Concrete mixes have approximately 15 to 30 percent pozzolan by weight as cement replacement. Air entraining admixtures conform to ASTM C 260, and water reducing and retarding admixtures conform to ASTM C 494 for types A and D. The admixtures do not contain chlorides and mixing water was controlled so as not to contain more than 250 ppm of chlorides nor more than 1000 ppm of sulfates. Concrete mix and proportions of ingredients provide required concrete strength, durability, and unit weight while maintaining adequate workability and proper consistency to permit required consolidation without excessive segregation or bleeding. Compression tests conform to ASTM Specifications C 39, C 138, and C 143. These measures provide a concrete with good freeze-thaw resistance.

As described above, the design and construction of reinforced concrete for Group 1 and 3 structures is in accordance with ACI specifications that preclude significant loss of material (spallng, scaling) and cracking due to freeze-thaw. Operating experience review has not identified significant loss of material and cracking due to freeze-thaw of reinforced concrete structures.

Therefore, loss of material (spalling, scaling), and cracking due to freeze-thaw of inaccessible reinforced concrete are insignificant and require no aging management. However, inaccessible reinforced concrete will be inspected if excavated for any reason, as required by Hope Creek Structures Monitoring Program, B.2.1.32. 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 to Hope Creek Groups 1 and 3 structures. Reinforced concrete for Groups 1 and 3 structures is designed in accordance with ACI 318-71 and constructed in accordance with ACI 301-72. The cement is Type II, Portland cement conforming to ASTM C-150, with alkali content limited to 0.6 percent by weight. Aggregates were tested in accordance with ASTM specifications C 289, and C 295. These requirements meet the intent of ACI 201.2R, Guide to Durable Concrete and demonstrate no potential for alkali reactivity for the aggregate.

   As described above, reinforced concrete is designed and constructed to meet ACI and ASTM specifications and meets the intent of ACI 201.2R. Aggregate was tested in accordance with ASTM specifications C 289, and C 295 to

demonstrate no potential for alkali reactivity for the aggregate. Thus, cracking due to expansion and reaction with aggregate is not applicable and requires no aging management. However, inaccessible concrete will be inspected for cracking if excavated for any reason, as required by the Hope Creek Structures Monitoring Program, B.2.1.32. 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.*

   The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increased stress level from settlement for Groups 1 and 3 structures. However this aging mechanism is insignificant for Hope Creek structures because the structures are founded on dense soil or the Vincetown Formation. Evaluation of pre-construction and post-construction soil explorations, predicted no more than 1.5 inches settlement for safety-related structures and settlement leveled off soon after construction. The building foundations for the safety-related structures consist of reinforced concrete mats, which bear on dense soil or the Vincetown Formation. Nonsafety-related building foundations for structures that meet 10 CFR 54.4(a)(3) consist of reinforced concrete slabs supported on concrete piles encased in steel. 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. Since the magnitude of the total settlements is small, the differential settlements are expected to be smaller, thus settlement distortion is insignificant for Hope Creek structures. A de-watering system is not relied upon in Hope Creek CLB to control settlement and porous concrete is not used in the design of sub-foundations. Operating experience review has not identified significant signs of distress due to settlement.

   The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increased stress levels from settlement. 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 and 3 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 condition of the accessible and above grade concrete are used as an indicator for the condition of the inaccessible and below grade structural components and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function. However inaccessible concrete for Groups 1 and 3 structures will be inspected for cracking and distortion due to settlement if excavated for any reason, as required by the Hope Creek Structures Monitoring Program, B.2.1.32. The Structures Monitoring Program is described in Appendix B.

Item Number 3.5.1-29 is not applicable to Hope Creek, Groups 1 and 3 structures. The structures are not subject to reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation because the structures are not founded on porous concrete subfoundation.

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.*

   At Hope Creek, inaccessible below-grade reinforced concrete for Groups 1 and 3 structures is subject to an aggressive environment. Test results for groundwater and river water samples taken in 2008 and 2009 showed pH limits are above the threshold limit pH > 5.5, and sulfates are lower than the threshold limit sulfates <1500 ppm and this would indicate a non- aggressive environment. Chlorides exceed the threshold limit chlorides < 500 ppm which indicates an aggressive environment. The ground water and river water are considered an aggressive environment due to chloride levels.

   Hope Creek will continue periodic ground water testing and will examine exposed portions of the below-grade concrete, when excavated for any reason. Also the results of 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 groups 1 and 3 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 reinforced 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 exposure and inspect the concrete is warranted. In addition Hope Creek will inspect inaccessible reinforced concrete if excavated for any reason, and monitor groundwater chemistry periodically as required by the Structures Monitoring Program, B.2.1.32. 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 and 3 structures. Operating experience at Hope Creek 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.2.1.32.

   At Hope Creek, the Portland cement conforms to ASTM C 150, Type II and 15 to 30 percent pozzolan was used in the concrete batch design. The use of Type II cement and pozzolan results in concrete resistant to the aging effect increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide. Hope Creek reinforced concrete is designed and constructed to meet ACI and ASTM Specifications that meets the intent of ACI 201.2R, cement and additives have been established to produce durable concrete. Therefore, managing the aging effect of increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide are not required for concrete in inaccessible areas in Groups 1 and 3 structures. However, Hope Creek 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 Hope Creek. Group 1 and 3 concrete structures are not subject to general area temperature greater than 150°F. Group 1 structures (Reactor Building) are subject to normal indoor air with temperatures not greater than 120° F and outdoor design temperature of 94° F. Group 3 structures are exposed to normal indoor air temperatures not greater than 115° F. Group 4 structures are exposed to normal indoor air temperature inside the drywell. The Technical Specification and UFSAR limit the bulk air temperature inside the drywell during normal plant operation to 135° F, with a maximum local area air temperature of 194° F above elevation 162'. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through the Drywell Air Cooling System. Group 5 structures, i.e., refuel floor and spent fuel storage pool, are part of the Reactor Building and are exposed to normal indoor air temperatures not greater than 104° F. The spent fuel storage pool water temperature is maintained at a maximum of 135° F under normal plant operating conditions.

Group 1, 3 and 4 concrete structural components are not subject to local temperature greater 200° F. Process piping operating at temperatures greater than 200° F is insulated through penetrations. The insulation in combination with compartment air circulation reduces concrete local temperature to less than 200° F. Plant operating experience has not identified elevated general and local temperature as a concern for concrete structural components.

3.5.2.2.2.4 Aging Management of Inaccessible Areas for Group 6 Structures

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 Hope Creek, RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to manage increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, and loss of material due to corrosion of

embedded steel in accessible areas of water-control structures (Group 6 structures). Evaluation of inaccessible areas follows.

Inaccessible below-grade reinforced concrete for Group 6 structures is subject to an aggressive environment. Test results for groundwater and river water samples taken in 2008 and 2009 showed pH limits are above the threshold limit pH > 5.5, and sulfates are lower than the threshold limit sulfates <1500 ppm and this would indicate a non- aggressive environment. Chlorides exceed the threshold limit chlorides < 500 ppm which indicates an aggressive environment. The ground water and river water are considered aggressive environments due to chloride levels.

Hope Creek will continue periodic groundwater testing and will examine exposed portions of the below-grade concrete, when excavated for any reason. Also the results of 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 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 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 concrete components and used as a leading indicator for the potential degradation to below-grade concrete structures. If the aging effects are significant for submerged concrete structures, corrective actions will be initiated to evaluate inaccessible concrete and determine if excavation to exposure and inspect the concrete is warranted. In addition, Hope Creek will inspect inaccessible concrete if excavated for any reason in accordance with RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33. Groundwater chemistry will be periodically monitored as required by the Structures Monitoring Program, B.2.1.32. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, and the Structures Monitoring Programs consists of periodic visual inspections, by qualified individuals, to identify and evaluate degradations of structures and components due to concrete deterioration such that there is no loss of structure or component intended function. This will ensure that the design basis remains valid through the period of extended operation. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, and the Structures Monitoring Program are described in Appendix B.

Components in the 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 this system. The Buried Non-Steel Piping Inspection program manages the buried piping and components that are not included in the Buried Piping Inspection program. The Buried Non-Steel Piping Inspection program manages piping and components that are exposed an external soil environment for cracking, loss of bond, increase in porosity and permeability and loss of material. These aging effects will be monitored and identified through visual inspections of the external surfaces of the piping and components. Inspection of buried components identifies coating degradation, if coated, or base metal corrosion, if uncoated. These inspections assure that existing environmental conditions are not causing material degradation that could result in a loss of component intended functions. The Buried Non-Steel Piping Inspection program is 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 Hope Creek, RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, 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.

   Hope Creek is located in severe weathering conditions. As a result loss of material (spalling, scaling) and cracking due to freeze-thaw are applicable to Group 6 structures. However, these concrete structures are designed and constructed in accordance with ACI 318-71 and ACI 301-72. The design provides for low permeability and adequate air entrainment (3% - 6%) such that the concrete is not susceptible to freeze-thaw aging effects. Concrete mixes have approximately 15 to 30 percent pozzolan by weight as cement replacement. Air entraining admixtures conform to ASTM C 260, and water reducing and retarding admixtures conform to ASTM C 494 for types A and D. Mixing water was controlled so as not to contain more than 250 ppm of chlorides or 1000 ppm of sulfates. Concrete mix and proportions of ingredients provide required concrete strength, durability, and unit weight while maintaining adequate workability and proper consistency to permit required consolidation without excessive segregation or bleeding. Compression tests conform to ASTM Specifications C 39, C 138, and C 143. The specified compressive strength for structural concrete of Group 6 structures is 4000 psi at 90 days. These measures provide a concrete with good freeze-thaw resistance.

   As described above, the design and construction of reinforced concrete for Group 6 structures is in accordance with ACI specifications that preclude significant loss of material (spallng, scaling) and cracking due to freeze-thaw.

Operating experience review has not identified significant loss of material and cracking of reinforced concrete in Group 6 structures.

Therefore, loss of material (spalling, scaling), and cracking due to freeze-thaw of inaccessible reinforced concrete are insignificant and require no aging management. However, inaccessible reinforced concrete will be inspected if excavated for any reason, as required by the Hope Creek Structures Monitoring Program, B.2.1.32. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, and the Structures Monitoring Program 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 to Hope Creek. Concrete specifications require Type II; low alkali cement shall be used. Alkali content is limited to 0.6 percent total alkali and testing of aggregates performed in accordance with ASTM C 289 and C 295 demonstrate no potential for alkali reactivity for the aggregate, see discussion below.

   For Item Number 3.5.1-37, RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used at Hope Creek to manage loss of strength due to leaching of calcium hydroxide of reinforced concrete components that have a flowing water environment in accessible and inaccessible areas of water-control structures (Group 6 structures). Leaching is a potential aging mechanism applicable to submerged portions of Group 6 structures exposed to flowing water. These areas are accessible for inspections when dewatered. Evaluation of inaccessible areas follows.

   Reinforced concrete for Hope Creek Group 6 structures is designed in accordance with ACI 318-71 and constructed in accordance with ACI 301-72. The Cement is Type II, Portland cement conforming to ASTM C-150, with alkali content limited to 0.6 percent by weight. Fine and coarse aggregates conform to ASTM C 33. Concrete mixes have approximately 15 to 30 percent pozzolan by weight as cement replacement. Air-entraining admixtures conform to ASTM C 260, and water reducing and retarding admixtures conform to ASTM C 494 for types A and D. Mixing water was controlled so as not to contain more than 250 ppm of chlorides or 1000 ppm of sulfates. Concrete mix and proportions of ingredients provide required concrete strength, durability, and unit weight while maintaining adequate workability and proper consistency to permit required consolidation without excessive segregation or bleeding. Aggregates were tested in accordance with ASTM Specifications C 40, C 88, C 127, C 128, C 131, C 289, and C 295. Compression tests conform to ASTM specifications C 39, C 138, and C 143. The specified compressive strength for structural concrete of Group 6 structures is 4000 psi at 90 days. These requirements meet the intent of ACI 201.2R, Guide to Durable Concrete.

As described above, reinforced concrete for Group 6 structures is designed and constructed to meet ACI and ASTM specifications and meets the intent of ACI 201.2R. Aggregate was tested in accordance with ASTM specifications C 289, and C 295 to confirm no reaction with aggregates. Thus, further evaluation of inaccessible areas is not necessary for these aging effects.

Therefore, concrete aging effects of cracking due to expansion and reaction with aggregates and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide are insignificant and require no aging management for inaccessible concrete. Periodic inspection of submerged reinforced concrete components will be used as a leading indicator for inaccessible concrete. Inaccessible concrete will also be inspected if excavated for any reason, as required by the Hope Creek Structures Monitoring Program, B.2.1.32. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, and the Structures Monitoring Program are 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.

Item Number 3.5.1-38 is not applicable. Hope Creek does not have Group 7 and 8 structures.

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 Hope Creek, (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.2.1.32. 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 this SRP-LR.

Item Number 3.5.1-42 is not applicable to Hope Creek. Hope Creek 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 required to be 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 Analysis

The time-limited aging analyses identified below are associated with the Containments, Structures and Components:

- Section 4.5, Loss of Prestress in Concrete Containment Tendons
- Section 4.6, Fatigue of Primary Containment, Attached Piping, and Components.

3.5.3 CONCLUSION

The Primary Containment, Structures, Component Supports, and Piping and Component Insulation 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 Primary Containment, Structures, Component Supports, and Piping and Component Insulation components 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 Primary Containment, Structures, Component Supports, and Piping and Component Insulation 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 3.5.1 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	Not Applicable. It is not applicable to the Hope Creek Mark I steel containment. The containment is located in the Reactor Building. The indoor environment of the Reactor Building does not subject the containment to an aggressive environment. Also, Hope Creek containment reinforced concrete is designed and constructed to meet ACI and ASTM specifications that meets the intent of ACI 201.2R. Inaccessible concrete areas of the Reactor Building is addressed by Item Number 3.5.1-31 and Item Number 3.5.1-23 address Group 4 concrete. 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 operation.	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon	Not Applicable. It is not applicable to the Hope Creek Mark I steel containment. The containment is supported from the Reactor Building foundation and its design does not incorporate a de-watering system. The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increase stress level from settlement for the Reactor Building. See Subsection 3.5.2.2.1.2.

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
3.5.1-3	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 Hope Creek Mark I steel containment concrete foundation and sub-foundation. The foundation design does not incorporate porous concrete and a de-watering system is not used. See Subsection 3.5.2.2.1.2.

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
3.5.1-4	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. It is not applicable to the Hope Creek Mark I steel containment. The containment concrete structural components are not subject to elevated temperature. The Technical Specification and UFSAR limit the bulk air temperature inside the Drywell during normal plant operation to 135° F, with a maximum local area air temperature of 194 ° F above elevation 162'. The bulk air temperature is maintained within the Technical Specification limits by recirculating air through the Drywell Air Cooling System. See Subsection 3.5.2.2.1.3.
3.5.1-5	Steel elements: Drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor,	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.2.1.30, will be used to manage loss of material due to general, pitting and crevice corrosion of steel elements of the drywell, torus, drywell head, embedded shell, drywell support skirt, torus ring girders, downcomers, torus vent line, vent header, penetration seals and closure components. Corrosion is not significant for inaccessible areas of the Hope Creek Mark I containment. The design has no "sand bed region", and water intrusion has not been detected at the air gap drains between the Reactor Building concrete and the drywell shell. Miscellaneous steel components (catwalks, stairs,

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
	suppression chamber (as applicable)				handrails, ladders, platforms, etc.) inside the Primary Containment suppression chamber have been aligned to this line item based on material, environment and aging effect. The Structures Monitoring Program will be substituted to manage loss of material due to general, pitting and crevice corrosion of these components. See Subsection 3.5.2.2.1.4.
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	Not Applicable. This is applicable only to the liner for PWR and BWR concrete containments. It is not applicable to the Hope Creek Mark I steel containment. See Subsection 3.5.2.2.1.4.
3.5.1-7	Prestressed containment tendons	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Not Applicable. This is applicable only to PWR and BWR prestressed concrete containments. It is not applicable to the Hope Creek Mark I steel containment. See Subsection 3.5.2.2.1.5.
3.5.1-8	Steel and stainless steel elements: vent line, vent header, vent line bellows; downcomers;	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	Fatigue is a TLAA; further evaluation is documented in Subsection 3.5.2.2.1.6.
3.5.1-9	Steel, stainless steel elements,	Cumulative fatigue damage	TLAA, evaluated in accordance with 10	Yes, TLAA	Fatigue is a TLAA; further evaluation is documented in 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
	dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	(CLB fatigue analysis exists)	CFR 54.21(c)		
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 (SCC) is not an applicable aging effect/mechanism for the Primary Containment stainless steel penetration sleeves, penetration bellows, and dissimilar metal welds. The components are located in an air-indoor environment. Aging management reviews concluded SCC of stainless steel is not considered credible because stainless steel SCC requires a concentration of chloride or sulfate contaminants, which is not present in significant quantities in this environment at Hope Creek. See Subsection 3.5.2.2.1.7.
3.5.1-11	Stainless steel vent line bellows,	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examination/evaluation for bellows assemblies and	Yes, detection of aging effects is to be evaluated	Not Applicable. Stress corrosion cracking (SCC) is not an applicable aging effect/mechanism for the vent line stainless steel bellows. The bellows are located in an air-indoor environment. Aging management reviews concluded SCC of stainless steel is not considered credible because stainless steel SCC requires a concentration of chloride or sulfate contaminants, which is not present in

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
			dissimilar metal welds.		significant quantities in this environment at Hope Creek. See Subsection 3.5.2.2.1.7.
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. Fatigue analysis exists in the Hope Creek CLB for these containment elements. Therefore cracking due to cyclic loading is a TLAA addressed by Item Number 3.5.1-9. Expansion bellows not associated with the containment are located in the Reactor Building and Yard Structures. These bellows have a design specification requirement of 2000 normal cycles. Evaluation of fatigue due to cyclic loading for these components shows the projected number of cycles for 60 years is less than the design cycles. Thus, significant cracking of the bellows due to cyclic loading is not expected to occur through the period of extended operation. Furthermore plant operating experience has not identified cracking of bellows as a concern. See Subsection 3.5.2.2.1.8
3.5.1-13	Steel, stainless steel elements, dissimilar metal welds: torus; vent line; vent header; vent line bellows; 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. Fatigue analysis exists in the Hope Creek CLB for steel, stainless steel elements, dissimilar metal welds, torus vent line, vent header, vent line bellows, downcomers. Therefore cracking due to cyclic loading is a TLAA addressed by Item Number 3.5.1-8. See Subsection 3.5.2.2.1.8.

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
3.5.1-14	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	Not Applicable. This is applicable only to PWR and BWR concrete containments. It is not applicable to the Hope Creek Mark I steel containment. 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	Not Applicable. This is applicable only to PWR and BWR concrete containments. It is not applicable to the Hope Creek Mark I steel containment. Also Hope Creek containment reinforced concrete is designed and constructed to meet ACI and ASTM specifications that meets the intent of ACI 201.2R. 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,	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE, B.2.1.28 will be used to manage loss of sealing of the containment moisture barrier (caulk) during period of extended operation, and 10 CFR Part 50, Appendix J, B.2.1.30, will be used to manage loss of sealing and leakage through containment due to deterioration of seals and gaskets.

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
		flashing, and other sealants)			
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. The 10 CFR Part 50, Appendix J, B.2.1.30, and Technical Specifications, will be used to manage loss of leak tightness in closed position due to mechanical wear of locks, hinges, closure mechanisms and other components.
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.2.1.30, will be used to manage loss of material due to general, pitting and crevice corrosion of Primary Containment steel penetration sleeves, dissimilar metal welds, personnel airlock, equipment hatch, and CRD hatch.
3.5.1-19	Steel elements: stainless steel suppression chamber shell (inner surface)	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not Applicable. Hope Creek is a Mark I steel containment. The suppression chamber (Torus) shell inner surface is carbon steel and has no stainless steel elements.
3.5.1-20	Steel elements: suppression chamber liner (interior	Loss of material due to general, pitting, and crevice	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not Applicable. This is applicable only to BWR concrete containments with suppression chamber steel liner. It is not applicable to the Hope Creek Mark I steel 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
	surface)	corrosion			
3.5.1-21	Steel elements: drywell head and downcomer pipes	Fretting or lock up due to mechanical wear	ISI (IWE)	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE, B.2.1.28, will be used to manage fretting or lock up due to mechanical wear of the drywell head and downcomers.
3.5.1-22	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion	ISI (IWL)	No	Not Applicable. The Hope Creek Primary Containment is a Mark I steel containment. It is not a prestressed concrete containment with tendons and anchorage components.
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.2.1.32, 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 components. Applicable structural groups for Hope Creek are Groups 1, 3, and 4 structures. 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.2.1.17, will be added to manage cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for concrete components for this system. See Subsection 3.5.2.2.2.1
3.5.1-24	All Groups	Increase in	Structures	Yes, if not within	Not Applicable. The component, material,

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
	except Group 6: interior and above grade exterior concrete	porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Monitoring Program	the scope of the applicant's structures monitoring program	environment, and aging effect/mechanism combination does not apply. Hope Creek does not have an aggressive chemical environment for interior and above-grade exterior concrete components. 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.2.1.32, will be used to manage loss of material due to corrosion of structural steel components including bolting in Groups 1, 3, and 4 structures. Protective coatings are not credited for managing the effects of aging of steel components. Coatings inside the Primary Containment 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.2.1.34, aging management program will manage the aging of coatings inside the Primary Containment. See Subsection 3.5.2.2.2.1.
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	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1) or for	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.32, will be used to manage loss of material (spalling, scaling) and cracking due to freeze-thaw for accessible concrete foundations.

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
			weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	inaccessible areas of plants located in moderate to severe weathering conditions (See subsection 3.5.2.2.2.2.1)	See Subsection 3.5.2.2.2.1. Further Evaluation of inaccessible areas is provided in 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 (See subsection 3.5.2.2.2.1) or concrete was not constructed as stated for inaccessible areas (See subsection 3.5.2.2.2.2.2)	Not Applicable. The aging effect/mechanism does not apply to Hope Creek Group 1 and 3 structures. Concrete specifications required the use of Type II, low alkali cement. Alkali content is limited to 0.6 percent total alkali and testing of aggregates was performed in accordance with ASTM C 289 and C 295 to demonstrate no potential for alkali reactivity with the aggregate. The Structures Monitoring Program, B.2.1.32, will be used to manage cracking of reinforced concrete in accessible areas of structures regardless of aging mechanism. See Subsection 3.5.2.2.2.1. 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	Yes, if not within the scope of the applicant's structures monitoring program (See subsection 3.5.2.2.2.1) or a de-watering system	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.32, will be used to manage cracks and distortion due to increased stress levels from settlement for structures founded on soil. Hope Creek design does not employ a de-watering system to control settlement. Components in the Fire Protection system have

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
			ensure proper functioning of the de-watering system through the period of extended operation.	is relied upon (See subsection 3.5.2.2.2.2.3)	been aligned to this item number based on material, environment and aging effect. The Fire Protection Program, B.2.1.17, will be added to manage cracks and distortion due to increased stress levels from settlement for concrete components for this system. 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 (See subsection 3.5.2.2.2.1) or a de-watering system is relied upon (See subsection 3.5.2.2.2.2.3)	Not Applicable. Hope Creek design does not employ a de-watering system to control settlement and does not include porous concrete subfoundations. 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	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 Structures Monitoring Program, B.2.1.32, will be used to manage lock-up due to wear for supports for the radial beam seats in the drywell. 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
	supports				
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.2.1.32, 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, B.2.1.32. See subsection 3.5.2.2.2.2.4 Components in the 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 cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel for reinforced concrete piping and fittings for this system.
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	Structures monitoring Program for accessible areas. None for inaccessible areas if concrete was	Yes, if concrete was not constructed as stated for inaccessible areas	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.32, will be used to manage Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in accessible areas. Hope Creek may have a flowing water environment in accessible or in inaccessible areas of exterior below grade

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
		hydroxide	constructed in accordance with the recommendations in ACI 201.2R-77.		reinforced concrete foundations for Groups 1 and 3 structures. At Hope Creek, the Portland cement conforms to ASTM C 150, Type II and 15 to 30 percent pozzolan was also used. The use of Type II cement and pozzolan result in concrete resistant to increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide. Hope Creek reinforced concrete is designed and constructed to meet ACI and ASTM specifications that meets the intent of ACI 201.2R, 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. The aging effect/mechanism does not apply to Hope Creek. Group 1, 3 and 4 concrete structural components are not subject to elevated temperature. 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	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of	Yes, plant-specific if environment is aggressive	Consistent with NUREG-1801. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to manage increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, and loss of material due to corrosion of embedded steel for concrete in accessible areas of Group 6 structures. A representative sample of below-grade concrete will be inspected, if excavated for any reason, and periodic groundwater monitoring

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
		corrosion of embedded steel	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.		and inspection of submerged concrete components will also be done. Components in the 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 this system. See Subsection 3.5.2.2.2.4.1.
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. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, 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. The aging effect/mechanism is not applicable to Hope Creek. Concrete specifications required the use of Type II, low alkali cement. Alkali content is limited to 0.6 percent total alkali and testing of aggregates was performed in accordance with ASTM C 289 and C 295 to demonstrate no potential for alkali reactivity with the aggregate. The Structures Monitoring Program, B.2.1.32, and RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to manage cracking of reinforced concrete in accessible areas of Group 6 structures regardless of aging mechanism. 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 the recommendations	Yes, if concrete was not constructed as stated for inaccessible areas	Consistent with NUREG-1801. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to manage the increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide for reinforced concrete in accessible areas of Group 6 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, that meets the intent of ACI 201.2R. Components in the Service Water System have

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
			in ACI 201.2R-77.		been aligned to this item number based on material, environment and aging effect. The Open-Cycle Cooling Water System Program, B.2.1.13, 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 this system. See Subsection 3.5.2.2.2.4.3.
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. Hope Creek does not have Group 7 and 8 structures. See Subsection 3.5.2.2.2.5.
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.2.1.32, will be used to manage loss of material due to general and pitting corrosion for support members, welds, bolted connections, and 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	Reduction in concrete anchor capacity due to local concrete degradation/	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.2.1.32, 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

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
	pads for support base plates	service-induced cracking or other concrete aging mechanisms			expansion and grouted anchors, and 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.2.1.32, will be used to manage reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading for vibration isolation elements. See subsection 3.5.2.2.2.6.
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. Hope Creek 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.2.1.31, as implemented by the Structures Monitoring Program, B.2.1.32, will be used to manage cracking due to restraint shrinkage, creep, and aggressive environment of structural masonry block walls.

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
					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.2.1.17, 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.2.1.32, will be used to manage loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) of structures.
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. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to monitor loss of material due to abrasion and cavitation for reinforced concrete 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.2.1.13, 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 this system.

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 with exceptions. Water Chemistry, B.2.1.2, and monitoring of spent fuel pool water level in accordance with technical specifications, and leakage from the leak chase channels in accordance with Hope Creek procedures, will be used to manage loss of material due to pitting and crevice corrosion of the Reactor Building spent fuel pool liner and components, in addition to the spent fuel storage racks. Cracking due to stress corrosion cracking is not an applicable aging effect since the spent fuel pool temperature is less than 140°F. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation.
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. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, B.2.1.33, will be used to monitor loss of material due to general, pitting and crevice corrosion of steel in water control structures (Group 6 structures). Protective coatings are not credited for managing the effects of aging of steel components for Group 6 structures. Components in Group 1 and Group 3 Structures and Components Supports have been aligned to this item number based on material, environment and aging effect. The Structures Monitoring Program, B.2.1.32, will be substituted to monitor

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
					loss of material due to general, pitting and crevice corrosion of steel in a water environment for these components.
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. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, 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	Consistent with NUREG-1801 with exceptions. Water Chemistry, B.2.1.2, and ASME Section XI, Subsection IWF Program, B.2.1.29, will be used to manage loss of material/general, pitting, and crevice corrosion for component supports in Treated Water environment. Exceptions apply to the NUREG-1801 recommendations for Water Chemistry program implementation.
3.5.1-50	Groups B2, and B4: galvanized steel, aluminum, stainless steel support	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	No	Consistent with NUREG-1801. The Structures Monitoring Program, B.2.1.32, will be used to manage loss of material due to pitting and crevice corrosion in Group B2, and Group B4 Component Supports. Components in the Auxiliary Systems, Engineered Safety Features, Steam and Power Conversion

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
	members; welds; bolted connections; support anchorage to building structure				Systems, Structures and Components Supports, and Electrical Components have been aligned to this item number based on material, environment and aging effect. The Open-Cycle Cooling Water System Program, B.2.1.13, Periodic Inspection Program, B.2.2.2, Aboveground Steel Tanks Program B.2.1.19, Aboveground Non-Steel Tanks Program B.2.2.3, and Fire Protection Program, B.2.1.17, will be substituted to monitor loss of material due to pitting and crevice corrosion of piping, tanks and miscellaneous mechanical components.
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	The ASME Section XI, Subsection IWF Program, B.2.1.29, will be substituted to monitor loss of material due to general corrosion for high strength low-alloy steel bolts used for Groups B1.1 component supports. Cracking due to stress corrosion cracking is not an applicable aging effect for Hope Creek Groups B1.1 component supports. Aging management reviews determined that high strength ASTM A-490 bolts (actual yield strength could be ≥150 ksi) used in NSSS Class 1 component supports (reactor pressure vessel support) are not subject to stress corrosion cracking. The bolts are not subject to high-sustained preload stress, an aggressive environment, and lubricants containing contaminants are not approved for use. Additionally, ASTM A-490 bolts have high resistance to stress corrosion cracking due to their

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
					ductility and industry and plant specific operating experience have not identified stress corrosion cracking of ASTM A-490 bolts as a concern.
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	Not Applicable. This component, material, environment, and aging effect/mechanism does not apply. Hope Creek does not have sliding support bearings and sliding support surfaces in Groups B2, and B4 component supports.
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, B.2.1.29, will be used to manage loss of material due to general and pitting corrosion in Groups B1.1, B1.2, and B1.3 component supports.
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	ISI (IWF)	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWF, B.2.1.29, 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 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
		cyclic thermal loads			
3.5.1-55	PWR Only				
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, B.2.1.29, will be used to manage loss of mechanical function in Groups B1.1, B1.2, and B1.3 sliding surfaces for component supports.
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. Hope Creek design does not have the component vibration isolation elements in Groups B1.1, B1.2, and B1.3 component supports.
3.5.1-58	Galvanized steel and aluminum support members; welds; bolted connections;	None	None	NA - No AEM or AMP	Consistent with NUREG-1801. Hope Creek aging management review concluded that galvanized steel and aluminum components exposed to an air - indoor environment have no aging effects requiring aging management.

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
	support anchorage to building structure exposed to air - indoor uncontrolled				
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. Hope Creek aging management review concluded that stainless steel components exposed to an air - indoor environment have no aging effects requiring aging management.

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

Table 3.5.2-1 Auxiliary Boiler 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	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	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	Concrete	None	None	VII.J-21	3.3.1-96	C
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

Table 3.5.2-1 Auxiliary Boiler 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	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	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

Table 3.5.2-1 Auxiliary Boiler Building (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 - 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
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

Table 3.5.2-1 Auxiliary Boiler 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	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A3-6	3.5.1-26	C
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	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
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

Table 3.5.2-1 Auxiliary Boiler 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 - 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	C
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	C
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	C
Precast 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	C
Precast 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	C

Table 3.5.2-1 Auxiliary Boiler 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	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	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)	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

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. Never the less, 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 3.5.2-2
Auxiliary Building Control/Diesel Generator Area
Summary of Aging Management Evaluation

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area

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	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
Compressible Joints and Seals (Seismic Gaps)	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 Gaps)	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 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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 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	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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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
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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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	Shielding	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	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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	Structures Monitoring Program	III.A3-5	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.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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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 - 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
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	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 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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
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	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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 - 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	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	Elastomers	Groundwater/Soil	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, 3
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 4
Penetration seals	Flood Barrier	Grout	Groundwater/Soil	Cracking/Shrinkage	Structures Monitoring Program			F, 3

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 4
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	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	Elastomers	Groundwater/Soil	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

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	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
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	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	Flood Barrier	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Flood Barrier	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	Flood Barrier	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Flood Barrier	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
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	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	HELB/MELB Shielding	Galvanized 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	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
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, 2
Pipe Whip Restraints and Jet Impingement 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	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
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	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 (Curbs)	Direct Flow	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	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-2 Auxiliary Building Control/Diesel Generator Area (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: 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
Tube Track	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. Never the less, 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. 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. Never the less 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 guidance.

Table 3.5.2-3
Auxiliary Building Service/Radwaste Area
Summary of Aging Management Evaluation

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Blowout Panel	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	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
Blowout Panel	Missile Barrier	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Blowout Panel	Missile Barrier	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	Pressure Relief	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	Pressure Relief	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	Pressure Relief	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Blowout Panel	Pressure Relief	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Blowout Panel	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
Blowout Panel	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Blowout Panel	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 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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	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
Compressible Joints and Seals (Seismic Gaps)	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 Gaps)	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
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 3.5.2-3 Auxiliary Building Service/Radwaste Area (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 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 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	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	Shielding	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	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	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: Above-grade exterior	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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: Below-grade exterior	Water retaining boundary	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 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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
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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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: Foundation	Water retaining boundary	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 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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
Concrete: Interior	Water retaining boundary	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 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	Water retaining boundary	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	HELB/MELB Shielding	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 - 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
Doors	Water retaining boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Doors	Water retaining boundary	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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.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	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 - 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	Shielding	Lead Blocks	Air - Indoor	None	None			F, 3
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	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 3.5.2-3 Auxiliary Building Service/Radwaste Area (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Metal components: Steel curb	Direct Flow	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	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	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
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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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	Elastomers	Groundwater/Soil	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, 4
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 4

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Groundwater/Soil	Cracking/Shrinkage	Structures Monitoring Program			F, 4
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, 5
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	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	Elastomers	Groundwater/Soil	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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
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	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	Flood Barrier	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Flood Barrier	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	Flood Barrier	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Flood Barrier	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (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	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	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	HELB/MELB Shielding	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	HELB/MELB Shielding	Galvanized 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	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
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, 2

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
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	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
Spray Shields	Shelter, Protection	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	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

Table 3.5.2-3 Auxiliary Building Service/Radwaste Area (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Tube Track	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. Never the less, 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. Based on plant operating experience, there are no aging effects requiring management for this material and environment combination.

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. Never less the aging effect will be monitored through the Structures Monitoring Program.

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

Table 3.5.2-4
Component Supports Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-4 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 Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.1-13	3.5.1-53	C
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 > 150 ksi	Air - Indoor	Loss of Material/General Corrosion	ASME Section XI, Subsection IWF	III.B1.1-4	3.5.1-51	E, 1, 2

Table 3.5.2-4 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 Low Alloy Steel Bolting with Yield Strength > 150 ksi	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF	VII.I-5	3.3.1-45	E, 1, 2, 3
Supports for ASME Class 1 Piping and Components (Sliding surfaces)	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
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 and Pitting 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 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
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, 3

Table 3.5.2-4 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	Galvanized Steel	Air - Indoor	None	None	III.B1.1-7	3.5.1-58	A
Supports for ASME Class 1 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	ASME Section XI, Subsection IWF	VII.I-5	3.3.1-45	E, 1, 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
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, 3

Table 3.5.2-4 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 (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
Supports for ASME Class 2 and 3 Piping and Components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	C
Supports for ASME Class 2 and 3 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.B1.2-2	3.5.1-54	A

Table 3.5.2-4 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 (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 Piping and Components (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
Supports for ASME Class 2 and 3 Piping and Components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	C
Supports for ASME Class 2 and 3 Piping and Components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	D
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.2-10	3.5.1-53	C

Table 3.5.2-4 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 (Sliding surfaces)	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	C
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	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 Piping and Components (Sliding surfaces)	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	C
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	Structural Support	Carbon Steel	Treated Water	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	ASME Section XI, Subsection IWF			G
Supports for ASME Class 2 and 3 Piping and Components (Sliding surfaces)	Structural Support	Carbon Steel	Treated Water	Loss of Mechanical Function/Corrosion, Distortion, Dirt, Overload, Fatigue due to Vibratory and Cyclic Thermal Loads	Water Chemistry			G

Table 3.5.2-4 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 (Sliding surfaces)	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.B1.2-3	3.5.1-56	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 - Indoor	Loss of Material/General and Pitting 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	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A

Table 3.5.2-4 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	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
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, 3

Table 3.5.2-4 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, 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	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A

Table 3.5.2-4 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	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
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	Treated Water	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			G, 1, 3
Supports for ASME Class 2 and 3 Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B1.2-5	3.5.1-58	A

Table 3.5.2-4 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	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF	VII.I-5	3.3.1-45	E, 1, 3
Supports for ASME Class 2 and 3 Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Nickel Alloy Bolting	Water - Flowing	Loss of Material/Galvanic Corrosion	ASME Section XI, Subsection IWF			J, 4
Supports for ASME Class 2 and 3 Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Nickel Alloy Bolting	Water - Flowing	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF			F, 1

Table 3.5.2-4 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 - 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 Bolting	Air - Indoor	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			H, 1, 3
Supports for ASME Class MC 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.B1.3-1	3.5.1-40	A
Supports for ASME Class MC Components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.3-10	3.5.1-53	C

Table 3.5.2-4 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 MC 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.B1.3-2	3.5.1-54	A
Supports for ASME Class MC Components (Sliding surfaces)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.3-10	3.5.1-53	C
Supports for ASME Class MC Components (Sliding surfaces)	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			F
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	ASME Section XI, Subsection IWF	III.B1.3-10	3.5.1-53	A
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A

Table 3.5.2-4 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 MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
Supports for ASME Class MC 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.B1.3-10	3.5.1-53	A
Supports for ASME Class MC 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, 3
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A

Table 3.5.2-4 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 MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Treated Water	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			G, 1, 3
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B1.3-7	3.5.1-59	A
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A

Table 3.5.2-4 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 MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Treated Water	Loss of Material/Pitting and Crevice Corrosion	ASME Section XI, Subsection IWF	III.B1.1-11	3.5.1-49	A
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.B1.1-11	3.5.1-49	B
Supports for ASME Class MC Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Treated Water	Loss of Preload/Self-Loosening	ASME Section XI, Subsection IWF			G, 1, 3

Table 3.5.2-4 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 (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 3.5.2-4 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 and Pitting 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	Water - Flowing	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	E, 5

Table 3.5.2-4 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 - 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, 3, 5
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

Table 3.5.2-4 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 Preload/Self-Loosening	Structures Monitoring Program			H, 3, 5
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/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	A

Table 3.5.2-4 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 - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 3, 5
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/General, 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, 3, 5

Table 3.5.2-4 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 - 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 Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 3, 5

Table 3.5.2-4 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 3.5.2-4 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 and Pitting 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 Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	A

Table 3.5.2-4 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 Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 3, 5
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

Table 3.5.2-4 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, 3, 5
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Vibration isolation elements)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	C
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc Mechanical Equipment (Vibration isolation elements)	Structural Support	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

Table 3.5.2-4 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 (Vibration isolation elements)	Vibration Isolation	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	Structures Monitoring Program	III.B4-10	3.5.1-39	C
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, 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 3.5.2-4 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, 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, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General and Pitting Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, 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

Table 3.5.2-4 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, 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 and Pitting Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, 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, 3, 5
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, 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 3.5.2-4 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, 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, 3, 5
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, 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, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.B5-7	3.5.1-39	A

Table 3.5.2-4 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, 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, 3, 5
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, and Other Misc Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	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, 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, 3, 5

Table 3.5.2-4 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 3.5.2-4 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 and Pitting 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 and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General and Pitting Corrosion	Structures Monitoring Program	III.B3-7	3.5.1-39	A

Table 3.5.2-4 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 - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 3, 5
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, 3, 5

Table 3.5.2-4 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 - 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/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	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	VII.I-5	3.3.1-45	E, 3, 5

Table 3.5.2-4 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/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	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	Structures Monitoring Program			H, 3, 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. ASME Section XI, Subsection IWF is the applicable aging management program for this component.

2. NSSS Class 1 component supports (reactor pressure vessel support) utilize high strength ASTM A490 bolts (actual yield strength could be greater than or equal to 150 ksi). The bolts are not subject to high-sustained preload stress, aggressive environment, and lubricants containing contaminants not approved for use. Additionally ASTM A490 bolts have high resistance to stress corrosion cracking due to their ductility and industry and plant specific operating experience have not identified stress corrosion cracking of ASTM A490 bolts as a concern. 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. They are monitored for loss of material due to corrosion and loss of preload by visual inspection using the ASME Section XI, Subsection IWF.

3. 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. Never the less, loss of preload/self-loosening will be monitored through the applicable aging management program.

4. Based on industry operating experience, galvanic corrosion has occurred for this material and the ASME Section XI, Subsection IWF is the applicable aging management program for this component.

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

Table 3.5.2-5
Fire Water Pump House
Summary of Aging Management Evaluation

Table 3.5.2-5 Fire Water 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	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
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: 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

Table 3.5.2-5 Fire Water 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	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
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

Table 3.5.2-5 Fire Water 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	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	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	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Doors	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Doors	Shelter, Protection	Fiberglass	Air - Indoor	None	None			F, 2
Doors	Shelter, Protection	Fiberglass	Air - Outdoor	None	None			F, 2
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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-5 Fire Water 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
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
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, 3
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, 3
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
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, 3

Table 3.5.2-5 Fire Water 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	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, 3
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	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.)	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
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

Table 3.5.2-5 Fire Water 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
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, 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 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, 6
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

Table 3.5.2-5 Fire Water 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
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, 6
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, 6
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 7
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	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-5 Fire Water 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
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

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. Never the less, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

2. Based on plant operating experience, there are no aging effects requiring management for this material and environment combination.

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

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. Never less the aging effect will be monitored through the Structures Monitoring Program.

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

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

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

Table 3.5.2-6
Piping and Component Insulation Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-6 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	"Min-K"	Air - Indoor	None	None			J, 1
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	Cellular glass	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	Ceramic Fiber	Air - Indoor	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 (Molded)	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	NUKON	Air - Indoor	None	None			J, 1
Insulation	Thermal Insulation	Stainless Steel (Mirror Insulation)	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 2
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Shelter, Protection	Fiberglass cloth	Air - Indoor	None	None			J, 1

Table 3.5.2-6 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, tie wires, straps, clips)	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Structural Support	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Periodic Inspection	III.B2-7	3.5.1-50	E, 2
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Structural Support	Fiberglass cloth	Air - Indoor	None	None			J, 1
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Insulation jacketing (includes wire mesh, tie wires, straps, clips)	Structural Support	Stainless Steel	Air - Indoor	None	None	III.B5-5	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 plant operating experience, there are no aging effects requiring management for this material and environment combination.
2. The Periodic Inspection program is the applicable aging management program for this component.

Table 3.5.2-7
Primary Containment
Summary of Aging Management Evaluation

Table 3.5.2-7 Primary Containment

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	V.E-4	3.2.1-23	E, 1
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)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	V.E-4	3.2.1-23	E, 1
Bolting (Containment Closure)	Structural Support	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)	Structural Support	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 (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, 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, 3
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	Structures Monitoring Program	IV.C2-8	3.1.1-52	E, 2, 3

Table 3.5.2-7 Primary Containment (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Cable Trays	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Coatings	Maintain Adhesion	Paint	Air - Indoor	Cracking, blistering, flaking, peeling, and delamination	Protective Coating Monitoring and Maintenance Program			J
Coatings	Maintain Adhesion	Paint	Treated Water	Cracking, blistering, flaking, peeling, and delamination	Protective Coating Monitoring and Maintenance Program			J
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	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	Concrete	None	None	VII.J-21	3.3.1-96	C
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 (Biological shield)	Shielding	Concrete	Encased in Steel	None	None			G, 4
Concrete: Interior (Biological shield)	Shielding	Concrete (High Density)	Encased in Steel	None	None			G, 4
Concrete: Interior (Biological shield)	Shielding	Grout (High Density)	Encased in Steel	None	None			F, 4
Concrete: Interior (Biological shield)	Structural Support	Concrete	Encased in Steel	None	None			G, 4
Concrete: Interior (Biological shield)	Structural Support	Concrete (High Density)	Encased in Steel	None	None			G, 4
Concrete: Interior (Biological shield)	Structural Support	Grout (High Density)	Encased in Steel	None	None			F, 4

Table 3.5.2-7 Primary Containment (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 (RPV Pedestal)	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
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	Shielding	Boron Concrete	Encased in Steel	None	None			F, 4
Doors	Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Hatches/Plugs	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-6	3.5.1-18	C
Hatches/Plugs	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-6	3.5.1-18	C
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-6	3.5.1-18	C
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-6	3.5.1-18	C
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	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	II.B1.1-2	3.5.1-5	E, 3
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

Table 3.5.2-7 Primary Containment (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	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
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	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	C
Penetration bellows	Expansion / Separation	Stainless Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration bellows	Pressure Boundary	Stainless Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration seals (End Caps)	Pressure Boundary	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	C
Penetration seals (End Caps)	Pressure Boundary	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	C
Penetration sleeves	Pressure Boundary	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration sleeves	Pressure Boundary	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-1	3.5.1-18	A

Table 3.5.2-7 Primary Containment (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	Pressure Boundary	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-1	3.5.1-18	A
Penetration sleeves	Pressure Boundary	Stainless Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration sleeves	Shelter, Protection	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration sleeves	Shelter, Protection	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-1	3.5.1-18	A
Penetration sleeves	Shelter, Protection	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-1	3.5.1-18	A
Penetration sleeves	Shelter, Protection	Stainless Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration sleeves	Structural Support	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Penetration sleeves	Structural Support	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-1	3.5.1-18	A
Penetration sleeves	Structural Support	Carbon Steel; Dissimilar Metal Welds	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-1	3.5.1-18	A
Penetration sleeves	Structural Support	Stainless Steel; Dissimilar Metal Welds	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B4-4	3.5.1-9	A, 5
Personnel airlock, equipment hatch, CRD hatch	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-6	3.5.1-18	A

Table 3.5.2-7 Primary Containment (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Personnel airlock, equipment hatch, CRD hatch	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-6	3.5.1-18	A
Personnel airlock, equipment hatch, CRD hatch	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B4-6	3.5.1-18	A
Personnel airlock, equipment hatch, CRD hatch	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B4-6	3.5.1-18	A
Personnel airlock, equipment hatch, CRD 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.B4-5	3.5.1-17	A, 6
Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	C
Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	C
Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	Structural Support	Carbon Steel	Air - Indoor	Loss of Leaktightness/ Mechanical Wear of Locks, Hinges and Closure Mechanisms	10 CFR Part 50, Appendix J	II.B4-5	3.5.1-17	A, 6
Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	C

Table 3.5.2-7 Primary Containment (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	C
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	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	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.B4-7	3.5.1-16	A, 7
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: Biological shield lateral truss	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Biological shield liner plates	Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Biological shield liner plates	Shielding	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Biological shield liner plates	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Biological shield liner plates	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-7 Primary Containment (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: Radial beam seats in BWR Drywell	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Radial beam seats in BWR Drywell	Structural Support	Lubrite	Air - Indoor	Lock-up/ wear	Structures Monitoring Program	III.A4-6	3.5.1-30	A
Steel Components: Sump Liners	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Sump Liners	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Sump Liners	Structural Support	Carbon Steel	Raw Water	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A6-11	3.5.1-47	E, 3
Steel Components: Sump Liners	Water retaining boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	3.5.1-25	A
Steel Components: Sump Liners	Water retaining boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Sump Liners	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	E, 3
Steel Elements: Drywell head; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Fretting or Lockup/Mechanical Wear	ASME Section XI, Subsection IWE	II.B1.1-1	3.5.1-21	A
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A

Table 3.5.2-7 Primary Containment (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: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A

Table 3.5.2-7 Primary Containment (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: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Elements: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A

Table 3.5.2-7 Primary Containment (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: Drywell; Torus; Drywell Head; Embedded shell; Drywell support skirt; Torus ring girder; Downcomers	Structural Support	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Expansion / Separation	Stainless Steel	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B1.1-4	3.5.1-8	A, 5
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B1.1-4	3.5.1-8	A, 5
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	10 CFR Part 50, Appendix J	II.B1.1-2	3.5.1-5	A

Table 3.5.2-7 Primary Containment (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: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	ASME Section XI, Subsection IWE	II.B1.1-2	3.5.1-5	A
Steel Elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	Pressure Boundary	Stainless Steel	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B1.1-4	3.5.1-8	A, 5
Thermowell	Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	VII.I-8	3.3.1-58	E, 3
Thermowell	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	One-Time Inspection	VII.E4-17	3.3.1-17	A
Thermowell	Pressure Boundary	Carbon Steel	Treated Water	Loss of Material/General, Pitting and Crevice Corrosion	Water Chemistry	VII.E4-17	3.3.1-17	B
Thermowell	Pressure Boundary	Stainless Steel	Air - Indoor	None	None	VII.J-15	3.3.1-94	A
Thermowell	Pressure Boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VII.A4-11	3.3.1-24	A
Thermowell	Pressure Boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A4-11	3.3.1-24	B
Tube Track	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A4-5	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. 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. Never the less, loss of preload/self-loosening will be monitored through the Structures Monitoring Program.

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

4. Concrete or Concrete (High Density) or Grout (High Density) or Boron Concrete encased in steel is protected from environments that promote age related degradations.

5. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.6.

6. Primary containment leakage is controlled in accordance with Hope Creek Technical Specifications.

7. 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 Section XI Code.

Table 3.5.2-8
Reactor Building
Summary of Aging Management Evaluation

Table 3.5.2-8 Reactor 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	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Blowout Panel	Pressure Relief	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Blowout Panel	Pressure Relief	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Blowout Panel	Pressure Relief	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Blowout Panel	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Blowout Panel	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Blowout Panel	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Blowout Panel	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
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.A1-12	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

Table 3.5.2-8 Reactor 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 - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	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.A1-12	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
Compressible Joints and Seals (Inflatable Pool Seals)	Water retaining boundary	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
Compressible Joints and Seals (Inflatable Pool Seals)	Water retaining boundary	Elastomer	Air/Gas - Dry (Internal)	Hardening and Loss of Strength/Elastomer Degradation	Structures Monitoring Program	VII.F3-7	3.3.1-11	E, 2
Compressible Joints and Seals (Inflatable Pool Seals)	Water retaining boundary	Elastomer	Treated Water	Hardening and Loss of Strength/Elastomer Degradation	Structures Monitoring Program	VII.A4-1	3.3.1-12	E, 2
Compressible Joints and Seals (Seismic Gaps)	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 Gaps)	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 3.5.2-8 Reactor 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.A1-12	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.A1-12	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 Curbs	Direct Flow	Concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-9	3.5.1-23	A
Concrete Curbs	Direct Flow	Concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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.A1-12	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	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.A1-9	3.5.1-23	A

Table 3.5.2-8 Reactor 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	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-6	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.A1-9	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.A1-3	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.A1-6	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.A1-9	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.A1-3	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.A1-6	3.5.1-26	A
Concrete: Above-grade exterior	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-9	3.5.1-23	A

Table 3.5.2-8 Reactor 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	Shielding	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Above-grade exterior	Shielding	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A1-6	3.5.1-26	A
Concrete: Above-grade exterior	Structural Pressure Boundary	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-9	3.5.1-23	A
Concrete: Above-grade exterior	Structural Pressure Boundary	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Above-grade exterior	Structural Pressure Boundary	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A1-6	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.A1-9	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.A1-3	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.A1-6	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.A1-4	3.5.1-31	A

Table 3.5.2-8 Reactor 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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-5	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.A1-7	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.A1-4	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.A1-3	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.A1-5	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.A1-7	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.A1-4	3.5.1-31	A

Table 3.5.2-8 Reactor 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	Groundwater/Soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-5	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.A1-7	3.5.1-32	A
Concrete: Below-grade exterior	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-4	3.5.1-31	A
Concrete: Below-grade exterior	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Below-grade exterior	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A1-5	3.5.1-31	A
Concrete: Below-grade exterior	Structural Pressure Boundary	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A1-7	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.A1-4	3.5.1-31	A

Table 3.5.2-8 Reactor 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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-5	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.A1-7	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.A1-4	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.A1-3	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.A1-5	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.A1-7	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.A1-4	3.5.1-31	A

Table 3.5.2-8 Reactor 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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-5	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.A1-7	3.5.1-32	A
Concrete: Foundation	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-4	3.5.1-31	A
Concrete: Foundation	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Foundation	Structural Pressure Boundary	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program	III.A1-5	3.5.1-31	A
Concrete: Foundation	Structural Pressure Boundary	Reinforced concrete	Water - flowing	Increase in Porosity and Permeability, Loss of Strength/ Leaching of Calcium Hydroxide	Structures Monitoring Program	III.A1-7	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.A1-4	3.5.1-31	A

Table 3.5.2-8 Reactor 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	Groundwater/Soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-5	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.A1-7	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.A1-9	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.A1-3	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.A1-9	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.A1-3	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.A1-9	3.5.1-23	A

Table 3.5.2-8 Reactor 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	Missile Barrier	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-9	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.A1-3	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.A1-9	3.5.1-23	A
Concrete: Interior	Shielding	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Interior	Structural Pressure Boundary	Reinforced concrete	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-9	3.5.1-23	A
Concrete: Interior	Structural Pressure Boundary	Reinforced concrete	Air - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	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.A1-9	3.5.1-23	A

Table 3.5.2-8 Reactor 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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A1-3	3.5.1-28	A
Concrete: Interior	Structural Support	Reinforced concrete	Encased in Steel	None	None			G, 3
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.A1-12	3.5.1-25	A
Doors	Flood Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Structural Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Doors	Structural Pressure Boundary	Carbon Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A

Table 3.5.2-8 Reactor 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.A1-9	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.A1-3	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.A1-9	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.A1-9	3.5.1-23	A
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.A1-9	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.A1-6	3.5.1-26	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.A1-9	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.A1-9	3.5.1-23	A

Table 3.5.2-8 Reactor 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 - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program	III.A1-6	3.5.1-26	A
Hatches/Plugs	Shielding	Concrete block	Air - Indoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)/Corrosion of Embedded Steel	Structures Monitoring Program	III.A1-9	3.5.1-23	C
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.A1-9	3.5.1-23	A
Hatches/Plugs	Shielding	Reinforced concrete	Encased in Steel	None	None			G, 3
Hatches/Plugs	Shielding	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	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.A1-9	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.A1-9	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.A1-6	3.5.1-26	A
Metal decking	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Metal panels	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Metal panels	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A

Table 3.5.2-8 Reactor 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	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	Treated Water	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VII.A4-5	3.3.1-24	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Aluminum	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A4-5	3.3.1-24	D
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.A1-12	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.A1-12	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.A1-12	3.5.1-25	A

Table 3.5.2-8 Reactor 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	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration bellows (HELB/MELB Shielding)	Flood Barrier	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration bellows (HELB/MELB Shielding)	HELB/MELB Shielding	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration bellows (HELB/MELB Shielding)	Shelter, Protection	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Penetration bellows (HELB/MELB Shielding)	Structural Pressure Boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C

Table 3.5.2-8 Reactor 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	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	Elastomers	Groundwater/Soil	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, 4
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 4
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 5
Penetration seals	Flood Barrier	Grout	Groundwater/Soil	Cracking/Shrinkage	Structures Monitoring Program			F, 4
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, 5

Table 3.5.2-8 Reactor 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	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	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	Elastomers	Groundwater/Soil	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

Table 3.5.2-8 Reactor 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	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)/ Aggressive Chemical Attack	Structures Monitoring Program			F, 5
Penetration seals	Structural Pressure Boundary	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	Structural Pressure Boundary	Grout	Air - Indoor	Cracking/Shrinkage	Structures Monitoring Program			F, 4
Penetration sleeves	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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.A1-12	3.5.1-25	A
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	Flood Barrier	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Flood Barrier	Galvanized Steel	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Penetration sleeves	Flood Barrier	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Flood Barrier	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

Table 3.5.2-8 Reactor 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	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Penetration sleeves	HELB/MELB Shielding	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	A
Penetration sleeves	HELB/MELB Shielding	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	HELB/MELB Shielding	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Penetration sleeves	Structural Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Structural Pressure Boundary	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Structural Pressure Boundary	Galvanized 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.A1-12	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.A1-12	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, 2
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.A1-12	3.5.1-25	A
Penetration sleeves	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-8 Reactor 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	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
Pipe Whip Restraints and Jet Impingement Shields	HELB/MELB Shielding	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Pipe Whip Restraints and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	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)	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)	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

Table 3.5.2-8 Reactor 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 - 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
Spent fuel pool gates	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Spent fuel pool gates	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	B, 6
Spray Shields	Shelter, Protection	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Spray Shields	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Steel Components: All structural steel	Missile Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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.A1-12	3.5.1-25	A
Steel Components: All structural steel	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Fuel pool liners	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Steel Components: Fuel pool liners	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel Components: Fuel pool liners	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	B, 7
Steel Components: Reactor Building dome liner	Structural Pressure Boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A

Table 3.5.2-8 Reactor 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: Reactor Building dome liner	Structural Pressure Boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Reactor Building dome liner	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Steel Components: Reactor Building dome liner	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Reactor Well, Dryer and Separator Pool and Cask Loading Pit liners	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Steel Components: Reactor Well, Dryer and Separator Pool and Cask Loading Pit liners	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel Components: Reactor Well, Dryer and Separator Pool and Cask Loading Pit liners	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	B, 8
Steel Components: Refueling bellows (RPV to Drywell and Drywell to Reactor Well)	Water retaining boundary	Stainless Steel	Air - Indoor	Cumulative Fatigue Damage/Fatigue	TLAA	II.B1.1-4	3.5.1-8	C, 9
Steel Components: Refueling bellows (RPV to Drywell and Drywell to Reactor Well)	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	III.A5-13	3.5.1-46	D, 8

Table 3.5.2-8 Reactor 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: Skimmer Surge Tank liner	Water retaining boundary	Stainless Steel	Air - Indoor	None	None	III.B5-5	3.5.1-59	C
Steel Components: Skimmer Surge Tank liner	Water retaining boundary	Stainless Steel	Concrete	None	None	VII.J-17	3.3.1-96	C
Steel Components: Skimmer Surge Tank liner	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VII.A4-11	3.3.1-24	C
Steel Components: Skimmer Surge Tank liner	Water retaining boundary	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A4-11	3.3.1-24	D
Steel Components: Skimmer Surge Tank screen	Filter	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	One-Time Inspection	VII.A4-11	3.3.1-24	C
Steel Components: Skimmer Surge Tank screen	Filter	Stainless Steel	Treated Water	Loss of Material/Pitting and Crevice Corrosion	Water Chemistry	VII.A4-11	3.3.1-24	D
Steel Components: Sump Liners	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Steel Components: Sump Liners	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Sump Liners	Water retaining boundary	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	3.5.1-25	A
Steel Components: Sump Liners	Water retaining boundary	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Steel Components: Sump Liners	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	E, 2
Tube Track	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	Structures Monitoring Program	III.A1-12	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. Never the less, 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. 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. Never the less the aging effect will be monitored through the Structures Monitoring Program.

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

6. The spent fuel pool water level is monitored in accordance with technical specifications.

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. Reactor well refueling water level is monitored in accordance with technical specifications.

9. The TLAA designation in the Aging Management Program column indicates fatigue of this component is evaluated in Section 4.7

Table 3.5.2-9
Service Water Intake Structures
Summary of Aging Management Evaluation

Table 3.5.2-9 Service Water Intake 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	Aluminum Bolting	Air - Indoor	Loss of Preload/Self-Loosening	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	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
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Water - Flowing	Loss of Preload/Self-Loosening	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 1

Table 3.5.2-9 Service Water Intake Structures (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	Galvanized Steel Bolting	Air - Indoor	Loss of Preload/Self-Loosening	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	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	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	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload/Self-Loosening	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			H, 1
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	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
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Water - Flowing	Loss of Preload/Self-Loosening	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants			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	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 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
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	Carbon and Low Alloy Steel Bolting	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 3.5.2-9 Service Water Intake 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 embedments (including Traveling Water Screens support)	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 (including Traveling Water Screens support)	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
Concrete embedments (including Traveling Water Screens support)	Structural Support	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Concrete embedments (including Traveling Water Screens support)	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
Concrete embedments (including Traveling Water Screens support)	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Concrete embedments (including Traveling Water Screens support)	Structural Support	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
Concrete embedments (including Traveling Water Screens support)	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C

Table 3.5.2-9 Service Water Intake 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 embedments (including Traveling Water Screens support)	Structural Support	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
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	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, 2
Concrete: Above-grade exterior	Flood Barrier	Reinforced concrete	Water - Flowing	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	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, 2
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

Table 3.5.2-9 Service Water Intake 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	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: 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	Missile Barrier	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, 2
Concrete: Above-grade exterior	Missile Barrier	Reinforced concrete	Water - Flowing	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	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, 2
Concrete: Above-grade exterior	Missile 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 3.5.2-9 Service Water Intake 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	Missile 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: 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
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	Shelter, Protection	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, 2
Concrete: Above-grade exterior	Shelter, Protection	Reinforced concrete	Water - Flowing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A6-4	3.5.1-28	A
Concrete: Above-grade exterior	Shelter, Protection	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, 2
Concrete: Above-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

Table 3.5.2-9 Service Water Intake 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	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: 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: Above-grade exterior	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, 2
Concrete: Above-grade exterior	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: Above-grade exterior	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, 2
Concrete: Above-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 3.5.2-9 Service Water Intake 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	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
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, 2
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
Concrete: Below-grade exterior	Missile 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, 2
Concrete: Below-grade exterior	Missile 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	Missile 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

Table 3.5.2-9 Service Water Intake 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	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	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, 2
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, 2
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

Table 3.5.2-9 Service Water Intake 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	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	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, 2
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, 2
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

Table 3.5.2-9 Service Water Intake 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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-6	3.5.1-37	A
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, 2
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	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, 2
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
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, 2

Table 3.5.2-9 Service Water Intake 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	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	Flood Barrier	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, 2
Concrete: Interior	Flood Barrier	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	Flood Barrier	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, 2
Concrete: Interior	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 3.5.2-9 Service Water Intake 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	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: Interior	Missile 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	Missile 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	Missile Barrier	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, 2
Concrete: Interior	Missile Barrier	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	Missile Barrier	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, 2
Concrete: Interior	Missile 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: Interior	Missile 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

Table 3.5.2-9 Service Water Intake 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	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	Shelter, Protection	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, 2
Concrete: Interior	Shelter, Protection	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	Shelter, Protection	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, 2
Concrete: Interior	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: Interior	Shelter, Protection	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	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 3.5.2-9 Service Water Intake 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	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, 2
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, 2
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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	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

Table 3.5.2-9 Service Water Intake Structures (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	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
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, 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	Missile 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	Missile 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

Table 3.5.2-9 Service Water Intake 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.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
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	Missile 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	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
Hatches/Plugs	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
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

Table 3.5.2-9 Service Water Intake 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	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
Hatches/Plugs	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
Hatches/Plugs	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
Hatches/Plugs	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
Ice Barrier	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	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	Shelter, Protection	Treated Wood	Air - Outdoor	Change in Material Properties, Loss of Material/Moisture Damage, Insect Damage	Structures Monitoring Program			J

Table 3.5.2-9 Service Water Intake Structures (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	Shelter, Protection	Treated Wood	Water - Flowing	Change in Material Properties, Loss of Material/Moisture Damage, Insect Damage	Structures Monitoring Program			J
Metal decking	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Metal decking	Structural Support	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	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
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	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
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
Panels, Racks, Cabinets, and Other Enclosures	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
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, 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
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-9 Service Water Intake Structures (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	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	Elastomers	Groundwater/Soil	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, 3
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Cracking/Shrinkage	Structures Monitoring Program			F, 3
Penetration seals	Flood Barrier	Grout	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking/Freeze-thaw	Structures Monitoring Program			F, 2
Penetration seals	Flood Barrier	Grout	Groundwater/Soil	Cracking/Shrinkage	Structures Monitoring Program			F, 3
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, 2

Table 3.5.2-9 Service Water Intake Structures (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 - 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	Elastomers	Groundwater/Soil	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, 2
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, 2
Penetration sleeves	Flood Barrier	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Table 3.5.2-9 Service Water Intake Structures (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	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
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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.C1-18	3.3.1-19	E, 4
Penetration sleeves	Flood Barrier	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
Penetration sleeves	Flood Barrier	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
Penetration sleeves	Flood Barrier	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	Flood Barrier	Galvanized 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, 4
Penetration sleeves	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General 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

Table 3.5.2-9 Service Water Intake Structures (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	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, 4
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	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	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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.C1-18	3.3.1-19	E, 4
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	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	VII.C1-18	3.3.1-19	E, 4
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 5
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

Table 3.5.2-9 Service Water Intake 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 - 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 (including 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: All structural steel (including 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: All structural steel (including trash racks)	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General 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 (including trash racks)	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 (including trash racks)	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
Tube Track	Structural Support	Carbon Steel	Air - Indoor	Loss of Material/General Corrosion	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	III.A6-11	3.5.1-47	A

Table 3.5.2-9 Service Water Intake Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
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. Never the less, loss of preload/self-loosening will be monitored through the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants aging management program.

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

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. Never less the aging effect will be monitored through the Structures Monitoring Program.

4. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants is the applicable aging management program for this component.

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

Table 3.5.2-10
Shoreline Protection and Dike
Summary of Aging Management Evaluation

Table 3.5.2-10 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
Earthen water-control structures: Embankments (dikes)	Shelter, Protection	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, 1, 2
Earthen water-control structures: Embankments (dikes)	Shelter, Protection	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)	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
Piles (Sheet Piles)	Shelter, Protection	Carbon Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Piles (Sheet Piles)	Shelter, Protection	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
Piles (Sheet Piles)	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

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 guidelines, earthen water-control structures are susceptible to loss of material and loss of form in Air - Outdoor environment.

2. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants is the applicable aging management program for this component.

Table 3.5.2-11
Switchyard
Summary of Aging Management Evaluation

Table 3.5.2-11 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 - 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 3.5.2-11 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 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 - 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 - 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 - 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 - 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

Table 3.5.2-11 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: 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
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

Table 3.5.2-11 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	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	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	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
Conduit	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C

Table 3.5.2-11 Switchyard (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 - 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
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 - 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

Table 3.5.2-11 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	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, Handholes & Duct Banks	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Manholes, Handholes & Duct Banks	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
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
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

Table 3.5.2-11 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, 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	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, Handholes & 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, Handholes & 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, Handholes & 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, 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

Table 3.5.2-11 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, 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
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
Manholes, Handholes & 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, Handholes & 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
Manholes, Handholes & 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, Handholes & 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
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

Table 3.5.2-11 Switchyard (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	Shelter, Protection	Concrete block	Air - Indoor	Cracking/Restraint, Shrinkage, Creep, and Aggressive Environment	Structures Monitoring Program	III.A3-11	3.5.1-43	A, 3
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, 3
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, 3
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, 3
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: Covers	Shelter, Protection	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C

Table 3.5.2-11 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Metal components: Covers	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Metal components: Covers	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 - 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	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.)	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
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 3.5.2-11 Switchyard (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
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, 4
Piles	Structural Support	Concrete	Encased in Steel	None	None			G, 5
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
Transmission towers	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 3.5.2-11 Switchyard (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Tunnel (Cable Vault)	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
Tunnel (Cable Vault)	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
Tunnel (Cable Vault)	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
Tunnel (Cable Vault)	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

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. Never the less, 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. 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)

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

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

Table 3.5.2-12
Turbine Building
Summary of Aging Management Evaluation

Table 3.5.2-12 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	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
Cable Trays	Structural Support	Aluminum	Air - Indoor	None	None	III.B5-2	3.5.1-58	C
Compressible Joints and Seals (Seismic Gaps)	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 Gaps)	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
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 3.5.2-12 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 - 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	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

Table 3.5.2-12 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	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	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

Table 3.5.2-12 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: 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
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

Table 3.5.2-12 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	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
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

Table 3.5.2-12 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	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	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 - Indoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	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.A3-9	3.5.1-23	A

Table 3.5.2-12 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	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	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: 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, 3
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, 3
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

Table 3.5.2-12 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, 3
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
Metal decking	Shelter, Protection	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	C
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.)	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	Galvanized Steel	Air - Indoor	None	None	III.B5-3	3.5.1-58	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

Table 3.5.2-12 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 - 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	Elastomers	Groundwater/Soil	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

Table 3.5.2-12 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 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
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, 2
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, 2
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 3.5.2-12 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 Panels	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
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	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	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
Precast 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
Precast Panels	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
Precast 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
Precast Panels	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 3.5.2-12 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 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
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	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. Never the less, 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. Masonry walls are inspected as a part of the Structures Monitoring Program, which includes the ten attributes of NUREG-1801 Masonry Walls Program (XI.S5).

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. Never the less the aging effect will be monitored through the Structures Monitoring Program.

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

Table 3.5.2-13
Yard Structures
Summary of Aging Management Evaluation

Table 3.5.2-13 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 - 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
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 - 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
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

Table 3.5.2-13 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 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	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: Above-grade exterior	Water retaining boundary	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	Water retaining boundary	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-13 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	Water retaining boundary	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
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	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: Below-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: Below-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 3.5.2-13 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	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	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: Below-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: Below-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	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 3.5.2-13 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	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: Below-grade exterior	Water retaining boundary	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: Below-grade exterior	Water retaining boundary	Reinforced concrete	Air - Outdoor	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Concrete: Below-grade exterior	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	Reinforced concrete	Groundwater/Soil	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A

Table 3.5.2-13 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	Water retaining boundary	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	Water retaining boundary	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	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 3.5.2-13 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	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
Concrete: Foundation	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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 3.5.2-13 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	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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	Water retaining boundary	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
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 - 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
Conduit	Structural Support	PVC	Concrete	None	None			J, 2
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 3.5.2-13 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 - 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 and 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
Hatches/Plugs (Manhole and 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 and Handhole covers)	Shelter, Protection	Cast Iron	Air - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Hatches/Plugs (Manhole and Handhole covers)	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 3.5.2-13 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 and 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 and 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
Manholes, Handholes & Duct banks	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
Manholes, Handholes & Duct banks	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
Manholes, Handholes & Duct banks	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
Manholes, Handholes & Duct banks	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
Manholes, Handholes & Duct banks	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
Manholes, Handholes & Duct banks	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

Table 3.5.2-13 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	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
Manholes, Handholes & Duct banks	Missile Barrier	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, Handholes & Duct banks	Missile Barrier	Reinforced concrete	Water - Standing	Cracks and Distortion/Increased Stress Levels from Settlement	Structures Monitoring Program	III.A3-3	3.5.1-28	A
Manholes, Handholes & Duct banks	Missile Barrier	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, 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
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

Table 3.5.2-13 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	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	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, Handholes & 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, Handholes & 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, Handholes & 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, 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

Table 3.5.2-13 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	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
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
Manholes, Handholes & 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, Handholes & 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
Manholes, Handholes & 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, Handholes & 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

Table 3.5.2-13 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
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
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 - Outdoor	Loss of Material/General, Pitting and Crevice Corrosion	Structures Monitoring Program	III.A3-12	3.5.1-25	A
Penetration bellows (Condensate Storage Tank Dike)	Shelter, Protection	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Penetration bellows (Condensate Storage Tank Dike)	Water retaining boundary	Stainless Steel	Air - Outdoor	Loss of Material/Pitting and Crevice Corrosion	Structures Monitoring Program	III.B2-7	3.5.1-50	C
Penetration seals	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 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	Elastomers	Groundwater/Soil	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	Water retaining boundary	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 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
Penetration seals	Water retaining boundary	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	Water retaining boundary	Elastomers	Groundwater/Soil	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	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	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 sleeves	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	Galvanized Steel	Concrete	None	None	VII.J-21	3.3.1-96	C
Penetration sleeves	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, 3
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

Table 3.5.2-13 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
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 - 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: Bus Duct	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
Steel Components: Bus Duct	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
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

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. Never the less, 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. 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.

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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)
- Fuse Holders (Not Part of a Larger Assembly): Fuse Holders - Metallic Clamp (2.5.2.5.3)
- High Voltage Insulators (2.5.2.5.4)
- Insulated Cables and Connections (2.5.2.5.5)
- Metal Enclosed Bus (2.5.2.5.6)
- Switchyard Bus and Connections, Transmission Conductors and Connections (2.5.2.5.7)

Electrical Penetrations (2.5.2.5.2) 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 Primary Containment aging management review (Table 3.5.2-7).

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.2.1.39)

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 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.

3.6.2.1.3 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 high voltage insulators in the Hope Creek Switchyard and the Salem-Hope Creek 500 kV cross-connection (the 5037 line).

- 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.

3.6.2.1.4 Insulated Cables and Connections

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.2.1.35)
- Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B.2.1.36)
- Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.37)

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.

3.6.2.1.5 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.2.1.38)
- Structures Monitoring Program (B.2.1.32)

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.

3.6.2.1.6 Switchyard Bus and Connections, Transmission Conductors and Connections

Materials

The materials of construction for the Switchyard Bus and Connections, Transmission Conductors and Connections are:

- Aluminum
- Steel
- Stainless Steel
- Copper

Environments

The Switchyard Bus and Connections, Transmission Conductors and Connections are exposed to the following environment:

- Air - Outdoor

Aging Effects Requiring Management

The Switchyard Bus and Connections, Transmission Conductors 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, Transmission Conductors 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, Transmission Conductors 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 4.4, "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 Hope Creek are those used to support in-scope, uninsulated, high voltage electrical commodities such as

transmission conductors and 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.

Hope Creek 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, Hope Creek is not considered to be a seacoast plant, where salt spray is prevalent. The majority of the insulators in scope for license renewal at Hope Creek is of a vertical configuration, and is designed with an increased creepage distance that is able to withstand "heavy to very heavy" pollution severity levels. Vertical insulators with increased creepage distance are less susceptible to flashover due to surface contamination. Horizontal overhead transmission line insulators are angled to form various "string" configurations, making them more susceptible 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 Hope Creek 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 overhead transmission line insulators in the Hope Creek Switchyard and the Salem-Hope Creek 500 kV cross-connection (the 5037 line).

Mechanical Wear

Mechanical wear is an aging effect for strain and suspension insulators in that they are subject to movement. Movement of the insulators can be caused by wind blowing the supported transmission conductor, causing it to swing from side to side. If this swinging is frequent enough, it could cause wear in the metal contact points of the insulator string and between an insulator and the supporting hardware. Although this mechanism is possible, experience has shown that the transmission conductors do not normally swing and that when they do, due to substantial wind, they do not continue to swing for very long once the wind has subsided.

Wind loading that can cause a transmission line and insulators to sway is considered in the design and installation. Although rare, surface rust of the metallic cap may form where galvanizing is burnt off due to flashover from lightning strikes. Surface rust is not a significant concern and would not cause a loss of intended function if left unmanaged for the period of extended operation. Wear and surface rust has not been identified during routine switchyard inspections.

Based on Hope Creek's design and confirmed by its operating experience, mechanical wear caused by wind blowing on transmission conductors is not significant enough to cause a loss of intended function. 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 Hope Creek Switchyard and the Salem-Hope Creek 500 kV cross-connection (the 5037 line). Aging management activities for mechanical wear due to wind are not required for the period of extended operation. 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

The transmission conductors and connections evaluated for Hope Creek are those credited for supplying power to in-scope components for recovery of offsite power following a station blackout. The in-scope transmission conductors at Hope Creek are 2493 MCM 54/37 aluminum conductor, aluminum-alloyed reinforced (ACAR) overhead electrical conductors.

Wind Induced Abrasion and Fatigue

Transmission conductor vibration or sway could be caused by wind loading. Experience has shown that the transmission conductors do not normally swing significantly. When transmission conductors swing due to a substantial wind, they do not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line to vibrate or sway is considered in design and installation. Therefore, the loss of material aging

effect that could result from wind induced transmission conductor vibration or sway is not applicable and would not cause a loss of intended function for transmission conductors for the period of extended operation.

Corrosion

Aging management activities regarding loss of conductor strength due to corrosion for Hope Creek transmission conductors are not required for the period of extended operation because the Hope Creek transmission conductors are not susceptible to corrosion. Moreover, if the Hope Creek ACAR transmission conductors do corrode at the same rate as comparable ACSR transmission conductors over 80 years, there would still be margin between the postulated 80-year ultimate conductor strength and the required design strength.

Specifically, the in-scope transmission conductors at Hope Creek are 2493 MCM 54/37 aluminum conductor, aluminum-alloyed reinforced (ACAR) overhead electrical conductors. Each phase has two conductors. These transmission conductors are approximately 1.8 inches in diameter and are configured with 37 aluminum-alloyed conductor wire strands wrapped by 54 aluminum conductor wire strands.

The PSE&G Transmission & Distribution design practices follows the National Electrical Safety Code (NESC) methodologies. The NESC Section 250.B sets the maximum tension a conductor must be designed to withstand under heavy load requirements, which includes consideration of ice, wind and temperature. NESC Section 260.H.1.a requires that heavy load tension on installed conductors be less than 60% of the ultimate conductor strength.

ACAR conductors are similar in construction to steel-reinforced design except that the core is an aluminum alloy that gives the conductor higher mechanical strength than that of all-aluminum conductor, while maintaining corrosion resistant properties in the core. ACAR conductors, unlike ACSR, are not susceptible to environmental influences, such as SO2 concentration in the air. When aluminum corrodes, it forms a protective oxide layer that protects the underlying material from further corrosion. When the steel core of an ACSR conductor loses its galvanized coating, it will continually corrode causing a decrease in ultimate strength. Therefore, the Hope Creek transmission conductors are not susceptible to the same corrosion phenomenon as ACSR transmission conductors.

Although the Hope Creek transmission conductors are not susceptible to same corrosion phenomenon as ACSR transmission conductors, in order to apply the findings from the Ontario Hydroelectric study of ACSR transmission conductors to the Hope Creek ACAR transmission conductors, it is postulated that the Hope Creek ACAR transmission conductors corrode at the same rate as comparable ACSR transmission conductors over 80 years.

The Ontario Hydroelectric study utilized data gathered by an eddy current sensor that travels along the conductor between transmission towers. The eddy current sensor measures potential conductor degradation. In addition, laboratory tests were performed for fatigue, tensile strength, torsional

ductility, and electrical performance. Fatigue tests simulating 50 years of service life were also performed to assess existing cables as well as new cables. The study performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength of an 80-year-old ACSR (Aluminum Conductor Steel Reinforced) conductor due to corrosion.

The Ontario Hydroelectric test did not include 2493 MCM 54/37 ACAR conductor. The Ontario Hydroelectric study did report:

> *"The aluminum layers were found to have retained their original properties to a large degree. On the other hand the steel strands showed reductions in both tensile strength and the number of turns to failure."*

The Ontario Hydroelectric study is considered to bound the Hope Creek configuration and corrosion rate because the aluminum alloy core is more corrosion resistant than galvanized steel.

The example presented in the EPRI License Renewal Electrical Handbook, TR-1013475, (page 13-10) compares a 4/0 ACSR conductor to the results of the Ontario Hydroelectric Study. The same comparison method is made here for the Hope Creek transmission conductor.

Tests performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength of an 80-year-old ACSR conductor due to corrosion. The ultimate strength and NESC design strength tension requirements of 2493 MCM 54/37 ACAR are 57600 lbs. and 34560 lbs, respectively. The margin between the NESC design strength and the ultimate strength is 23040 lbs. The Ontario Hydroelectric study showed a 30% loss of composite conductor strength in an 80-year-old conductor. In the case of the 2493 MCM ACAR transmission conductors, postulating a 30% loss of ultimate strength would mean that there would still be 5760 lbs. of margin between what is required by the NESC and the postulated 80-year ultimate conductor strength.

2493 MCM 54/37 ACAR Transmission Conductor	
Ultimate Strength (new)	57600 lbs.
Postulated ultimate strength at 80 years	> 40320 lbs.
NESC Design Strength (required)	34560 lbs.
Heavy Load Tension (HLT) for longest span on Line 5037 (885 ft)	22800 lbs.

This illustrates with reasonable assurance that Hope Creek transmission conductors will have ample strength margin through the period of extended operation. Therefore, aging management activities regarding loss of conductor strength due to corrosion for Hope Creek transmission conductors are not required for the period of extended operation.

Oxidation or Loss of Preload

Transmission conductor connections are treated with corrosion inhibitors to avoid connection oxidation and are torqued to avoid loss of pre-load, at the time of installation. The transmission conductor bolted connections are designed and installed using lock and stainless steel Belleville washers (not electroplated) that provide vibration absorption and prevent loss of preload.

2. Switchyard Bus and Connections

The switchyard bus and connections evaluated for Hope Creek 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 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

Hope Creek switchyard bus is not subject to an ocean environment or industrial air pollution. Hope Creek 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, Hope Creek 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 transmission cable, switchyard bus and connections. These maintenance activities have not revealed significant aging effects or mechanisms associated with the equipment to date.

Conclusion

Aging management activities for Hope Creek transmission conductors and connections, and 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 Hope Creek, there are eight 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. Four enclosed electrical panels that contain only fuse holders and terminal blocks are located in the Auxiliary Building Control/Diesel Generator Area. Four electrical panels that contain only fuse holders and terminal blocks are also located in switchyard control building. Other Hope Creek fuse holders that are not part of a larger assembly are for circuits that do not perform a license renewal intended function.

The potential aging effects as discussed in NUREG-1801 are not applicable to the fuse holders in these eight in-scope electrical panels. The evaluation of aging effects is discussed below.

Moisture, Chemical Contamination, Oxidation, and Corrosion

The eight fuse panels are located in an environment that does not subject them to environmental aging mechanisms. Four fuse panels located inside the Auxiliary Building Control/Diesel Generator Area are in an electrical panel room. Access into the room is restricted. The environment inside the room is air-conditioned. The other four fuse panels are located inside the switchyard control house. Access into the switchyard control house is restricted. The environment inside the switchyard control house 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 located inside the Auxiliary Building Control/Diesel Generator Area are not subject to outside weather conditions and are therefore not subject to moisture from precipitation. Their indoor location in the Auxiliary Building Control/Diesel Generator Area means 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.

The fuse holders located inside the switchyard control house are not subject to outside weather conditions and are therefore not subject to moisture from precipitation. Their indoor location in the switchyard control house means 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 on an electrical panel under a plastic shield.

All of the fuse holders are protected from chemical contamination, and are within a mild environment inside a building. There are no sources of chemicals in the vicinity of the electrical panels.

A walkdown of these electrical panels containing the in-scope fuse holders confirmed that the operating conditions for these 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 Control/Diesel Generator Area are for 120 VAC Class 1E control power. The loads are instrumentation and control circuits that operate at low currents where no appreciable thermal cycling or ohmic heating occurs. The fuse holders located in the switchyard control house are for switchyard breaker DC control power. The normal supply of DC control power is from the battery charger. The battery is normally on a float charge, thus the fuses are lightly loaded with a small constant current. 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 effects/mechanisms of fatigue, mechanical stresses and/or frequent manipulation.

Conclusion

Based on installed location, design configuration, and operating service conditions, fuse holders inside of the eight 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 4.4 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.2.1.35, 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.2.1.36, will be used to manage reduced insulation resistance and electrical failure, due to various mechanisms, in adverse localized environments, for insulated cables and connections used in neutron monitoring 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.2.1.37, 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	PWR Only				
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 Hope Creek. There are no fuse holders located outside of active devices that are susceptible to the aging effects of fatigue, mechanical stress (frequent manipulation), vibration, chemical contamination, corrosion, and oxidation. See subsection 3.6.2.3.1 for additional evaluation.
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.2.1.38, will be used to manage loosening of bolted connections for the metal enclosed bus – bus/connections.

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
3.6.1-8	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.2.1.38, will be used to manage reduced insulation 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. Hope Creek predicts the aging effect of loss of material caused by the mechanisms of pitting and crevice corrosion for aluminum metal enclosed bus – enclosure assemblies. The Hope Creek metal enclosed bus material, environment and aging effect/mechanism 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.2.1.32, will be used to manage hardening and loss of strength due to elastomer 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 Hope Creek design and operating experience, loss of material is not applicable for Hope Creek 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	Loss of material, loss of conductor strength, and increased resistance of connection are not applicable for Hope Creek switchyard bus and connections, and transmission conductors and connections. Based on Hope Creek design and operating experience, in-scope switchyard bus and connections are not subject to wind-induced abrasion and fatigue, corrosion, oxidation or loss of pre-load. In-scope transmission conductors and connections are not subject to wind-induced abrasion and fatigue, corrosion, oxidation or loss of pre-load 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.2.1.39, 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
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
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

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	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
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

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 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
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

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	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
Transmission Conductors and Connections	Electrical Continuity	Aluminum, Steel	Air - Outdoor (External)	None	None	VI.A-16	3.6.1-12	I, 6

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 Hope Creek design and operating experience, aging effects and mechanisms are not applicable for Hope Creek 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 Hope Creek design and operating experience, loss of material is not applicable for Hope Creek 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 Hope Creek design and operating experience, loss of material, loss of conductor strength, and increased resistance of connection are not applicable for Hope Creek 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.

6. NUREG-1801 specifies a plant-specific program for transmission conductors and connections. Based on Hope Creek design and operating experience, loss of material, loss of conductor strength, and increased resistance of connection are not applicable for Hope Creek transmission conductors and connections. In-scope transmission conductors 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 Hope Creek Generating Station (HCGS) in accordance with 10 CFR 54.3(a) and 10 CFR 54.21(c). The document is divided into sections, each containing one or more TLAAs associated with a common category: Table 4.1-1 lists the TLAAs in categories and provides a reference to the section where they are evaluated.

Information about the TLAAs in a category is presented within each section, as follows:

Summary Description: A brief description of the TLAA topic is provided.

Analysis: A description of the current license analysis is provided.

Disposition: The disposition is provided and 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 HCGS are consistent with the NUREG-1800 Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP) and with the License Renewal Rule, 10 CFR 54, which states those licensee calculations and analyses are "Time-Limited Aging Analyses" (TLAAs) only if they meet all six of the defining criteria per 10 CFR 54.3(a). These are:

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a);
2. Consider the effects of aging;
3. Involve time-limited assumptions defined by the current operating term, for example, 40 years;
4. Were determined to be relevant by the licensee in making a safety determination;

5. Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended function(s), as delineated in 10 CFR 54.4(b); and
6. Are 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 HCGS 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)
- HCGS and NRC Licensing Correspondence

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:

- 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;

(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 of these three methods was used to disposition each TLAA identified for HCGS, and the method used is 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 no exemptions that are based upon a TLAA that require evaluation for continued use during the period of extended operation.

4.1.3 SUMMARY OF RESULTS

Six general categories of TLAAs applicable to HCGS were identified in Sections 4.2 through 4.7 of this section, with their dispositions. A summary is presented in Table 4.1-1. The table includes a reference to the applicable section of this report that discusses the TLAA.

NUREG-1800, Tables 4.1-2 and 4.1-3, list examples of analyses that could be TLAAs, depending on the applicant's current licensing basis (CLB). Table 4.1.3-1 of this section compares the TLAAs found for HCGS to the potential TLAAs identified in Tables 4.1-2 and 4.1-3 of NUREG-1800.

Table 4.1-1
Time-Limited Aging Analyses Applicable to HCGS

TLAA Category	Description	Disposition Category	Section
1.	**Neutron Embrittlement of the Reactor Pressure Vessel and Internals**		4.2
	Reactor Pressure Vessel Materials Upper-Shelf Energy Reduction Due to Neutron Embrittlement	§54.21(c)(1)(ii)	4.2.1
	Adjusted Reference Temperature for Reactor Pressure Vessel Materials Due to Neutron Embrittlement	§54.21(c)(1)(ii)	4.2.2
	Reactor Pressure Vessel Analyses: Pressure – Temperature Limits	§54.21(c)(1)(iii)	4.2.3
	Reactor Pressure Vessel Circumferential Weld Examination Relief	§54.21(c)(1)(ii)	4.2.4
	Reactor Pressure Vessel Axial Weld Failure Probability	§54.21(c)(1)(ii)	4.2.5
	Reactor Pressure Vessel Core Reflood Thermal Shock Analysis	§54.21(c)(1)(ii)	4.2.6
	Reactor Internals Components	§54.21(c)(1)(iii)	4.2.7
2.	**Metal Fatigue of the Reactor Pressure Vessel, Internals, and Reactor Coolant Pressure Boundary Piping and Components**		4.3
	Reactor Pressure Vessel Fatigue Analyses	§54.21(c)(1)(iii)	4.3.1
	Reactor Pressure Vessel Internals Fatigue Analyses	§54.21(c)(1)(ii)	4.3.2
	Reactor Coolant Pressure Boundary Piping and Component Fatigue Analyses	§54.21(c)(1)(iii)	4.3.3
	Non-Class 1 Component Fatigue Analyses	§54.21(c)(1)(i)	4.3.4
	Effects of Reactor Coolant Environment on Fatigue Life of Components and Piping (GSI-190)	§54.21(c)(1)(iii)	4.3.5
3.	**Environmental Qualification of Electrical Equipment**		
	Environmental Qualification of Electrical Equipment	§54.21(c)(1)(iii)	4.4
4.	**Loss of Prestress in Concrete Containment Tendon**	Not Applicable	4.5
5.	**Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analyses**		4.6
	Fatigue Analysis of Primary Containment, Attached Piping, and Components	§54.21(c)(1)(iii)	4.6.1
	Primary Containment Process Penetrations and Bellows Fatigue Analysis	§54.21(c)(1)(iii)	4.6.2
	Vent Line Bellows	§54.21(c)(1)(i)	4.6.3
6.	**Other Plant-Specific Time-Limited Aging Analyses**		4.7
	Crane Load Cycle Limit	§54.21(c)(1)(i)	4.7.1
	Refueling Bellows Fatigue	§54.21(c)(1)(i)	4.7.2
	Neutron Fluence-Induced Stress Relaxation - Jet Pump Auxiliary Spring Wedges and Slip Joint Clamps	§54.21(c)(1)(i) and (iii)	4.7.3

Table 4.1.3-1

Review of Analyses Listed in NUREG-1800, Tables 4.1-2 and 4.1-3		
NUREG-1800 Examples	**Applicability to HCGS**	**LRA Section**
NUREG-1800, Table 4.1-2 – Examples of Potential TLAAs		
Reactor vessel neutron embrittlement	Yes	4.2
Concrete containment tendon prestress	No	4.5
Metal fatigue	Yes	4.3
Environmental qualification of electrical equipment	Yes	4.4
Metal corrosion allowance	No	N/A
Inservice flaw growth analyses that demonstrate structure stability for 40 years	No	N/A
Inservice local metal containment corrosion analyses	No	N/A
High-energy line-break postulation based on fatigue cumulative usage factor	Yes	4.3.3
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	No	N/A
Low-temperature overpressure (LTOP) analyses	No (PWR)	N/A
Fatigue analysis for the main steam supply lines to the turbine driven auxiliary feedwater pumps	No (PWR)	N/A
Fatigue analysis for the reactor coolant pump flywheel	No (PWR)	N/A
Fatigue analysis of polar crane	Yes	4.7.1
Flow-induced vibration endurance limit for the reactor vessel internals	Yes	4.3.2
Transient cycle count assumptions for the reactor vessel internals	Yes	4.3.2
Leak-before-break	No (PWR)	N/A
Fatigue analysis for the containment liner plate	Yes	4.6.1
Containment penetration pressurization cycles	Yes	4.6.2
Reactor vessel circumferential weld inspection relief (BWR)	Yes	4.2.4

4.2 NEUTRON EMBRITTLEMENT OF THE REACTOR PRESSURE VESSEL AND INTERNALS

The ferritic materials of the reactor pressure vessel are subject to embrittlement due to high energy (E > 1 MeV) neutron exposure. Embrittlement means the material has lower toughness (i.e., will absorb less strain energy during a crack or rupture), thus allowing a crack to propagate more easily under thermal and/or pressure loading.

Toughness (indirectly measured in foot-pounds of absorbed energy in a Charpy impact test) is temperature dependent in ferritic materials. An initial nil-ductility reference temperature (RT_{NDT}), the temperature associated with the transition from ductile to brittle behavior, is determined for vessel materials through a combination of Charpy and drop weight testing. Toughness increases with temperature up to a maximum value called the "upper-shelf energy," or USE. Neutron embrittlement results in a decrease to the USE of reactor pressure vessel steels. The increase or shift in the initial nil-ductility reference temperature (ΔRT_{NDT}) means higher temperatures are required for the material to continue to act in a ductile manner.

To reduce the potential for brittle fracture during reactor pressure vessel operation, changes in material toughness as a function of neutron radiation exposure (fluence) are accounted for by operating pressure-temperature (P-T) limit curves that are included in the HCGS Technical Specifications. The P-T curves account for the decrease in material toughness associated with a given fluence, which is used to predict the loss in toughness of the reactor pressure vessel materials. Based on the projected drop in toughness for a given fluence, the P-T curves are generated to provide a minimum temperature limit associated with the reactor pressure vessel pressure. The P-T curves are determined using the RT_{NDT} and ΔRT_{NDT} values for the licensed operating period along with appropriate margins.

The reactor pressure vessel material ΔRT_{NDT} and USE values, calculated on the basis of neutron fluence, are part of the licensing basis and support safety determinations. The increases in RT_{NDT} (ΔRT_{NDT}) affect the bases for relief from circumferential weld inspection and their associated supporting calculation of limiting axial weld conditional failure probability. Therefore, these calculations are TLAAs. Section 4.2 includes the following TLAA discussions related to the issue of neutron embrittlement:

- Reactor Pressure Vessel Materials Upper-Shelf Energy Reduction Due to Neutron Embrittlement (4.2.1)
- Adjusted Reference Temperature for Reactor Pressure Vessel Materials Due to Neutron Embrittlement (4.2.2)
- Reactor Pressure Vessel Analyses: Pressure – Temperature Limits (4.2.3)
- Reactor Pressure Vessel Circumferential Weld Examination Relief (4.2.4)
- Reactor Pressure Vessel Axial Weld Failure Probability (4.2.5)

- Reactor Pressure Vessel Core Reflood Thermal Shock Analysis (4.2.6)
- Reactor Internals Components (4.2.7)

The chemistry data used for the supporting HCGS materials evaluations (e.g., USE, ART, circumferential weld examination relief, and axial weld failure probability) reported in the TLAA discussions in Section 4.2 are taken from the values documented in Reference 4.8.1. Reference 4.8.1 reports the results of a recent systematic review and analysis of the metallurgical data available for the HCGS reactor pressure vessel weld, plate, and forging materials. Included in Reference 4.8.1 are incorporation of the most recent data to be used for materials evaluations from the BWR Vessel and Internals Project (BWRVIP) Integrated Surveillance Program (ISP). A review of the NRC Reactor Vessel Integrity Database (RVID2), Reference 4.8.32, indicates that not all of the values documented in Reference 4.8.1 are reflected in RVID2. The TLAA analyses reported in Section 4.2 are based on the data provided in Reference 4.8.1, which is the most recent estimate of the chemistry data for the HCGS reactor pressure vessel.

Neutron Fluence Analysis

To determine the total accumulated fluence for 60 years, fluence was calculated using the actual power histories for cycles 1-14, and conservatively assumed the Extended Power Uprate (EPU) power level for the remainder of the 60 year period with a capacity factor of 100 percent. As a result, fluence was calculated at 56 EFPY. This is bounding for license renewal purposes, since a capacity factor of 100 percent is not achievable due to planned and forced shutdowns, and power reductions. Therefore, 56 EFPY bounds the actual exposure that will be accrued over the 60-year life of the plant.

Fluence was calculated for the HCGS reactor pressure vessel for the extended 60-year (56 EFPY) licensed operating period (Reference 4.8.2), using the methodology of the RAMA Fluence Methodology software package as described in BWRVIP-126 (Reference 4.8.3). The RAMA methodology was developed for EPRI and complies with the requirements of Regulatory Guide 1.190 (Reference 4.8.4) as recommended in NUREG-1800, Section 4. The NRC has reviewed and approved RAMA for BWR reactor pressure vessel fluence predictions (Reference 4.8.5). The HCGS fluence analysis complies with the conditions of the RAMA SER (Reference 4.8.31). As part of the fluence analysis for the reactor pressure vessel, results of fluence measurements from HCGS surveillance specimens were evaluated to develop a plant specific uncertainty analysis as required by the SER for the application of RAMA to HCGS (Reference 4.8.2). The uncertainty analysis demonstrates compliance to the requirements of Regulatory Guide 1.190. The RAMA fluence values for HCGS were used in the TLAA evaluations that follow.

4.2.1 REACTOR PRESSURE VESSEL MATERIALS UPPER-SHELF ENERGY REDUCTION DUE TO NEUTRON EMBRITTLEMENT

Summary Description

The regulations governing reactor pressure vessel integrity are in 10 CFR 50 (Reference 4.8.6). Section 50.60 requires that all light-water reactors meet the fracture toughness, pressure-temperature limits, and material surveillance program requirements for the reactor coolant pressure boundary as set forth in 10 CFR 50 Appendices G and H. The HCGS current licensing basis analyses evaluating reduction of fracture toughness of the reactor pressure vessel for 40 years are TLAAs. The reactor pressure vessel neutron embrittlement TLAA has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii) as summarized below.

Appendix G of 10 CFR 50 requires that reactor pressure vessel beltline materials "...have Charpy upper-shelf energy...of no less than 75 ft-lb (102 J) initially and must maintain Charpy upper-shelf energy throughout the life of the vessel of no less than 50 ft-lb (68 J)..." These bounding limits are addressed using the methodology defined by BWRVIP-74-A (Reference 4.8.7), which has been reviewed and approved by the NRC (Reference 4.8.8). NRC Regulatory Guide 1.99, Revision 2 (RG 1.99) (Reference 4.8.9) defines the method for predicting upper-shelf energy (USE) drop in terms of a percentage from the unirradiated value.

USE is the standard industry parameter used to indicate the maximum toughness of a material at high temperature. 10 CFR 50 Appendix G requires the predicted end-of-life Charpy impact test USE for reactor pressure vessel materials to be at least 50 ft-lb (absorbed energy), unless an approved analysis supports a lower value. The predicted USE drop is determined in accordance with RG 1.99, Revision 2. For BWRs that cannot meet the 50 ft-lb criterion, the BWRVIP has provided a bounding equivalent margins USE analysis for plants in BWRVIP-74-A, which is valid for up to 54 EFPY of operation.

Predicted USE drop for each reactor pressure vessel material in the beltline region exposed to fluence greater than 1.0×10^{17} n/cm^2 for 56 EFPY was determined in accordance with RG 1.99 Revision 2. In all cases, the 50 ft-lb criterion was met, so an equivalent margin analysis (EMA) using BWRVIP-74-A was not required.

The 40-year end-of-life USE calculations satisfy the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

Analysis

The 60-year USE assessment for the HCGS reactor pressure vessel materials is shown in Table 4.2.1-1. The list of materials included in Table 4.2.1-1 includes any reactor pressure vessel weld, forging, and plate materials exposed to a fluence greater than $1x10^{17}$ n/cm^2. As shown in Table 4.2.1-1, the projected 60-year (56 EFPY) USE values for all plate and weld materials are greater than 50 ft-lbs, and do not require an EMA. Therefore, all HCGS materials are acceptable from a USE standpoint for 56 EFPY.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The Upper Shelf Energy TLAAs for HCGS have been satisfactorily projected through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

Table 4.2.1-1
HCGS USE Assessment for 56 EFPY

	RPV Material Description		Heat/Lot Number	Cu (wt %)	Unirradiated Transverse C_vUSE (ft-lbs)*	1/4t Fluence (n/cm^2)	% Drop in C_vUSE	C_vUSE @ 1/4t (ft-lbs)**	Requires EMA
Plates	**Intermediate Shell (IS)**								
	Course 3	-	5K3025/1	0.15	75	4.161E+17	11.4	66.44	NO
	Course 3	-	5K2608/1	0.09	75	4.161E+17	8.9	68.29	NO
	Course 3	-	5K2698/1	0.10	75	4.161E+17	8.9	68.29	NO
	Lower Intermediate Shell								
	Course 4	-	5K2963/1	0.07	102	1.068E+18	11.2	90.60	NO
	Course 4	-	5K2530/1	0.08	86	1.068E+18	11.2	76.39	NO
	Course 4	-	5K3238/1	0.09	76	1.068E+18	11.2	67.51	NO
	Lower Shell								
	Course 5	-	5K3230/1	0.07	121	7.350E+17	10.2	108.62	NO
	Course 5	-	6C35/1	0.09	107	7.350E+17	10.2	96.06	NO
	Course 5	-	6C45/1	0.08	97	7.350E+17	10.2	87.08	NO
	RPV Material Description	**Flux Type**	**Heat/Lot Number**	**%Cu**	**Unirradiated Transverse C_vUSE (ft-lbs)***	**1/4t Fluence (n/cm^2)**	**% Drop in C_vUSE**	**C_vUSE @ 1/4t (ft-lbs)****	**Requires EMA**
Welds	**Vertical**								
	W13	SMAW	510-01205	0.09	92.5	4.098E+17	11.0	82.36	NO
	W13	SAW	D53040/1125-02205	0.084	135	4.098E+17	10.7	120.56	NO
	W14	SMAW	510-01205	0.09	92.5	9.292E+17	13.3	80.23	NO
	W14	SAW	D53040/1125-02205	0.084	135	9.292E+17	13.0	117.51	NO
	W15	SMAW	510-01205	0.09	92.5	6.733E+17	12.3	81.12	NO
	W15	SAW	D53040/1125-02205	0.084	135	6.733E+17	12.0	118.78	NO
	Girth								
	W6	SMAW	519-01205	0.01	109	4.161E+17	8.9	99.26	NO
	W6	SMAW	504-01205	0.01	125	4.161E+17	8.9	113.82	NO
	W6	SMAW	510-01205	0.09	92.5	4.161E+17	11.0	82.32	NO
	W6	SAW	D53040/1810-02205	0.084	95	4.161E+17	10.7	84.80	NO
	W6	SAW	D55733/1810-02205	0.10	68	4.161E+17	11.4	60.24	NO
	W7	SMAW	510-01205	0.09	92.5	7.350E+17	12.6	80.88	NO
	W7	SAW	D53040/1125-02205	0.084	95	7.350E+17	12.3	83.35	NO
	LPCI Nozzle								
	W179	SMAW	001-01205	0.020	109	3.668E+17	8.7	99.54	NO
	W179	SMAW	519-01205	0.010	109	3.668E+17	8.7	99.54	NO
	W179	SMAW	504-01205	0.010	125	3.668E+17	8.7	114.15	NO
	RPV Material Description	**Plate Location**	**Heat/Lot Number**	**%Cu**	**Unirradiated Transverse C_vUSE (ft-lbs)***	**1/4t Fluence (n/cm^2)**	**% Drop in C_vUSE**	**C_vUSE @ 1/4t (ft-lbs)****	**Requires EMA**
Nozzles	LPCI (N17; A-D)	IS Course 3	19468/1	0.120	79	3.668E+17	9.7	71.35	NO
	LPCI (N17; A-D)	IS Course 3	10024/1	0.140	70	3.668E+17	10.6	62.56	NO

Notes: Terms used: RPV = reactor pressure vessel, Cu = copper content, CvUSE = Charpy V-notch upper shelf energy, 1/4t = one-quarter RPV wall thickness location,

EMA = Equivalent Margins Analysis

SMAW = Shield Metal Arc Welding

SAW = Submerged Arc Welding

* Transverse plate values conservatively estimated as described in the HCGS UFSAR.
** Where information is limited or unavailable,weld values are conservatively estimated from data taken at 10°F.
*** C_vUSE @ 1/4t calculated by the following formula:
Unirradiated CvUSE X ((100 – %Drop CvUSE) / 100)

4.2.2 ADJUSTED REFERENCE TEMPERATURE FOR REACTOR PRESSURE VESSEL MATERIALS DUE TO NEUTRON EMBRITTLEMENT

Summary Description

The adjusted reference temperature (ART) of the limiting beltline material is used to adjust the beltline P-T curves to account for irradiation effects. RG 1.99, Revision 2 provides the methods for determining the ART. The methodology for determining the limiting material and adjusting the P-T curves using ART are discussed in this section.

The initial nil-ductility reference temperature, RT_{NDT}, is the temperature at which a non-irradiated metal (ferritic steel) changes in fracture characteristics going from ductile to brittle behavior. RT_{NDT} is evaluated according to the procedures in the American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section III, Paragraph NB-2331. Neutron embrittlement increases the initial RT_{NDT}. 10 CFR 50 Appendix G defines the fracture toughness requirements for the life of the vessel. The shift in the initial RT_{NDT} (ΔRT_{NDT}) is evaluated as the difference in the 30 ft-lb index temperatures from the average Charpy curves measured before and after irradiation. This increase (ΔRT_{NDT}) means that higher temperatures are required for the material to continue to act in a ductile manner. The ART is defined as Initial RT_{NDT} + ΔRT_{NDT} + Margin. The Margin term is defined in RG 1.99, Revision 2.

The current P-T curves are developed from limiting ART values for the vessel materials and are valid for 32 EFPY. Since the ART values are determined by adding the unirradiated RT_{NDT} and the ΔRT_{NDT} values for the 40-year licensed operating period, these ART calculations meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

Analysis

56 EFPY fluence values were calculated for the HCGS reactor pressure vessel for the extended 60-year licensed operating period, using the RAMA Fluence Methodology software package (Reference 4.8.2). Peak fluence was calculated at the vessel inner surface (inner diameter at clad/base metal interface) for purposes of evaluating ART. The value of neutron fluence was also calculated for the 1/4T location into the vessel wall base material measured radially from the inside diameter (ID) at the clad/base metal interface, using Equation 3 from Paragraph 1.1 of RG 1.99. This 1/4T depth is recommended in the ASME Code, Section XI, Appendix G, 2001 Edition, with Addenda up to and including 2003 (Reference 4.8.10), Sub-article G-2120, as the maximum postulated defect depth.

The 56 EFPY ΔRT_{NDT} values for all beltline materials (i.e., those materials with a fluence exposure greater than $1x10^{17}$ n/cm^2) were calculated based on the embrittlement correlation found in RG 1.99. The peak fluence, ΔRT_{NDT}, and ART values for the 60-year (56 EFPY) licensed operating period are presented in Table 4.2.2-1. HCGS will re-project, as necessary, the 56 EFPY ΔRT_{NDT} and ART values in conjunction with the surveillance capsule results from the BWRVIP ISP (BWRVIP Reports –86 and -116). See the Reactor Pressure Vessel Surveillance program

(B.2.1.21) for additional details. The material information shown in Table 4.2.2-1 incorporates the most recent data from the BWRVIP ISP, so the values shown may differ from those previously published in the NRC's Reactor Vessel Integrity Database (RVID2).

As shown in Table 4.2.2-1 ΔRT_{NDT} and ART values are provided for the beltline materials. Also shown are 56 EFPY fluence values at the inner surface and ¼ T depth, as well as plate, forging, and weld specific chemistry information. The material with the limiting ART value occurs in the reactor pressure vessel intermediate shell plate material.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The analysis has been projected through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

Table 4.2.2-1
56 EFPY Adjusted Reference Temperatures for HCGS Reactor Pressure Vessel Materials

	RPV Material Description	Heat/Lot Number		Initial RT_{NDT} (°F)	Chemistry (wt %) Cu	Chemistry (wt %) Ni	Chemistry Factor (°F)	Adjustments For 1/4t: ΔRT_{NDT} (°F)	Margin Terms σ_Δ (°F)	Margin Terms σ_I (°F)	ART_{NDT} (°F)
Plates	**Intermediate Shell (3)**	**5K3025/1**	-	**19**	**0.15**	**0.71**	**112.75**	**29.8**	**14.9**	**0.0**	**78.7**
	Intermediate Shell (3)	5K2608/1	-	19	0.09	0.58	58.00	15.4	7.7	0.0	49.7
	Intermediate Shell (3)	5K2698/1	-	19	0.10	0.58	65.00	17.2	8.6	0.0	53.4
	Lower Intermediate Shell (4)	5K2963/1	-	-10	0.07	0.58	44.00	18.9	9.5	0.0	27.9
	Lower Intermediate Shell (4)	5K2530/1	-	19	0.08	0.56	51.00	21.9	11.0	0.0	62.9
	Lower Intermediate Shell (4)	5K3238/1	-	7	0.09	0.64	58.00	24.9	12.5	0.0	56.9
	Lower Shell (5)	5K3230/1	-	-10	0.07	0.56	44.00	15.8	7.9	0.0	21.5
	Lower Shell (5)	6C35/1	-	-11	0.09	0.54	58.00	20.6	10.4	0.0	30.5
	Lower Shell (5)	6C45/1	-	1	0.08	0.57	51.00	18.3	9.1	0.0	37.5

	RPV Material Description	Heat/Lot Number	Flux Type	Initial RT_{NDT} (°F)	Chemistry (wt %) Cu	Chemistry (wt %) Ni	Chemistry Factor (°F)	Adjustments For 1/4t: ΔRT_{NDT} (°F)	Margin Terms σ_Δ (°F)	Margin Terms σ_I (°F)	ART_{NDT} (°F)
Welds	Vertical W13	510-01205	SMAW	-40	0.09	0.54	108.70	28.5	14.3	0.0	17.1
	Vertical W13	D53040/1125-02205	SAW	-30	0.084	0.626	110.12	28.9	14.4	0.0	27.8
	Vertical W14	510-01205	SMAW	-40	0.09	0.54	108.70	43.7	21.9	0.0	47.5
	Vertical W14	**D53040/1125-02205**	**SAW**	**-30**	**0.084**	**0.626**	**110.12**	**44.3**	**22.2**	**0.0**	**58.6**
	Vertical W15	510-01205	SMAW	-40	0.09	0.54	108.70	37.2	18.6	0.0	34.4
	Vertical W15	D53040/1125-02205	SAW	-30	0.084	0.626	110.12	37.7	18.9	0.0	45.4
	Girth W6 (Shell 3-4)	519-01205	SMAW	-49	0.01	0.53	20.00	5.3	2.6	0.0	-38.4
	Girth W6 (Shell 3-4)	504-01205	SMAW	-31	0.01	0.51	20.00	5.3	2.6	0.0	-20.4
	Girth W6 (Shell 3-4)	510-01205	SMAW	-40	0.09	0.54	108.70	28.8	14.4	0.0	17.5
	Girth W6 (Shell 3-4)	D53040/1810-02205	SAW	-49	0.084	0.626	110.12	29.1	14.6	0.0	9.3
	Girth W6 (Shell 3-4)	D55733/1810-02205	SAW	-40	0.10	0.68	126.40	33.5	16.7	0.0	26.9
	Girth W7 (Shell 4-5)	510-01205	SMAW	-40	0.09	0.54	108.70	38.9	19.5	0.0	37.9
	Girth W7 (Shell 4-5)	D53040/1125-02205	SAW	-30	0.084	0.626	110.12	39.4	19.7	0.0	48.9
	LPCI Nozzle W179	001-01205	SMAW	-40	0.02	0.51	27.00	6.7	3.3	0.0	-26.7
	LPCI Nozzle W179	519-01205	SMAW	-49	0.01	0.53	20.00	4.9	2.5	0.0	-39.1
	LPCI Nozzle W179	504-01205	SMAW	-31	0.01	0.51	20.00	4.9	2.5	0.0	-21.1

	RPV Material Description	Heat/Lot Number	Plate Location	Initial RT_{NDT} (°F)	Chemistry (wt %) Cu	Chemistry (wt %) Ni	Chemistry Factor (°F)	Adjustments For 1/4t: ΔRT_{NDT} (°F)	Margin Terms σ_Δ (°F)	Margin Terms σ_I (°F)	ART_{NDT} (°F)
Nozzles	LPCI (N17; A-D)	19468/1	Intermediate Shell (3)	-20	0.12	0.80	86.00	21.2	10.6	0.0	22.4
	LPCI (N17; A-D)	10024/1	Intermediate Shell (3)	-20	0.14	0.82	105.10	25.9	13.0	0.0	31.8
	Instrument (N16; A, D)	**5K3025/1***	**Intermediate Shell (3)**	**19**	**0.15**	**0.71**	**112.75**	**22.2**	**11.1**	**0.0**	**63.3**
	Instrument (N16; B, C)	5K2698/1*	Intermediate Shell (3)	19	0.10	0.58	65.00	12.8	6.4	0.0	44.6

Fluence Data

	Location	Wall Thickness (in) Full	Wall Thickness (in) 1/4t	Fluence at ID (n/cm^2)	Attenuation, 1/4t $e^{-0.24x}$	Fluence at 1/4t (n/cm^2)	Fluence Factor, FF $f^{(0.29 - 0.10 \log f)}$
Plates	Intermediate Shell (3)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Intermediate Shell (3)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Intermediate Shell (3)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Lower Intermediate Shell (4)	6.102	1.526	1.54E+18	0.693	1.068E+18	0.430
	Lower Intermediate Shell (4)	6.102	1.526	1.54E+18	0.693	1.068E+18	0.430
	Lower Intermediate Shell (4)	6.102	1.526	1.54E+18	0.693	1.068E+18	0.430
	Lower Shell (5)	6.102	1.526	1.06E+18	0.693	7.35E+17	0.358
	Lower Shell (5)	6.102	1.526	1.06E+18	0.693	7.35E+17	0.358
	Lower Shell (5)	6.102	1.526	1.06E+18	0.693	7.35E+17	0.358
Welds	Vertical W13	6.102	1.526	5.91E+17	0.693	4.098E+17	0.262
	Vertical W13	6.102	1.526	5.91E+17	0.693	4.098E+17	0.262
	Vertical W14	6.102	1.526	1.34E+18	0.693	9.292E+17	0.402
	Vertical W14	6.102	1.526	1.34E+18	0.693	9.292E+17	0.402
	Vertical W15	6.102	1.526	9.71E+17	0.693	6.733E+17	0.342
	Vertical W15	6.102	1.526	9.71E+17	0.693	6.733E+17	0.342
	Girth W6 (Shell 3-4)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Girth W6 (Shell 3-4)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Girth W6 (Shell 3-4)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Girth W6 (Shell 3-4)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Girth W6 (Shell 3-4)	6.102	1.526	6.00E+17	0.693	4.161E+17	0.265
	Girth W7 (Shell 4-5)	6.102	1.526	1.06E+18	0.693	7.35E+17	0.358
	Girth W7 (Shell 4-5)	6.102	1.526	1.06E+18	0.693	7.35E+17	0.358
	LPCI Nozzle W179	6.102	1.526	5.29E+17	0.693	3.668E+17	0.247
	LPCI Nozzle W179	6.102	1.526	5.29E+17	0.693	3.668E+17	0.247
	LPCI Nozzle W179	6.102	1.526	5.29E+17	0.693	3.668E+17	0.247
Nozzles	LPCI (N17; A-D)	6.102	1.526	5.29E+17	0.693	3.668E+17	0.247
	LPCI (N17; A-D)	6.102	1.526	5.29E+17	0.693	3.668E+17	0.247
	Instrument (N16; A, D)	6.102	1.526	3.59E+17	0.693	2.489E+17	0.197
	Instrument (N16; B, C)	6.102	1.526	3.59E+17	0.693	2.489E+17	0.197

Notes: Terms used: RPV = reactor pressure vessel, RT_{NDT} = reference temperature of nil ductility transition, Cu = copper content, Ni = nickel content, ΔRT_{NDT} = shift in RT_{NDT} due to irradiation, 1/4t = one-quarter RPV wall thickness location, ART_{NDT} = adjusted reference temperature, σ_Δ standard deviation for ΔRT_{NDT}= , σ_I = standard deviation for RT_{NDT}, ID = inside diamater, x = distance into RPV wall.

* Heat/Lot No. corresponds to plate where nozzles are located.

4.2.3 REACTOR PRESSURE VESSEL ANALYSES: PRESSURE – TEMPERATURE LIMITS

Summary Description

10 CFR Part 50 Appendix G requires reactor pressure vessel analyses to determine operating P-T limits for boltup, hydrotest, pressure tests and normal operating and anticipated operational occurrences. The ART of the limiting beltline material is used to adjust the beltline P-T limits to account for irradiation effects. Operating limits for pressure and temperature are required for three categories of operation: 1) hydrostatic pressure tests and leak tests, referred to as Curve A; 2) non-nuclear heat-up / cooldown and low-level physics tests, referred to as Curve B; and 3) core critical operation, referred to as Curve C. P-T limits are developed for three bounding vessel regions: the upper vessel region (non-beltline, including the head flange region), the core beltline region, and the vessel bottom head region.

The calculations associated with generation of the P-T curves satisfy the criteria of 10 CFR 54.3(a). As such, these calculations are a TLAA.

Analysis

The current HCGS Technical Specifications contain P-T curves for hydrostatic pressure and leak tests, non-nuclear heat-up/cooldown and low-level physics tests, and critical operation. Technical Specifications also limit the maximum rate of change of the reactor coolant temperature. These P-T curves provide limits up to 32 EFPY. The P-T curves were developed to present steam dome pressure versus minimum vessel metal temperature, incorporating appropriate non-beltline limits and irradiation embrittlement effects in the beltline. Because of the relationship between the P-T limits and the fracture toughness transition of the HCGS reactor pressure vessel, new P-T limits are required to be calculated and will be submitted as updates to the NRC, in compliance with 10 CFR Part 50,Appendix G.

HCGS will re-project the P-T curves using approved fluence calculations when there are changes in power or significant changes in core design in conjunction with surveillance capsule results from the BWRVIP Integrated Surveillance Program (ISP) (BWRVIP -86-A, Reference 4.8.33 and BWRVIP-116, Reference 4.8.34). See the Reactor Pressure Vessel Surveillance program (B.2.1.21) for additional discussion.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

Reactor Pressure Vessel Analyses for P-T limits, considering the effects of aging on the intended function will be adequately managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

4.2.4 REACTOR PRESSURE VESSEL CIRCUMFERENTIAL WELD EXAMINATION RELIEF

Summary Description

ASME Code, Section XI governs inspection of the reactor pressure vessel circumferential welds, as implemented by the HCGS In-service Inspection program. These welds are required to be inspected at regular intervals described in Table IWB-2500-1, Examination Category B-A of ASME Code, Section XI. HCGS has received inspection relief for the circumferential welds for the time remaining in the current 40-year licensed operating period (Reference 4.8.11). This inspection relief is based upon NRC Generic Letter 98-05 (Reference 4.8.12).

Relief from reactor pressure vessel circumferential weld examination requirements under NRC Generic Letter 98-05 is based on probabilistic assessments that predict an acceptably low probability of failure per reactor operating year. The analysis is based on reactor pressure vessel metallurgical conditions as well as flaw indication sizes and frequencies of occurrence that are expected through the end of the current licensed operating period. The basis for this relief request was an analysis that satisfied the limiting conditional failure probability for the circumferential welds at the expiration of the current license, based on BWRVIP-05 (Reference 4.8.13) and the extent of neutron embrittlement expected through 40 years of operation. The methodology provided in BWRVIP-05 has been reviewed and approved by the NRC (References 4.8.14, 4.8.15, and 4.8.16). The anticipated metallurgical effects due to increased fluence expected during the period of extended operation require evaluation for 56 EFPY (corresponding to 60 years) and approval by the NRC to extend this relief request.

The circumferential weld examination relief analysis meets the requirements of 10 CFR 54.3(a) and is a TLAA.

Analysis

To address this TLAA for 60 years, an evaluation was performed based upon the methodology presented in BWRVIP-05. There are two circumferential welds, W6 (attaching Shells 3 and 4) and W7 (attaching Shells 4 and 5), in the HCGS beltline region. Nine axial welds (W13-1, W13-2, W-13-3, W14-1, W14-2, W14-3, W15-1, W15-2, and W15-3) have at least a portion of their length in the beltline region. The beltline region is defined as that portion of the reactor vessel which experiences sufficient radiation damage to be of concern.

The circumferential weld examination relief request was reevaluated in accordance with BWRVIP-74-A (Reference 4.8.7), which provides a basis for supporting the elimination of reactor pressure vessel (RPV) circumferential welds from the ISI program. The requirements for continuing this relief into the period of extended operation are provided in the NRC's SER for BWRVIP-74 (Reference 4.8.8).

The NRC evaluation of BWRVIP-05 utilized the FAVOR computer code to perform a probabilistic fracture mechanics (PFM) analysis to estimate the reactor pressure vessel shell weld failure probabilities. Three key assumptions of the PFM analysis are that: 1) the neutron fluence was the estimated end-of-life

mean fluence, 2) the chemistry values are mean values based on vessel types, and 3) the potential for beyond-design-basis events is considered.

Table 4.2.4-1 provides a comparison of the HCGS reactor pressure vessel limiting circumferential weld properties for 56 EFPY to those used in the NRC analysis for 64 EFPY for the first two key assumptions. Data provided in Table 4.2.4-1 was supplied from Table 2.6-5 of the Final Safety Evaluation of BWRVIP-05 (Reference 4.8.15) and Table 4.2.2-1 of this document.

The HCGS 56 EFPY fluence is significantly lower than the limits of the NRC analysis, and the chemistry factor is approximately the same for HCGS compared to the NRC analysis value. As a result, the shift in reference temperature (ΔRT_{NDT} w/o margin) is significantly lower for HCGS for 56 EFPY compared to the NRC analysis. Although the unirradiated reference temperature ($RT_{NDT(U)}$) for HCGS is higher, the combination of $RT_{NDT(U)}$ and ΔRT_{NDT} w/o margin yields a HCGS ART value that is considerably lower than the NRC mean analysis value. The Mean RT_{NDT} value at 56 EFPY is bounded by the 64 EFPY Mean RT_{NDT} provided by the NRC.

The probability of a failure event (PoF) results were calculated for 60 years (56 EFPY) for the reactor pressure vessel beltline circumferential welds, including the consideration of the limiting event occurrence probability of $1x10^{-3}$ per year. The PoF for the beltline circumferential welds due to a limiting event is $4.10x10^{-8}$ at 60 years (56 EFPY) and $6.83x10^{-10}$ per year. The $4.10x10^{-8}$ value is less than the value of $1.78x10^{-5}$ for the CB&I reference plant in Table 2.6-5 of the Final Safety Evaluation of BWRVIP-05 (Reference 4.8.15). The $1.78x10^{-5}$ value reported in Table 2.6-5 of the Final Safety Evaluation of BWRVIP-05 is for 64 EFPY. In order to have a one-to-one comparison with the PoF determined for HCGS, the reference CB&I plant PoF was interpolated at 56 EFPY. Using the value of $2.0x10^{-7}$ in the Final Safety Evaluation of BWRVIP-05 for 32 EFPY and interpolating to obtain the 56 EFPY value results in a PoF value of $1.56x10^{-5}$. The $4.10x10^{-8}$ value for HCGS is less than this interpolated CB&I value of $1.56x10^{-5}$. The difference between the two inspection coverage cases (0% and 90%) for the circumferential welds is $1.66x10^{-10}$ probability of failure event per year. This difference is less than the $1x10^{-6}$ per year requirement as specified in Regulatory Guide 1.174 (Reference 4.8.17).

These results justify the elimination of the reactor pressure vessel circumferential volumetric weld examination in the vessel beltline region to the end of the extended period of operation (60 years or 56 EFPY) for HCGS.

The procedures and training used to limit reactor pressure vessel cold over-pressure events will be the same as those approved by the NRC when HCGS requested the BWRVIP-05 technical alternative be used for the current term (Reference 4.8.19). A request for extension of this relief for HCGS for the extended operating period will be submitted to the NRC, in accordance with 10 CFR 50.55(a), prior to the period of extended operation.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The analysis has been projected through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

Table 4.2.4-1
Effects of Irradiation on Reactor Pressure Vessel Circumferential Weld Properties for HCGS

Group	CB&I Vessel 64 EFPY [1]	HCGS Vessel 56 EFPY [3]
Copper Content, Cu (wt. %)	0.10	0.084
Nickel Content, Ni (wt. %)	0.99	0.626
Chemistry Factor, CF (°F)	109.5	110.12
Fluence at clad/base metal interface (10^{19} n/cm^2)	1.02	0.106
Unirradiated Reference Temperature, $RT_{NDT(U)}$ (°F)	-65	-30
Shift in Reference Temperature, ΔRT_{NDT} (without margin) (°F)	135.6	39.4
Mean RT_{NDT} (°F) [2]	70.6	9.4

Notes:

1. Information reported in Table 2.6-5 of the SER for BWRVIP-05 (Reference 4.8.15).
2. Mean RT_{NDT} was determined using the peak neutron fluence for the limiting weld.
3. The HCGS values are obtained from Table 4.2.2-1 for limiting circumferential weld W7 (SAW).

4.2.5 REACTOR PRESSURE VESSEL AXIAL WELD FAILURE PROBABILITY

Summary Description

The BWRVIP recommendations for inspection of reactor pressure vessel shell welds in BWRVIP-05 (Reference 4.8.13) contain generic analyses supporting a conclusion in the NRC SER (Reference 4.8.15) that the generic-plant axial weld failure rate is no more than 5×10^{-6} per reactor year. BWRVIP-05 showed that this axial weld failure rate of 5×10^{-6} per reactor year is orders of magnitude greater than the 40-year end-of-life circumferential weld failure probability, and used this analysis to justify relief from inspection of the circumferential welds as described in Section 4.2.4. The failure frequency is dependent upon given assumptions of flaw density, distribution, and location. The failure frequency also assumes that "essentially 100%" of the reactor pressure vessel axial welds will be inspected. Despite various obstructions within the reactor pressure vessel, HCGS has been able to meet the "essentially 100%" inspection requirement.

The anticipated changes in metallurgical conditions expected over the extended licensed operating period require an additional analysis for 56 EFPY. As such, this analysis meets the requirements of 10 CFR 54.3(a) and has been identified as a TLAA requiring evaluation for the period of extended operation.

Analysis

As stated above, the probability of a failure event, PoF, calculated by the NRC in the BWRVIP-05 SER and its supplements depends in part on an assumption that essentially 100% (≥90%) of axial welds can be inspected. At HCGS greater than 90% of the axial welds can be examined.

The axial weld failure probability analysis has been reanalyzed for 56 EFPY to address the material property changes associated with increased fluence. Table 4.2.5-1 compares the HCGS limiting axial weld properties at 56 EFPY to the values taken from Table 2.6-5 found in the NRC Final Safety Evaluation for BWRVIP-05 (Reference 4.8.15) and the associated supplement to the Final Safety Evaluation (Reference 4.8.16). The Final Safety Evaluation Supplement required the limiting axial weld to be compared with data found in Table 3 of the document. For HCGS, the comparison was made to the CB&I information; although Hitachi manufactured the HCGS reactor pressure vessel, the Final Safety Evaluation for BWRVIP-05 (Reference 4.8.15) determined that the Hitachi-fabricated vessel is comparable to the CB&I vessels.

The HCGS limiting axial weld chemistry, chemistry factor, and 56 EFPY mean RT_{NDT} values are within the limits of the values assumed in the analysis performed by the NRC staff in the March 7, 2000 BWRVIP-05 Final Safety Evaluation Supplement (Reference 4.8.16) and the 64 EFPY limits and values obtained from Table 2.6-5 of the SER. The 56 EFPY mean RT_{NDT} is also less than those specified in Table 1 of the NRC SER for BWRVIP-74 (Reference 4.8.8). Since the comparison of neutron fluence, initial RT_{NDT}, chemistry factor amounts of copper and nickel, delta RT_{NDT}, and the projected mean RT_{NDT} of the limiting axial weld at the end of the period of extended operation has been projected to be less than that found in the reference case in the BWRVIP and

NRC analyses, the axial weld failure probability continues to be bounded by the previously approved value of less than 5E-6 per reactor year.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The analysis has been projected through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

Table 4.2.5-1
Effects of Irradiation on Reactor Pressure Vessel Axial Weld Properties for HCGS

Group	CB&I Vessel 64 EFPY [1]	HCGS Vessel 56 EFPY [3]
Copper Content, Cu (wt. %)	0.10	0.084
Nickel Content, Ni (wt. %)	1.08	0.626
Chemistry Factor, CF (°F)	135.0	110.12
Fluence at clad/base metal interface (10^{19} n/cm^2)	1.38	0.134
Unirradiated Reference Temperature, $RT_{NDT(U)}$ (°F)	-30	-30
Shift in Reference Temperature, ΔRT_{NDT} (without margin) (°F)	147.1	44.3
Mean RT_{NDT} (°F) [2]	117.1	14.3

Notes:

1. Information reported in Table 2.6-5 of the SER for BWRVIP-05 (Reference 4.8.15).
2. Mean RT_{NDT} was determined using the peak neutron fluence for the limiting weld.
3. The HCGS values are obtained from Table 4.2.2-1 for limiting axial weld W14 (SAW).

4.2.6 REACTOR PRESSURE VESSEL CORE REFLOOD THERMAL SHOCK ANALYSIS

Summary Description

General Electric Report No. NEDO-10029 (Reference 4.8.20) addressed the concern for brittle fracture of the reactor pressure vessel due to reflood following a postulated Loss of Coolant Accident (LOCA). The thermal shock analysis documented in the report assumed a design basis LOCA followed by a Low Pressure Coolant Injection (LPCI) accounting for the full effects of neutron embrittlement at the end of 40 years. The analysis showed that the total maximum vessel irradiation (E> 1 MeV) at the mid-core inside of the reactor pressure vessel would be 2.4×10^{17} n/cm^2, which was considered to be below the threshold level of any nil-ductility temperature shift for the reactor pressure vessel material. As a result, it was concluded that the irradiation effects on all locations of the reactor pressure vessel could be ignored. This analysis bounded only 40 years of operation. NEDO-10029 is referenced in Section 5.3.3 of the HCGS Updated Final Safety Analysis Report (UFSAR) (Reference 4.8.21). Therefore, reflood thermal shock of the reactor pressure vessel has been identified as a TLAA for HCGS requiring evaluation for the period of extended operation.

Analysis

Since the time of the NEDO-10029 analysis, another analysis has been performed for BWR-6 vessels (Reference 4.8.22). The more recent analysis is appropriate for the HCGS reactor pressure vessel because it evaluates the bounding LOCA event, a main steam line break, for a BWR vessel design that is similar to the HCGS reactor pressure vessel. The HCGS reactor pressure vessel inside diameter of 251" is the same size as one of the vessel sizes evaluated in the BWR-6 analysis, and the HCGS reactor pressure vessel wall thickness of 6.102" is slightly larger than the 6" thickness evaluated in the BWR-6 analysis. Therefore, the temperature change (cooldown) due to the reflood event at the 1/4T depth would potentially be different for the HCGS reactor pressure vessel than that of the BWR-6 vessel. Because of these differences, the more recent BWR-6 analysis was reevaluated for the HCGS BWR-4 reactor pressure vessel.

The BWR-6 analysis results in a peak stress intensity factor, K, at 1/4T of approximately 100 ksi√inch. For HCGS, the re-evaluation showed that the allowable material fracture toughness resides on the upper shelf of 200 ksi√inch based on the maximum calculated reactor pressure vessel beltline material ART is 78.7°F for Plate 5K3025/1 from Table 4.2.2-1 at 56 EFPY. The peak applied stress intensity factor of 100 ksi√inch from the BWR-6 analysis was determined to be bounding for HCGS. Since the value of 100 ksi√inch is less than the available fracture toughness of 200 ksi√inch after 56 EFPY (corresponding to 60 years), brittle fracture of the HCGS reactor pressure vessel due to vessel reflood following a design basis LOCA is not possible during the period of extended operation.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The analysis has been projected through the period of extended operation and found to be acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

4.2.7 REACTOR INTERNALS COMPONENTS

Summary Description

A number of the reactor internals components are subject to high fluence because of their proximity to the core. This high fluence can lead to stress relaxation for bolting.

An analysis was performed to assess the effect of neutron fluence on the core plate rim hold down bolts in support of the extended power uprate. Therefore it has been identified as a TLAA.

Additionally, the fluence experienced by components is a function of the life of the plant, the NRC SER for BWRVIP-25 has identified that neutron aging of these components is a TLAA issue. BWRVIP-25 identifies stress relaxation of the core plate rim hold down bolts as a TLAA issue.

Analysis

Although the original analysis assumed the fluence value would bound the period of extended operation considering extended power uprate, a plant-specific fluence analysis was performed to determine fluence values at the core plate rim hold down bolt locations at various Effective Full Power Years (EFPY) values up to 56 EFPY. A plant-specific structural analysis was then performed using the new fluence values and it determined that the pre-load of the rim hold down bolts would be sufficient to prevent lateral motion of the core plate until the plant reaches 43.9 EFPY, which will occur after entry into the period of extended operation.

Since this analysis will not bound 56 EFPY (60 years), additional actions are required. Prior to the period of extended operation, which is prior to the analyzed limit of 43.9 EFPY, the plant will either; (1) install core plate wedges or (2) perform an analysis that demonstrates the component function is maintained.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The aging effects of the core plate rim hold-down bolts will be managed by the analysis that projects sufficient preload of the bolts until 43.9 EFPY, and by taking action as described above, prior to the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

4.3 METAL FATIGUE OF THE REACTOR PRESSURE VESSEL, INTERNALS, AND REACTOR COOLANT PRESSURE BOUNDARY PIPING AND COMPONENTS

Fatigue is the progressive localized permanent structural change that occurs in a material subjected to repeated or fluctuating strains at nominal stresses having maximum values often much less than the tensile strength of the material. A cyclically loaded metal component may fail because of fatigue even though the cyclic stresses are considerably less than the static design limit. Some design codes therefore contain explicit metal fatigue calculations or design limits, such as the ASME Code. Cyclic or fatigue design of other components may not be to this code, but may use similar methods. In the case of the HCGS reactor pressure vessel, fatigue calculations were performed based on the postulated cycles during operation of the plant, the most common of these being the startup/shutdown cycle. These calculations are tied to cycle count limits or to fatigue usage factor limits, and may therefore be TLAAs.

Fatigue TLAAs for HCGS are evaluated in the following groupings:

- Reactor Pressure Vessel Fatigue Analyses (4.3.1)
- Reactor Pressure Vessel Internals Fatigue Analyses (4.3.2)
- Reactor Coolant Pressure Boundary Piping and Component Fatigue Analyses (4.3.3)
- Non-Class 1 Component Fatigue Analyses (4.3.4)
- Effects of Reactor Coolant Environment on Fatigue Life of Components and Piping (Generic Safety Issue 190) (4.3.5)

NUREG-1801 (Reference 4.8.23) identifies numerous fatigue related aging effects that require evaluation as possible TLAAs in accordance with 10 CFR 54.21(c). Each of these is summarized in NUREG-1800 (Reference 4.8.24) and presented in Section 3 of this LRA and referenced to the appropriate TLAA section.

4.3.1 REACTOR PRESSURE VESSEL FATIGUE ANALYSES

Summary Description

Reactor pressure vessel fatigue analyses, including the vessel support skirt, shell, upper and lower heads, closure flanges and studs, nozzles and penetrations, nozzle safe ends, and refueling bellows support depend on the assumed numbers and the severity of normal and upset event pressure and thermal operating cycles to predict end-of-life fatigue usage factors in accordance with Section III of the ASME Code. These assumed cycle counts used to determine fatigue usage factors are based on the original 40-year design life of the plant. The calculation of fatigue usage factors is part of the current licensing basis and is used to support safety determinations. As such the reactor

pressure vessel fatigue analyses meet the requirements of 10 CFR 54.3(a) for a TLAA.

Analysis

The original HCGS reactor pressure vessel stress report included fatigue analyses for the reactor pressure vessel components based on a set of design basis duty cycles. These duty cycles are listed in Table 3.9-1 and 3.9-1a of the HCGS UFSAR, and are shown in Table 4.3.1-1. The original 40-year analyses demonstrated that the cumulative usage factors (CUFs) for all critical components would remain below the allowable fatigue usage value of 1.0 specified in Section III of the ASME Code. The HCGS reactor pressure vessel was designed in accordance with ASME Code, Section III, 1968 Edition, with addenda up to and including Winter 1969, as documented in Section 5.3.3.1 of the HCGS UFSAR.

Revised CUF evaluations were also performed to assess the impact of Extended Power Uprate (EPU) on the reactor pressure vessel for HCGS. These evaluations revised the CUF values for some reactor pressure vessel components based on the change in reactor operating conditions resulting from EPU. The revised CUF evaluations were approved by the NRC as a part of the EPU approval process (Reference 4.8.18).

In addition, revised fatigue evaluations were performed for the recirculation inlet nozzle for containment or "new" loads in 1988, for the top head and vessel flanges for asymmetric head spray cooling in 1990, for the main closure region to support reduced-pass stud tensioning in 2000, for the reactor pressure vessel support skirt to evaluate cumulative fatigue loadings in 1996, and for the core spray nozzles to evaluate the impact of additional HPCI injections in 2008.

The list of design transients used in the reactor pressure vessel fatigue analyses was intended to envelope all foreseeable thermal and pressure cycles that could be expected to occur within a nominal 40-year operating period for the plant. The list of controlling transients for HCGS is shown in Table 4.3.1-1. This list encompasses all transients listed in Tables 3.9-1 and 3.9-1a of the HCGS UFSAR for the reactor pressure vessel, but also includes all transients relevant to fatigue accumulation in all reactor pressure vessel, Class 1 piping, and containment components where a fatigue basis exists. The actual numbers of events experienced to-date (12/31/2007) are also listed in Table 4.3.1-1. The number of transients experienced to-date for the reactor pressure vessel and other analyzed components was compiled from the HCGS Cycle Counting program, which has been in place since plant startup. The sources of data used by that program include operator log books, plant instrument data, event reports, NRC correspondence, surveillance test results, equipment logs and operating experience reports. The numbers of occurrences expected for 40 and 60 years of operation were obtained by extrapolating the numbers of occurrences actually incurred to-date, and using the rate of occurrence experienced during the last twelve years of operation (nine operating cycles). The frequency of events, such as scrams and shutdowns, experienced in the last twelve years is significantly less than that experienced during the first ten years of operation, and is expected to remain equal to or less than the trend over the past twelve years through the period of extended operation by maintaining careful attention to good operating practices. Conservatism was added beyond the mathematically projected

number of cycles to accommodate potential variation in plant performance late in plant life, as well as to allow for additional events where the projected number of cycles was very low and the likelihood of additional events could not be ruled out.

The projected numbers of occurrences for each event for 40 and 60 years are also included in Table 4.3.1-1, as are the numbers of cycles assumed in the design basis 40-year fatigue analyses. There are several transients in this table whose 60-year Assumed Number of Cycles exceed the Designed Analyzed Cycles for 40 years. The number of design basis cycles does not represent a design limit. The fatigue for a component is normally the result of several different thermal and pressure transients. Exceeding the number of cycles for one transient does not necessarily imply the fatigue usage will exceed an acceptance limit. Those transients that are important to determining a CUF for all critical reactor coolant pressure boundary locations by the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program are noted in Table 4.3.1-1.

The CUFs of the reactor pressure vessel, including the vessel support skirt, shell, upper and lower heads, closure flanges and studs, nozzles and penetrations, nozzle safe ends, and refueling bellows support will be managed by the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program. This program will monitor critical reactor pressure vessel CUFs through the use of a fatigue monitoring software application using either stress-based fatigue (SBF) monitoring or cycle-based fatigue (CBF) monitoring versus the allowable value.

Stressed-based fatigue monitoring consists of computing a "real time" stress history for a given component from actual temperature, pressure, and flow histories via a finite element-based Green's Function approach. CUF is then computed from the computed stress history using appropriate cycle counting techniques and appropriate ASME Code, Section III fatigue analysis methodology. The NRC concern regarding the simplified input to the Greens' function of only one value of stress expressed in RIS 2008-30 has been addressed in completion of the work done for Hope Creek by completing a detailed stress analysis using the six stress components as discussed in ASME Code, Section III, Subsection NB, Subarticle NB-3200. SBF monitoring is intended to duplicate the methodology used in the governing ASME Code stress report for the component in question, but uses actual transient severity in place of design basis transient severity. Confirmatory evaluation has been performed to verify the conservatism of the HCGS Green's Function and associated SBF methodology.

Cycle-based fatigue monitoring consists of a two-step process: (a) automated cycle counting, and (b) CUF computation based on the counted cycles. Automated cycle counting evaluates each transient that is defined in the plant licensing basis based upon the mechanistic process or sequence of events experienced by the plant (as determined from monitored plant instruments). The approach is conservative because it assumes each actual transient has a severity equal to that assumed in the design basis. The unique severity of any transient identified by the aging management program software is captured for each monitored component for ready comparison to design basis transient severity. Transients defined in the HCGS UFSAR are identified and implemented into the fatigue monitoring software. CUF computation calculates

fatigue directly from counted transients and parameters for the monitored components. CUF is computed via a design-basis fatigue calculation where the actual numbers of counted cycles are substituted for the assumed design basis number of cycles using the governing stress report methodology.

All locations with CUF ratios (i.e., CUF/allowable) predicted to exceed 0.4 (or 40% of allowable) in the original design basis fatigue analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects as discussed in Section 4.3.5 below, have been included in the program. The list of monitored reactor pressure vessel locations is listed in Table 4.3.1-2.

One of the reactor pressure vessel components, the core spray nozzles, indicated fatigue usage over the allowable value prior to 40 years of operation when using actual numbers of cycles accumulated to-date and projected to 40 years of plant operation. The CUF for this component was re-analyzed in accordance with ASME Code, Section III, 2001 Edition, including addenda up to and including 2003, which have been accepted for use by the NRC through 10 CFR 50.55(a). Reconciliation was performed to justify the use of the later edition of the ASME Code compared to the edition originally used to design the HCGS reactor pressure vessel). The updated CUF value for the core spray nozzles is listed in Table 4.3.1-2.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for critical reactor pressure vessel components. All necessary plant transient events, as shown in Table 4.3.1-1, will be tracked to ensure that the CUF remains less than the allowable CUF limit for all monitored components. In the event the monitored CUF is predicted to exceed the allowable value for any component prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded. HCGS has an existing program in place to track operating thermal and pressure cycles and to assess their effect on vessel fatigue. The requirements from this program will be incorporated into the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program. The required implementing actions will be completed prior to the period of extended operation. As such, the Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the reactor pressure vessel in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.3.1-1
HCGS Reactor Pressure Vessel Design Transients and 60-Year Cycle Projections

Transient	Included in Table 3.9-1 or 3.9-1a of UFSAR?	Design Number of Cycles [1]	Cycles as of 12/31/07	40-Year Projected Number of Cycles [9]	60-Year Projected Number of Cycles [9]	60-Year Number of Cycles Assumed for Analysis
Boltup [8]	Y	44	18	34	50	55
Design Hydrostatic Test (1,250 psig) [8]	Y	44	18	34	50	55
Startup [8]	Y	117	79	125	174	180
Turbine Roll and Increase to Rated Power [8]	Y	117	79	125	174	180
Daily Reduction to 75% Power	Y	6,667	See Note 10			6,667
Weekly Reduction to 50% Power	Y	1,233	See Note 10			1,233
Rod Pattern Change	Y	400	See Note 10			400
Loss of Feedwater Heaters (Turbine Trip with 100% Steam Bypass and Partial Feedwater Heater Bypass) [8]	Y	23	10	16	22	25
SCRAM (Turbine Generator Trip-Feedwater On-Isolation Valves Stay Open and All Other) [8]	Y	136	80	124	169	175
Reduction to 0% Power [8]	Y	111	79	125	174	180
Hot Standby [8]	Y	111	79	125	174	180
Shutdown [8]	Y	111	79	125	174	180
Vessel Flooding [8]	Y	111	79	125	174	180
Hydrostatic Test (1,563 psig) [8]	Y	1	2	2	2	3
Unbolt [8]	Y	44	18	34	50	55
Pre-Op Blowdown [8]	Y	10	1	1	1	2
Loss of Feedwater Pumps, Isolation Valves Close [2,8]	Y	5	6	10	13	15
Reactor Overpressure with Delayed Scram, Feedwater Stays On, Isolation Valves Stay Open [8]	Y	1	0	0	0	See Note 3
Single Relief or Safety Valve Blowdown [8]	Y	8	2	4	6	See Note 3
Automatic Blowdown [8]	Y	1	0	0	0	See Note 3
Improper Start of Cold Recirc. Loop [8]	Y	1	0	0	0	See Note 3
Sudden Start of Pump in Cold Recirc. Loop [8]	Y	1	0	0	0	See Note 3
Improper Startup with Recirculation Pumps Off & Drain Shut Off [8]	Y	1	0	0	0	See Note 3
Pipe Rupture and Blowdown [8]	Y	1	0	0	0	See Note 4
Natural Circulation Startup [8]	Y	3	0	0	0	3
Loss of AC Power Natural Circulation Restart [8]	Y	5	See Note 6			5
RPV Drain Line Flow Transient	N	480	See Note 7			480
Operating Basis Earthquake (OBE) [8]	Y	10 / 50 [5]	0	0	0	10 / 50 [5]
Safe Shutdown Earthquake (SSE) at Rated Operating Conditions [8]	Y	1	0	0	0	See Note 4
Safety Relief Valve (SRV) Actuations [8]:	N	966	390	505	618	966
+ Single		596	380	487	592	596
+ Multiple		370	10	18	26	370
Core Spray Injection [8]	N	10	3	3	5	5
High Pressure Coolant Injection (HPCI) [8]	N	15	21	25	34	35
RWCU Pump Trip [8]	N	240	85	140	200	240

For notes, see next page.

Table 4.3.1-1 (continued)
HCGS Reactor Pressure Vessel Design Transients and 60-Year Cycle Projections

Transient	Included in Table 3.9-1 or 3.9-1a of UFSAR?	Design Analyzed Number of Cycles (1)	Cycles as of 12/31/07	40-Year Projected Number of Cycles (9)	60-Year Projected Number of Cycles (9)	60-Year Number of Cycles for Assumed for Analysis
Standby Liquid Control (SLC) Injection (8)	N	10	0	0	0	10
Control Rod Drive (CRD) Events (8):	N	360	30	61	94	205
+ CRD Isolation		50	Note 11	Note 11	Note 11	100
+ Single CRD Scram		10	7	12	17	20
+ Single CRD Scram During Refueling		300	23	49	77	85
Low Pressure Coolant Injection (LPCI) (8)	N	11	3	4	5	5
Reactor Recirculation Single Loop Operation (8)	N	50	10	18	26	29
Alternate Flood-up Event (8)	Y	28	2	18	34	38

Notes:

1. Minimum number of events reported from all UFSAR sources.
2. Reclassified from an Emergency event to an Upset event.
3. Emergency event, so not included in fatigue analysis.
4. Faulted event, so not included in fatigue analysis..
5. 50 peak OBE cycles for the NSSS piping; 10 peak OBE cycles for other NSSS equipment and components.
6. Event no longer considered relevant to HCGS, as it is procedurally prevented; events will be included in the Fatigue Monitoring program for any components where this event was included in the fatigue analysis.
7. Event specified on design basis Thermal Cycle Diagram; insignificant impact on fatigue for all critical RPV Class 1 component fatigue analyses, so not tracked in Fatigue Monitoring program.
8. Transient will be tracked by the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program.
9. Projected for 40 and 60 years based on the number of events as of 12/31/07 and the trends from the past twelve years (nine operating cycles) of actual plant operation.
10. This event has an insignificant impact on fatigue, and load following is not practiced at HCGS; events will be included in the Fatigue Monitoring Program for any components where this event was included in the fatigue analysis.
11. CRD isolations are not a normal practice at HCGS and are not tracked as part of the existing fatigue monitoring program. A conservative and bounding number of cycles has been provided for analysis purposes, and an initial bounding number of cycles will be assigned as part of the enhanced Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program prior to the period of extended operation.

Table 4.3.1-2
Fatigue Monitoring Locations for HCGS Reactor Pressure Vessel Components and Estimated CUFs

Component	Design Basis 40-Year CUF (1)	Estimated CUF as of 12/31/07 (2)	Estimated 40-Year CUF (3)	Estimated 60-Year CUF (3)	Monitoring Technique (4, 5)
Main Closure Studs	0.872	0.505	0.854	1.221 (8)	CBF
Shroud Support (Shroud Cylinder)	0.672	0.205	0.333	0.465	CBF
CRD Penetrations (CRD Housing @ Weld)	0.021	0.011	0.019	0.034	CBF (NUREG/CR-6260 component)
Core Spray Nozzle (Safe End/Thermal Sleeve)	0.067 (6)	0.038	0.047	0.065	CBF (NUREG/CR-6260 component)
Core Spray Nozzle (Nozzle Body)	0.107 (6)	0.040	0.063	0.087	CBF (NUREG/CR-6260 component)
Top Head Lifting Lug Bracket	0.688	0.260	0.410	0.565	CBF
CRD Penetrations with Excavation (B)	0.456	0.093	0.154	0.216	CBF (NUREG/CR-6260 component)
Recirculation Outlet Nozzle (Nozzle Body)	0.086	0.022	0.036	0.051	CBF (NUREG/CR-6260 component)
Recirculation Inlet Nozzle (Nozzle Body)	0.116	0.036	0.058	0.081	CBF (NUREG/CR-6260 component)
Feedwater Nozzle (Safe End)	0.014	0.084	0.121	0.198	SBF (NUREG/CR-6260 component)
Feedwater Nozzle (Nozzle Forging)	0.118 (7)	0.066 (7)	0.115 (7)	0.168 (7)	SBF (NUREG/CR-6260 component)

Notes:

1. Based on the currently governing design basis 40-year fatigue analysis. Allowable CUF = 1.0 for all components.
2. Estimated CUF as of 12/31/07 is based on the cycles accumulated to-date as of 12/31/07 from Table 4.3.1-1. For the feedwater nozzle (SBF) locations, the estimated CUF as of 12/31/07 is based on a linear ratio of the Design Basis 40-year CUF.
3. Estimated CUF for 40 years or 60-years based on the CUF as of 12/31/07 and the trends from the past twelve years (nine operating cycles) of actual plant operation.
4. CBF = Cycle-Based Fatigue and SBF = Stress-Based Fatigue.
5. All locations with 40-year design basis CUF ratios (i.e., CUF/allowable) expected to exceed 0.4 (or 40% of allowable) based on the original analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects as discussed in Section 4.3.5, have been included in the program.
6. CUF value shown is for 60 years of operation based on updated fatigue analysis.
7. CUF is the sum of system cycling CUF plus rapid cycling CUF.
8. Estimated 60-year CUF exceeds the allowable value of 1.0. As discussed in Section 4.3.1, if the Metal Fatigue of Reactor Coolant Pressure Boundary program predicts the CUF will reach the allowable value prior to 60 years of operation, appropriate action will be taken in accordance with the corrective action process prior to the allowable limit being exceeded, including replacement of the main closure studs.

4.3.2 REACTOR PRESSURE VESSEL INTERNALS FATIGUE ANALYSES

Summary Description

The HCGS reactor pressure vessel internals were not designed in accordance with the codes described in Section 4.3.1 for the reactor pressure vessel. However, per Section 3.9.5.3.5 of the HCGS UFSAR, stress and fatigue criteria for evaluation of the HCGS reactor pressure vessel internals are described, which are summarized in Tables 3.9-21 through 3.9-24 of the HCGS UFSAR. CUF values are reported for three reactor pressure vessel internals components in Table 3.9-4c of the HCGS UFSAR: (1) a value of 0.111 for the core support plate (at stud), (2) a value of 0.435 for the top guide (at beam slot), and (3) a value of < 0.05 for the core differential pressure sensing line (at elbow). As such, the reactor pressure vessel internals fatigue analyses have been identified as TLAAs that meet the requirements of 10 CFR 54.3(a).

Analysis

The reactor pressure vessel internals are not a part of the Class 1 pressure boundary (other than the shroud support and brackets that are attached to the reactor pressure vessel – these components were addressed in the reactor pressure vessel stress report using ASME Code, Section III methodology and are therefore covered by the discussion in Section 4.3.1). To project the fatigue usage for 60 years for the components above, each of the values above was multiplied by a factor of 1.5 (60 years/40 years). The values for CUF obtained were as follows: (1) 0.167 for the core support plate (at stud), (2) 0.653 for the top guide (at beam slot), and (3) <0.08. The calculated fatigue usage factors, when extrapolated to 60 years, indicate acceptable fatigue value for the period of extended operation when compared to the allowable CUF of 1.0.

The primary contributor to fatigue of reactor pressure vessel internals is from non-thermal dynamic loads (such as accident or seismic loads). These loads seldom, if ever, occur. High cycle mechanical fatigue (i.e., due to vibration) is also a possible contributor to fatigue, but, as discussed in the SER for EPU (Reference 4.8.18), adequate fatigue design for vibration was demonstrated as a part of prototype plant startup testing, where confirmatory vibration measurements were made on all major reactor internals to verify that vibration levels are below the material endurance limit.

Disposition: Revision, 10 CFR 54.21(c)(1)(ii)

The analysis has been projected through the period of extended operation and found to be acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

4.3.3 REACTOR COOLANT PRESSURE BOUNDARY PIPING AND COMPONENT FATIGUE ANALYSES

Summary Description

The HCGS reactor coolant pressure boundary (RCPB) piping was designed in accordance with ASME Code, Section III, Class 1, as stated in Section 3.2.2 of the HCGS UFSAR (Reference 4.8.21).

The HCGS piping systems in the scope of license renewal designed to ASME Code, Section III, Class 1 requirements were explicitly analyzed for fatigue. The analyses demonstrated that the 40-year CUFs for the limiting components in the affected systems were below the ASME Code Section III allowable value of 1.0.

High energy line breaks (HELB) in the HCGS piping have been postulated, and based on analyses performed for these breaks, means for avoiding damage to surrounding equipment and systems have been incorporated in the plant. Potential damage could arise from fluid jet impingement, flooding, compartment pressurization, environmental effects, and pipe whip. Section 3.6 of the HCGS UFSAR addresses these effects, provides criteria for determining break locations and types of breaks that could occur, descriptions of analysis methodologies, and results for significant attached piping showing where breaks could develop and where restraints were to be installed. It is noted that cumulative fatigue usage factors (CUFs) for the high energy lines are included in the criteria to determine postulated breaks. The CUFs, as calculated in the design fatigue analyses, account for the design transients assumed for the original 40-year life of the plant. An allowable value below 0.1 is used for the CUF for HELB limiting locations.

The postulated breaks are in piping for systems important to safety and integrity of the reactor coolant pressure boundary. The restraints designed for these potential breaks are significant for protection of systems and equipment important to plant safety. Therefore, the CUF calculations used in the selection of postulated high energy line break locations are a TLAA.

Since these breaks are postulated to occur only once in the lifetime of the plant, and restraints were installed appropriately to mitigate these potential breaks, the results of analyses for the potential breaks and the restraints installed in the plant remain unchanged for the extended life of 60 years. However, it is possible that other locations that had 40-year CUFs below the criteria for postulated breaks could exceed the CUF criteria in 60 years. The possibility of these additional postulated breaks will need to be managed based on the actual fatigue accumulation encountered as the plant ages.

Because the number of cycles increases with the operating life of the plant, the above piping design satisfies the requirements of 10 CFR 54.3 and is therefore considered to be a TLAA.

Analysis

The HCGS RCPB piping component stress reports include fatigue analyses for all Class 1 piping components based on a set of design basis duty cycles. The

original 40-year analyses demonstrated that the CUFs for all critical piping components would remain below the allowable fatigue usage value of 1.0 specified in Section III of the ASME Code.

The limiting high energy line break locations were considered as a part of the Class 1 piping screening evaluation for identifying locations to monitor in the HCGS Metal Fatigue of Reactor Coolant Pressure Boundary program. High Energy Line Break locations selected for monitoring are identified in Table 4.3.3-1 with allowable CUFs of 0.1. As such, all critical High Energy Line Break locations are encompassed by the HCGS Metal Fatigue of Reactor Coolant Pressure Boundary program.

Revised CUF evaluations have been performed on the piping since the time of original plant construction. These evaluations revised the CUF values for some piping components based on the change in piping configuration or the change in reactor and piping operating conditions.

The list of design transients used in the piping component fatigue analyses was intended to envelope all foreseeable thermal and pressure cycles that could be expected to occur within a nominal 40-year operating period for the plant. The list of controlling transients for HCGS is shown in Table 4.3.1-1. This list encompasses all transients listed in Tables 3.9-1 and 3.9-1a of the HCGS UFSAR for the reactor pressure vessel, but also includes all transients relevant to fatigue accumulation in all piping components where a fatigue basis exists. The actual numbers of events experienced to-date (12/31/2007), the numbers of occurrences expected for 40 and 60 years of operation, and the numbers of cycles assumed in the design basis 40-year fatigue analyses are also listed in Table 4.3.1-1. The development of these values is discussed in Section 4.3.1. Those transients that are important to determining CUF for all critical RCPB component locations by the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program are noted in Table 4.3.1-1.

The CUFs of the bounding piping components will be managed by the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program. This program will monitor critical piping component CUFs through the use of a fatigue monitoring software application, using CBF monitoring versus the allowable value. CBF monitoring is discussed in Section 4.3.1.

All bounding Class 1 piping component locations with CUF ratios (i.e., CUF/allowable) predicted to exceed 0.4 (or 40% of allowable) in the original design basis fatigue analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects as discussed in Section 4.3.5 below, have been included in the program. The list of monitored piping component locations is listed in Table 4.3.3-1.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for critical Class 1 piping components including high energy line break limiting locations. All necessary plant transient events, as shown in Table 4.3.1-1, will be tracked to ensure that the CUF remains less than the allowable CUF limit for all

monitored components. In the event the monitored CUF is predicted to exceed the allowable value for any component prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded.

HCGS has an existing program in place to track operating thermal and pressure cycles and to assess their effect on vessel fatigue. The requirements from this program will be incorporated into the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program. The required implementing actions will be completed prior to the period of extended operation. As such, the Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the RCPB piping in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.3.3-1
Fatigue Monitoring Locations for HCGS RCPB Piping Components and Estimated CUFs

Component	Design Basis 40-Year CUF (1)	Allowable CUF (2)	Estimated CUF as of 12/31/07 (3)	Estimated 40-Year CUF (4)	Estimated 60-Year CUF (4)	Monitoring Technique (5,6)
Main Steam Line A (Node 200)	0.041	0.1	0.047	0.073	0.099	CBF
Main Steam Line B (Node 200)	0.081	0.1	0.034	0.052	0.069	CBF
Main Steam Line C (Node 100)	0.051	0.1	0.029	0.044	0.059	CBF
Main Steam Line D (Node 300)	0.097	0.1	0.059	0.091	0.124 (8)	CBF
Reactor Recirculation A						
Node 204	0.015	1.0	0.008	0.013	0.017	CBF
28" Discharge Gate Valve)	0.111	1.0	(9)	(9)	(9)	CBF
Reactor Recirculation B						
Node 204	0.016	1.0	0.009	0.015	0.021	CBF
28" Discharge Gate Valve	0.111	1.0	(9)	(9)	(9)	CBF
Feedwater Line No. AE-035						
Node 200	0.602	1.0	0.370	0.582	0.808	CBF
Node 315	0.484	1.0	0.322	0.508	0.705	CBF
Node 265	0.471	1.0	0.313	0.493	0.684	CBF
Node 270	0.096	0.1	0.049	0.071	0.094	CBF
Feedwater Line No. AE-036						
Node 200	0.573	1.0	0.385	0.606	0.841	CBF
Node 315	0.481	1.0	0.322	0.507	0.704	CBF
Node 265	0.472	1.0	0.314	0.494	0.685	CBF
Node 197	0.095	0.1	0.062	0.098	0.136 (8)	CBF
Node 130	0.214	1.0	0.103	0.147	0.192	CBF (7)
Reactor Water Cleanup						
Node 570	0.609	1.0	0.309	0.492	0.689	CBF
Node 575	0.639	1.0	0.321	0.512	0.717	CBF
Node 905	0.523	1.0	0.268	0.430	0.603	CBF
Head Vent Line (Node 320)	0.648	1.0	0.001	0.001	0.001	CBF
RHR Shutdown Cooling Suction (Node 535)	0.0365	0.1	0.025	0.039	0.055	CBF (7)
RHR SDC Return A						
Node 601	0.094	0.1	0.077	0.095	0.113 (8)	CBF
Node 608	0.080	0.1	0.061	0.082	0.106 (8)	CBF
RHR SDC Return B (Node 601)	0.2264	1.0	0.196	0.217	0.240	CBF (7)
Nuclear Boiler Instrument. Line No. BB-230-CCA-1" (Node 25B)	0.483	1.0	0.032	0.050	0.068	CBF

Notes:

1. Based on the currently governing design basis 40-year fatigue analysis.
2. Allowable CUF is 1.0, except for High Energy Line Break (HELB) locations, as discussed in Section 4.3.3.
3. Estimated CUF as of 12/31/07 is based on the events accumulated to-date as of 12/31/07 from Table 4.3.1-1.
4. Estimated CUF for 40 years or 60-years based on the CUF as of 12/31/07 and the trends from the past twelve years (nine operating cycles) of actual plant operation.
5. CBF = Cycle-Based Fatigue.

Notes cont'd:

6. All locations with 40-year design basis CUF ratios (i.e., CUF/allowable) expected to exceed 0.4 (or 40% of allowable) based on the original analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects as discussed in Section 4.3.4, have been included in the program.
7. NUREG/CR-6260 component.
8. Estimated 60-year CUF exceeds the allowable value of 0.1. As discussed in Section 4.3.3, if the Metal Fatigue of Reactor Coolant Pressure Boundary program predicts the CUF will reach the allowable value prior to 60 years of operation, appropriate action will be taken in accordance with the corrective action process prior to the allowable limit being exceeded.
9. This location will be incorporated into the Metal Fatigue of Reactor Coolant Pressure Boundary program prior to the period of extended operation.

4.3.4 NON-CLASS 1 COMPONENT FATIGUE ANALYSES

Summary Description

Non-Class 1 components include pipe, tubing, fittings, tanks, vessels, heat exchangers, valve bodies, pump casings, and miscellaneous process components. As listed in UFSAR Tables 3.2-1, 3.2-2, and 3.2-3, these components were generally designed in accordance with appropriate ASME Section III subsections or American National Standards Institute (ANSI) B31.1, or B31.7, depending on their function.

Calculation of cumulative fatigue usage is not required for non-Class 1 components. For non-Class 1 components, stresses due to thermal expansion and anchor movement, which are important for fatigue evaluations, are analyzed using stress intensification factors and stress allowables. Allowable stresses are defined for 7000 full temperature cycles with reductions in allowable stresses as cycles increase beyond 7000.

Analysis

The following HCGS piping systems in the scope of license renewal designed to B31.1 or ASME Code, Section III, Class 2 and 3; Core Spray, Feedwater, High Pressure Coolant Injection (HPCI), Main Steam, Reactor Recirculation, Reactor Water Cleanup, and Residual Heat Removal (RHR) systems. For these systems, the assumed thermal cycle count can conservatively be approximated by the thermal cycles expected for the reactor pressure vessel. The expected 60-year numbers of cycles for these events are listed in Table 4.3.1-1. When combined, the total expected count of the thermal cycles in Table 4.3.1-1 is less than 2,700 for 60 years of plant operation, which is a fraction of the 7,000-cycle threshold. Therefore, the existing piping analyses designed to B31.1 or ASME Code, Section III, Class 2 and 3 within the scope of license renewal are valid for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i)

The expected 60-year numbers of cycles for non-class 1 piping and piping components has been demonstrated to be within the allowed number of cycles assumed in the design for these components and the fatigue design remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

4.3.5 EFFECTS OF REACTOR COOLANT ENVIRONMENT ON FATIGUE LIFE OF COMPONENTS AND PIPING (GENERIC SAFETY ISSUE 190)

Summary Description

Generic Safety Issue (GSI) 166, later renumbered as GSI 190 (Reference 4.8.25), was identified by the NRC because of concerns about the effects of reactor water environment on the fatigue life of components and piping during the period of extended operation. GSI-190 was closed in December of 1999 (Reference 4.8.26), and concluded that environmental effects have a negligible impact on core damage frequency and, as such, no generic regulatory action was required. However, as part of the closure of GSI 190, the NRC concluded that licensees who apply for license renewal should address the effects of coolant environment on component fatigue life as part of their aging management programs.

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 Section X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," requires detailed, vintage-specific, fatigue calculations for plants applying for license renewal for the locations identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components." Since such calculations do not form a part of the HCGS current licensing basis and therefore do not satisfy the requirements of 10 CFR 54.3, they are not TLAA. However, since the environmental fatigue calculations for HCGS are related to the reactor pressure vessel and piping fatigue analyses covered in Sections 4.3.1 and 4.3.3, they are addressed in this section.

Analysis

As a part of the NRC's Fatigue Action Plan, incorporation of environmental fatigue effects originally involved a reduced set of fatigue design curves, such as those proposed by Argonne National Laboratory (ANL) in NUREG/CR-5999 (Reference 4.8.27). As a part of the effort to close GSI 166 (later GSI 190) for operating nuclear power plants during the current 40-year licensing term, Idaho National Engineering Laboratory (INEL) evaluated fatigue-sensitive component locations at plants designed by all four U.S. nuclear steam supply system (NSSS) vendors. The ANL fatigue curves were used by INEL to recalculate the CUFs for fatigue-sensitive component locations in older and newer vintage Combustion Engineering (CE) pressurized water reactors (PWRs), older and newer vintage Westinghouse PWRs, older and newer vintage General Electric (GE) boiling water reactors (BWRs), and Babcock & Wilcox Company (B&W) PWRs. The results of the INEL calculations were published in NUREG/CR-6260 (Reference 4.8.28). The INEL calculations took advantage of conservatisms present in governing ASME Code fatigue calculations, including the numbers of actual plant transients relative to the numbers of design basis transients, but did not recalculate stress ranges based on actual plant transient profiles.

The BWR calculations in NUREG/CR-6260, especially the newer-vintage General Electric plant calculations, are directly relevant to HCGS. The newer-vintage General Electric plant evaluated in NUREG/CR-6260 is the most appropriate comparison to HCGS, since the HCGS piping design is in

accordance with ASME Code, Section III. Although the newer vintage plant evaluated in NUREG/CR-6260 was a BWR-6 that has some systems that differ from HCGS (which is a BWR-4), the NUREG/CR-6260 locations were identified for HCGS by considering both vintage GE plants in NUREG/CR-6260. Accounting for BWR-type differences, the specific locations selected for each of the GE vintage plants in NUREG/CR-6260 were based on selecting the limiting (highest fatigue usage) location for each of the same six identical reactor pressure vessels and Class 1 piping regions. Therefore, detailed environmental fatigue calculations were performed for HCGS primarily based on the locations associated with the newer-vintage General Electric plant.

From NUREG/CR-6260 for the newer-vintage General Electric plant, the following locations require evaluation:

- Reactor pressure vessel shell and lower head
- Reactor pressure vessel feedwater nozzle
- Reactor recirculation piping (including reactor pressure vessel inlet and outlet nozzles)
- Core spray line reactor pressure vessel nozzle and associated Class 1 piping
- Residual heat removal nozzles and associated Class 1 piping
- Feedwater Class 1 piping

Per Section X.M1 of the GALL Report, the environmental fatigue evaluation must use the appropriate environmental fatigue multiplier, or F_{en}, relationships from NUREG/CR-6583 (Reference 4.8.29) for carbon/low alloy steels, and NUREG/CR-5704 (Reference 4.8.30) for stainless steels, as appropriate for the material for each location. Therefore, the methodology documented in NUREG/CR-6583 and NUREG/CR-5704 was used to evaluate environmental effects for HCGS components.

The results of the environmental fatigue calculations performed for all HCGS locations are shown in Table 4.3.5-1. The locations selected for HCGS and presented in Table 4.3.5-1 represent the most limiting locations at HCGS represented by the above list of six items for environmental effects and, therefore, the results are bounding for the HCGS RCPB. The environmental fatigue calculations make use of the 60-year cycles for HCGS as listed in Table 4.3.5-1. The results demonstrate that CUF values, including appropriate environmental effects, are less than 1.0 for 60 years of plant operation for all locations except for the reactor pressure vessel feedwater nozzle safe end. Corrective action will be taken prior to exceeding the environmental assisted fatigue CUF value of 1.0.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

As noted in Sections 4.3.1 and 4.3.3, all of the locations shown in Table 4.3.5-1 will be included in the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program, and the CUF for these locations will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.3.5-1
Environmental Fatigue Results for HCGS for NUREG/CR-6260 Components

NUREG/CR-6260 Location	Equivalent HCGS Location(s) (1)	Material	60-Year Fatigue Usage Factor (2)	60-Year Fatigue Usage Factor with Environmental Effects (3)	Overall Environmental Fatigue Multiplier (4)
Reactor pressure vessel shell and lower head	CRD Penetration Drive Housing	Stainless Steel	0.0393	0.5615	14.30
	CRD Penetration with Excavation	Alloy 600	0.2765	0.4119	1.49
Reactor pressure vessel feedwater nozzle	Safe End	Stainless Steel	0.1982	2.3810 (5)	12.01
	Nozzle Forging	Low Alloy Steel	0.1031	0.8096 (6)	7.22
Reactor recirculation piping (including inlet and outlet nozzles)	RHR Return Tee	Stainless Steel	0.2405	0.6250	2.60
	RPV inlet nozzle forging	Low Alloy Steel	0.1033	0.3589	3.48
	RPV outlet nozzle forging	Low Alloy Steel	0.0701	0.2457	3.51
Core spray line reactor pressure vessel nozzle and associated Class 1 piping	Core Spray Nozzle	Low Alloy Steel	0.1063	0.7678	7.22
	Core Spray Nozzle Safe End	Alloy 600	0.0202	0.0301	1.49
Residual heat removal nozzles and associated Class 1 piping	RHR Supply Piping	Stainless Steel	0.0252	0.2105	8.36
	RHR Supply Piping	Carbon Steel	0.0547	0.3551	6.49
Feedwater Class 1 piping	Tee on header to RPV Nozzle N4E	Carbon Steel	0.074	0.350	4.73

Notes:

1. Locations shown are the bounding locations for HCGS.
2. Revised fatigue usage factors were computed for all of the NUREG/CR-6260 components based on the assumed number of cycles for 60 years of plant operation.
3. Environmental fatigue usage was computed using the methodology of NUREG/CR-6583 (for carbon/low alloy steels) and NUREG/CR-5704 (for stainless steels), as appropriate for the material for each location.
4. Environmental multipliers (F_{en}s) were calculated based on the assumption that Hydrogen Water Chemistry (HWC) conditions exist for 85% of the overall 60-year operating period, and Normal Water Chemistry (NWC) conditions exist for 15% of the overall 60-year operating period. The following dissolved oxygen (DO) conditions were used based on review of historical DO data:
   - Feedwater line DO is 31 ppb for pre-HWC and 86 ppb for post-HWC conditions.
   - Recirculation line DO is 266 ppb pre-HWC and 57 ppb post-HWC.
   - RPV Upper Region DO is 103 ppb pre-HWC and 81 ppb post-HWC.
   - RPV Beltline DO is 106 ppb pre-HWC and 4 ppb post-HWC.
   - RPV Bottom Head Region DO is 109 ppb pre-HWC and 33 ppb post-HWC.
5. The estimated 60-year CUF with environmental effects exceeds the allowable value of 1.0. As discussed in Section 4.3.5, corrective action will be taken prior to exceeding the environmental assisted fatigue CUF value of 1.0.
6. Rapid cycling effects are included in the 60-year Environmental CUF value, but are not multiplied by the Overall Environmental Multiplier based on guidance of Section 4.2.6 of MRP-47, Revision 1.

4.4 ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT

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 Hope Creek. 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 Hope Creek Environmental Qualification (EQ) of Electric Components program 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 Hope Creek Environmental Qualification (EQ) of Electric 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 Hope Creek 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 Hope Creek 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 Hope Creek 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 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 Hope Creek 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 assumed ambient temperature of the component, 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 Hope Creek 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 Hope Creek 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 Hope Creek 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.

Underlying Assumptions

The Hope Creek Environmental Qualification (EQ) of Electric Components program component aging evaluations contain sufficient conservatism. Additionally, plant modifications that have potential impact to the Hope Creek Environmental Qualification (EQ) of Electric Components program are evaluated during the modification process to determine the impact of the plant modification on the Hope Creek Environmental Qualification (EQ) of Electric 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 Hope Creek 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 Hope Creek 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 in accordance with 10 CFR 54.21(c)(1)(iii).

4.5 LOSS OF PRESTRESS IN CONCRETE CONTAINMENT TENDONS

The HCGS containment does not have pre-stressed tendons. As such, this topic is not a TLAA.

4.6 CONTAINMENT LINER PLATE, METAL CONTAINMENTS, AND PENETRATIONS FATIGUE ANALYSES

4.6.1 FATIGUE ANALYSIS OF PRIMARY CONTAINMENT, ATTACHED PIPING, AND COMPONENTS

Summary Description

The HCGS containment vessel is a Mark I design with a drywell and toroidal suppression chamber. The suppression chamber assembly is often referred to as the "torus", and is used interchangeably with the phrase "suppression chamber" in the discussions that follow. The HCGS primary containment was designed in accordance with the ASME Code, Section III. Subsequently, during large scale testing for the Mark III containment system and the in-plant testing for Mark I primary containment systems, new suppression chamber hydrodynamic loads were identified. These loads result from blowdown into the suppression chamber during a postulated Loss of Coolant Accident (LOCA) and during Safety Relief Valve (SRV) operation for plant transients. Re-evaluation of the primary containment structure was performed in two parts: generic analyses applicable to each of the several classes of BWR containments, and Mark I Containment Program plant-unique analyses. The scope of the analyses included the pressure suppression chamber (shells and welds), the drywell-to-pressure suppression chamber vents (header and downcomers), SRV discharge piping, other piping attached to the pressure suppression chamber, penetrations, and vent bellows.

The Mark I analyses are detailed in the HCGS Plant Unique Analysis Report (PUAR) and assume 370 multiple SRV lifts and 596 single SRV lifts. Since these analyses include fatigue evaluations based on the occurrence of a limited number of transient cycles during the current licensed term of operation (40 years), they satisfy the requirements of 10 CFR 54.3 and are TLAAs.

Analysis

To address license renewal requirements, the historical number of SRV Lifts was researched to determine the number of SRV lifts from 1986 (initial plant startup testing) through the end of 2007. Relevant documentation that was reviewed for this effort included plant start-up tests, post trip logs, surveillance tests, and annual reports required by Technical Specifications. Using this information and projecting the results for 60 years of operation provided a projected number of 592 single SRV lifts for 60 years, and a projected number of 26 multiple lifts for 60 years (see Table 4.3.1-1). Both of these numbers are below the values assumed in the Mark I analyses (596 single SRV lifts and 370 multiple SRV lifts).

Containment fatigue analyses exist for the following component groups:

- Drywell shell and vent line penetrations
- Suppression Chamber Components and Welds
- Vent System Components and Welds

- Suppression Chamber Penetrations
- SRV Discharge Piping
- Other Torus Attached Piping

Table 4.6.1-1 summarizes the design basis fatigue CUF values from the analyses described above.

For all primary containment system components, the majority of the CUF is caused by Design Basis Accident (DBA) or Small Break Accident (SBA) and Operating Basis Earthquake (OBE) loadings, all of which are not expected to occur during the operating lifetime of HCGS. The contribution to CUF by SRV Actuations is generally small, and will remain small for the number of events anticipated for the 60-year life of the plant. Because the projected number of actual events for 60 years of operation is less than the number assumed in the design basis (40-year) analysis, this 40-year design basis analysis remains bounding for the period of extended operation. Therefore, CUFs for these locations are expected to remain below the allowable value of 1.0 for the 60-year life of the plant.

Even though the projected number of cycles and the associated CUF are projected to be within the original design assumptions, all relevant plant transient events will be tracked to ensure that the CUF remains less than 1.0 for all monitored components. Validation for primary containment locations will be performed by monitoring the high CUF limiting containment locations. All governing fatigue analyses have been reviewed to establish a comprehensive and bounding set of primary containment locations for inclusion in the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program.

Bounding locations with design basis CUFs that exceed 0.4 (or 40% of the allowable value) will be included in the program, as identified in Table 4.6.1-1. As identified in Table 4.3.1-1, SRV lifts will be monitored to ensure that the CUFs remain less than 1.0.

For locations with a CUF less than 0.4 in Table 4.6.1-1, a 20-year increase in service life will not raise the CUF significantly close to the allowable value of 1.0. Therefore, these locations are not included in the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program.

In the event fatigue usage for any component is predicted to exceed 1.0 as a result of monitoring prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process. The required implementing actions will be completed prior to the period of extended operation.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for critical primary containment components. All necessary plant transient events, as shown in Table 4.3.1-1, will be tracked to ensure that the CUF remains less than the allowable CUF limit for all monitored components. In the event the monitored CUF is predicted to exceed the allowable value for any component

prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded. HCGS has an existing program in place to track operating thermal and pressure cycles and to assess their effect on vessel fatigue. The requirements from this program will be incorporated into the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program. The required implementing actions will be completed prior to the period of extended operation. As such, the Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the primary containment in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.6.1-1
Fatigue Monitoring Locations for HCGS Primary Containment and Estimated CUFs

Component	Design Basis 40-Year CUF (1)	Estimated CUF as of 12/31/07 (2)	Estimated 40-Year CUF (3)	Estimated 60-Year CUF (3)	Monitoring Technique (4,5)
Suppression Chamber Components and Welds					
+ Torus Shell	0.725	0.230	0.299	0.366	CBF
+ Weld	0.801	0.207	0.271	0.334	CBF
Vent System Components and Welds					
+ Vent Header (at Downcomer-Vent Header Intersection)	0.630	0.132	0.169	0.206	CBF
+ Weld (at Downcomer-Vent Header Intersection)	0.791	0.182	0.233	0.283	CBF
Drywell Shell at Vent Line Penetration	0.98	(8)	(8)	(8)	CBF
Suppression Chamber Penetrations	< 1.0	(7)	(7)	(7)	Not monitored – bounded by other locations (6)
SRV Discharge Piping	< 0.5	(7)	(7)	(7)	Not monitored – bounded by other locations (6)
Other Torus Attached Piping	< 0.5	(7)	(7)	(7)	Not monitored -- bounded by other locations (6)

Notes:
1. Based on the currently governing design basis 40-year fatigue analysis, the allowable CUF for all components is 1.0.
2. Estimated CUF as of 12/31/07 is based on the events accumulated to-date as of 12/31/07 from Table 4.3.1-1.
3. Estimated CUF for 40 years or 60-years based on the CUF as of 12/31/07 and the trends from the past twelve years (nine operating cycles) of actual plant operation.
4. CBF = Cycle-Based Fatigue.
5. All locations with 40-year design basis CUF ratios (i.e., CUF/allowable) expected to exceed 0.4 (or 40% of allowable) based on the original analysis will be included in the program.
6. If fatigue monitoring results for other components approaches or exceeds a CUF of 0.8, monitoring of this component will be implemented.
7. Component fatigue is bounded by other locations because suppression chamber and vent system components and welds are limiting to the associated piping and penetrations.
8. This location will be included into the fatigue monitoring program prior to the period of extended operation.

4.6.2 PRIMARY CONTAINMENT PROCESS PENETRATIONS AND BELLOWS FATIGUE ANALYSIS

Summary Description

The primary containment process piping penetrations use flued heads to connect the process piping to the drywell sleeves. The primary containment process piping penetrations meet ASME Section III, Class I or II requirements, as applicable. The flued heads for the ASME Section III, Class 1 process piping systems have been analyzed for fatigue. These Class 1 fatigue analyses are based upon thermal cycles specified for the 40-year life for the plant and have therefore been identified as TLAAs requiring evaluation for the period of extended operation. The primary containment process piping penetrations with triple flued heads are anchored to the concrete shield wall around the drywell. As a result, the penetration design includes a flexible bellows to seal the triple flued head to the drywell penetration sleeve. The single and double flued heads are sealed directly to the drywell sleeves, without a flexible bellows. The flexible bellows were designed in accordance with ASME Section III, Class 2 requirements, but this included CUF analyses that have also been identified as TLAA's requiring evaluation for 60 years. The drywell penetration sleeves were evaluated for cyclic loads under the ASME Section III, Class II requirements, and it was determined that the penetration sleeves were exempt from a detailed fatigue evaluation.

Analysis

Containment Process Penetrations: The maximum 40-year CUF ratio (CUF/allowable) identified for any of these penetrations is 0.957 for feedwater penetrations P-2A and P-2B. Since these two penetration locations have CUF ratios that exceed 0.4 (or 40% of the allowable value), the triple flued heads will be included in the Metal Fatigue of Reactor Coolant Pressure Boundary program (B.3.1.1) as a program enhancement. All relevant plant transient events will be tracked to ensure that the CUF remains less than 0.1 for these two triple flued heads. All other governing penetration fatigue analyses have been reviewed, and the CUF ratios for all other penetrations are well less than 0.4 (maximum value of 0.057).

Flexible Bellows:

Analyses for the flexible bellows were reviewed. It was determined the fatigue usage experienced by the flexible bellows was bounded by the corresponding attached triple flued head. Monitoring of the fatigue usage for the triple flued heads will provide assurance that no flexible bellows will exceed its allowable value.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for the triple flued head. All necessary plant transient events, as shown in Table 4.3.1-1, will be tracked to ensure that the CUF remains less than the allowable CUF limit for all monitored components. In the event the monitored CUF is

predicted to exceed the allowable value for any component prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded. HCGS has an existing program in place to track operating thermal and pressure cycles and to assess their effect on vessel fatigue. The requirements for monitoring these components will be incorporated into the Metal Fatigue of Reactor Coolant Pressure Boundary (B.3.1.1) aging management program as a program enhancement. The required implementing actions will be completed prior to the period of extended operation. As such, the Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the containment process penetrations and the flexible bellows in accordance with 10 CFR 54.21(c)(1)(iii).

4.6.3 VENT LINE BELLOWS

Summary Description

Fatigue was evaluated for the vent line bellows that seal the drywell shell to the vent lines, which connect to the torus. The fatigue evaluation for these bellows is based on the number of cycles assumed for the 40-year life of the plant; therefore these analyses satisfy the criteria 10 CFR 54.3(a) and are evaluated as TLAA in accordance with 10 CFR 54.21(c).

Analysis

The maximum differential displacements of the vent line bellows are determined using the results of the torus reanalysis. The displacements at the attachment points of the bellows to the drywell side of the vent line and to the torus side of the vent line are determined for each load case. The differential displacement is computed from these values. The results of each load case are combined to determine the total differential displacements for the controlling load combinations. The results are compared to the allowable bellows displacements. The loads that cause the highest number of displacement cycles at the vent line bellows are seismic loads, SRV loads, and LOCA related loads such as pool swell, condensation oscillation, and chugging. The bellows displacements for these loads are small compared to the maximum allowable displacement and their effect on fatigue is negligible. The thermal loads and internal pressure loads are the largest contributors to bellows displacements. The originally specified number of thermal load and internal pressure cycles was 150. Since the bellows have a rated capacity of 230 cycles at maximum displacements for normal operating conditions, their adequacy for fatigue is not a concern.

As listed in Table 4.3.1-1, the maximum number of startup and shutdown cycles expected for 60 years of operations at Hope Creek is 180 for startup and shutdown. Since the allowable number of cycles, at maximum displacements for normal operating conditions, are greater than those projected for 60 years, the fatigue evaluation for the vent line bellows remain valid for the period of extended operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i)

The fatigue evaluation for the vent line bellows remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

4.7 OTHER PLANT-SPECIFIC TIME LIMITED AGING ANALYSES

4.7.1 CRANE LOAD CYCLE LIMIT

Summary Description

The load cycle limits for cranes was identified as a potential TLAA. The following Hope Creek cranes are in the scope of License Renewal and have been identified as having a TLAA, which requires evaluation for 60 years:

- Reactor Building Polar Crane
- Service Water Intake Structure Gantry Crane

The method of review applicable to the crane cyclic load limit TLAA involves (1) reviewing the existing 40-year design basis to determine the number of load cycles considered in the design of each of the cranes in the scope of License Renewal, (2) developing 60-year projections for load cycles for each of the cranes in the scope of License Renewal and compare with the number of design cycles for 40 years.

Analysis

Reactor Building Polar Crane

The Reactor Building Polar Crane at Hope Creek is designed to meet or exceed the design fatigue requirements of the Crane Manufacturers Association of America (CMAA) Specification 70. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

The Reactor Building Polar Crane is designed in accordance with CMAA Specification 70 for a minimum of 100,000 load cycles. A review of Reactor Building Polar Crane operation during the current life of the plant, including an estimated 200 lifts during original construction, indicates that the total number of lifts above 25 tons to date is less than 800. Using an average rate of 42 lifts per year over the course of 60 years results in the Polar Crane experiencing 2,520 lifts. Additionally, the Polar Crane will be used in the handling of casks, which are projected to be less than 200 lifts from campaign initiation through the period of extended operation. Therefore, the total number of lifts for the Polar Crane has been estimated to be 2,720 for the total life of plant, including the extended period of operation associated with license renewal. This is less than the minimum allowable design value of 100,000 cycles and is therefore acceptable. Therefore, the Reactor Building Polar Crane load cycle fatigue analysis remains valid for 60 years of plant operation.

Service Water Intake Structure Gantry Crane

The Hope Creek Service Water Intake Structure Gantry Crane purchasing specification required that the crane conform to the latest edition of

CMAA, Specification 70 for Electric Overhead Traveling Cranes and was designed for 100,000 to 500,000 load cycles.

A review of Service Water Intake Structure Gantry Crane operation during the current life of the plant, including an estimated 200 lifts during original construction, indicates that the total number of lifts is less than 600. Using an average rate of 32 lifts per year over the course of 60 years results in the Service Water Intake Structure Gantry Crane experiencing 1,920 lifts. This is less than the minimum allowable design value of 100,000 cycles, and is therefore acceptable. Therefore, the Service Water Intake Structure Gantry Crane load cycle fatigue analysis remains valid for 60 years of plant operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i)

Based on the above information, the number of design cycles assumed in the designs associated with the Reactor Building Polar Crane and Service Water Intake Structure Gantry Crane remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

4.7.2 REFUELING BELLOWS FATIGUE

Summary Description

A fatigue analysis was performed for each of the two bellows that seal the drywell bulkhead and reactor vessel and the drywell bulkhead and drywell shell for refueling operations. The fatigue analysis for each of these bellows is based on the number of cycles assumed for the 40-year life of the plant; therefore these analyses satisfy the criteria 10 CFR 54.3(a) and are evaluated as TLAA in accordance with 10 CFR 54.21(c).

Analysis

The bulkhead-to-drywell bellows exhibited the highest calculated fatigue usage of 0.124. The fatigue usage for both bellows was determined by the number of cycles of startup and shutdown and the number flood-up events at each refueling outage. The fatigue analysis assumed 360 cycles for startup and shutdown and reflood over the life of the plant. As listed in Table 4.3.1-1 the maximum number of startup and shutdown cycles expected for 60 years of operations at Hope Creek is 180 for startup and shutdown and 55 for refueling operations, for a total of 235 cycles. Since the number of cycles used in the analyses for these events are greater than those projected for 60 years, the fatigue analyses for the refueling bellows remain valid for the period of extended operation. The refueling bellows support is addressed in Section 4.3.1.

Disposition: Validation, 10 CFR 54.21(c)(1)(i)

The fatigue analysis for the refueling bellows remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i)

4.7.3 NEUTRON FLUENCE-INDUCED BOLT STRESS RELAXATION - JET PUMP AUXILIARY SPRING WEDGES AND SLIP JOINT CLAMPS

Summary Description

Auxiliary Spring Wedges and a Slip Joint Clamp have been installed on jet pumps at the Hope Creek Generating Station. The auxiliary spring wedges were installed during refueling outage R14 (2007) and R15 (2009), and the slip joint clamp was installed during refueling outage R13 (2006). Structural analysis of the repair devices evaluated the loss of preload for structural bolting due to exposure to neutron fluence during the 40 years of operation after their installation. The analysis for each of these devices is based on the fluence assumed for the 40-year life of the device; therefore these analyses satisfy the criteria 10 CFR 54.3(a) and are evaluated as a TLAA in accordance with 10 CFR 54.21(c).

Auxiliary Spring Wedges Bolts:

Analysis

The auxiliary spring wedge bolts were previously evaluated for neutron exposure up to a fluence of 1.07E20 n/cm^2 for a 40-year life. To disposition this TLAA, a fluence analysis was performed to determine the fluence values at the locations of the installed devices after 60 years of plant operation. The analysis determined that the bolts fluence levels remained below the analyzed value of 1.07E20 n/cm^2. Since the fluence bounds that which would be experienced within the period of extended operation, the analysis remains valid for 60 years of plant operation.

Disposition: Validation, 10 CFR 54.21(c)(1)(i)

Based on the above information, the current analysis (TLAA) remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Slip Joint Clamp Bolt:

Analysis

The slip joint clamp bolt was previously evaluated for neutron exposure up to a fluence of 1.50E18 n/cm^2 for a 40-year life. To disposition this TLAA, a fluence analysis was performed to determine the fluence value at the location of the installed device at 60 years of plant operation. This analysis determined the slip joint clamp experiences a fluence greater than that previously evaluated prior to reaching 35.4 Effective Full Power Years (EFPY). Since the analysis does not bound the remaining 60 years of operation, additional actions are required. Prior to the period of extended operation, or prior to reaching the analyzed limit of 35.4 EFPY, whichever comes first, the plant will either; (1) replace the slip joint clamp or (2) perform an analysis that demonstrates the component function is maintained.

Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)

The slip joint clamp TLAA will be dispositioned in accordance with 10 CFR 54.21(c)(1)(iii) by managing the aging effects with the analysis and taking action

as described above prior to the period of extended operation, or prior to reaching the analyzed limit of 35.4 EFPY, whichever comes first.

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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 programs 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 programs 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 programs at the time the License Renewal Application was submitted.
- Section A.1.4 contains a listing of the Time-Limited Aging Analyses summaries (TLAAs).
- 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 unit's 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. BWR Vessel ID Attachment Welds (Section A.2.1.4) [Existing]
5. BWR Feedwater Nozzle (Section A.2.1.5) [Existing]
6. BWR Control Rod Drive Return Line Nozzle (Section A.2.1.6) [Existing]
7. BWR Stress Corrosion Cracking (Section A.2.1.7) [Existing – Requires Enhancement]
8. BWR Penetrations (Section A.2.1.8) [Existing]
9. BWR Vessel Internals (Section A.2.1.9) [Existing]
10. Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section A.2.1.10) [New]
11. Flow-Accelerated Corrosion (Section A.2.1.11) [Existing]
12. Bolting Integrity (Section A.2.1.12) [Existing – Requires Enhancement]
13. Open-Cycle Cooling Water System (Section A.2.1.13) [Existing]
14. Closed-Cycle Cooling Water System (Section A.2.1.14) [Existing – Requires Enhancement]
15. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section A.2.1.15) [Existing – Requires Enhancement]
16. Compressed Air Monitoring (Section A.2.1.16) [Existing]

17. Fire Protection (Section A.2.1.17) [Existing – Requires Enhancement]

18. Fire Water System (Section A.2.1.18) [Existing – Requires Enhancement]

19. Aboveground Steel Tanks (Section A.2.1.19) [Existing – Requires Enhancement]

20. Fuel Oil Chemistry (Section A.2.1.20) [Existing – Requires Enhancement]

21. Reactor Vessel Surveillance (Section A.2.1.21) [Existing – Requires Enhancement]

22. One-Time Inspection (Section A.2.1.22) [New]

23. Selective Leaching of Materials (Section A.2.1.23) [New]

24. Buried Piping Inspection (Section A.2.1.24) [Existing – Requires Enhancement]

25. External Surfaces Monitoring (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 IWF (Section A.2.1.29) [Existing]

30. 10 CFR Part 50, Appendix J (Section A.2.1.30) [Existing]

31. Masonry Wall Program (Section A.2.1.31) [Existing – Requires Enhancement]

32. Structures Monitoring Program (Section A.2.1.32) [Existing – Requires Enhancement]

33. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section A.2.1.33) [Existing – Requires Enhancement]

34. Protective Coating Monitoring and Maintenance Program (Section A.2.1.34) [Existing]

35. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.35) [New]

36. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section A.2.1.36) [New]

37. Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.37) [New]

38. Metal Enclosed Bus (Section A.2.1.38) [New]

39. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.39) [New]

A.1.2 Plant-Specific Aging Management Programs

The plant-specific aging management 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 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]

6. Small-Bore Class 1 Piping Inspection (Section A.2.2.6) [New]

A.1.3 NUREG-1801 Chapter X Aging Management Programs

The NUREG-1801 Chapter X Aging Management Programs (AMP) 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 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. Neutron Embrittlement of the Reactor Vessel and Internals (Section A.4.2)
2. Metal Fatigue of the Reactor Pressure Vessel, Internals, and Reactor Coolant Pressure Boundary Piping and Components (Section A.4.3)
3. Environmental Qualification of Electrical Equipment (EQ) (Section A.4.4)
4. Loss of Prestress in Concrete Containment Tendons (Section A.4.5)
5. Containment Liner Plate, Metal Containment, and Penetrations Fatigue Analyses (Section A.4.6)
6. Other Plant-Specific Time Limited Aging Analyses (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 nonsafety-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 and treated 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 Water Chemistry aging management program is an existing program whose activities consist of monitoring and control of water chemistry to manage the aging of reactor vessel, reactor internals, piping, piping elements and piping components, heat exchangers and tanks that are exposed to treated water. The Water Chemistry aging management program keeps peak levels of various contaminants below system-specific limits based on industry-recognized guidelines of EPRI, BWR Vessel and Internals Project BWR Water Chemistry Guidelines for the prevention or mitigation of loss of material, reduction of heat transfer, reduction of neutron-absorbing capacity and cracking aging effects. In addition, the water chemistry program is also credited for mitigating loss of material and cracking for components exposed to sodium pentaborate, steam and reactor coolant environments. To mitigate aging effects on component surfaces the chemistry program is used to control water chemistry for impurities that accelerate corrosion.

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, loss of material and coolant leakage. 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 BWR Vessel ID Attachment Welds

The BWR Vessel ID Attachment Welds program is an existing aging management program that incorporates the inspection and evaluation recommendations of BWRVIP-48-A, as well as the water chemistry recommendations of BWRVIP-130. The program is implemented through station procedures that provide for mitigation of cracking through water chemistry and monitoring for cracking through in-vessel examinations of the reactor vessel internal attachment welds. Reactor vessel attachment weld inspections are implemented through station procedures that are part of in-service inspection and incorporate the requirements of ASME, Section XI.

A.2.1.5 BWR Feedwater Nozzle

The BWR Feedwater Nozzle aging management program is an existing program that manages the effects of cracking in the feedwater nozzles by enhanced inservice inspection (ISI) in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, Subsection IWB, Table IWB-2500-1 and the recommendations GE-NE-523-A71-0594-A, Rev. 1. Inspections of the feedwater nozzles are performed in accordance with the Hope Creek ISI Program Plan.

A.2.1.6 BWR Control Rod Drive Return Line Nozzle

The BWR Control Rod Drive Return Line Nozzle aging management program is an existing program that provides for condition monitoring of the N9 nozzle (originally intended to be used as the CRD Return Line Nozzle) for cracking through station ISI procedures based on the ASME Section XI requirements. Hope Creek has capped the N9 nozzle to mitigate fatigue cracking. The program performs Inservice Inspection (ISI) examinations to monitor the effects of cracking on the intended function of the N9 nozzle. ISI examinations include ultrasonic inspection of the nozzle inside radius section and nozzle-to-vessel weld. Future inspections of the inside radius of the N9 nozzle will be performed using EVT-1 in accordance with NRC accepted Code case N648-1, subject to the conditions specified in Regulatory Guide 1.147. Hope Creek also conducts UT examinations of the N9 nozzle-to-cap weld in accordance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) document BWRVIP-75-A as part of the BWR Stress Corrosion Cracking program. The inspection methods used in the program have been proven effective in detecting cracking in RPV nozzles. The frequency of the inspection program is adequate to prevent significant degradation before loss of the intended function of the N9 nozzle.

A.2.1.7 BWR Stress Corrosion Cracking

The BWR Stress Corrosion Cracking aging management program is an existing program that manages intergranular stress corrosion cracking (IGSCC) in coolant pressure boundary piping and piping components made of stainless steel (SS) and nickel based alloy components as delineated in NUREG-0313, Rev. 2, and Generic Letter (GL) 88-01 and its Supplement 1. The program includes preventive measures to mitigate IGSCC, and inspection and flaw evaluation to monitor IGSCC and its effects. The schedule and extent of the inspections are performed in accordance with the NRC staff-approved BWRVIP-75-A report. To reduce the effects of IGSCC Hope Creek has also applied mechanical stress improvement process (MSIP) to several reactor pressure vessel nozzle welds. Similarly, Hope Creek has implemented Hydrogen Water Chemistry (HWC) and Noble Metals Chemical Addition (NMCA) to mitigate the environment that promotes IGSCC.

The program will be enhanced to clarify that:

1. For the components within the scope of the BWR Stress Corrosion Cracking program, resistant materials will be used for new and replacement components. This includes low carbon stainless piping and stainless steel weld material limited to a maximum carbon content 0.035 wt. % and a minimum ferrite content of 7.5%.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.8 BWR Penetrations

The BWR Penetrations aging management program is an existing program that manages the effects of cracking of reactor vessel instrumentation penetrations (nozzles) exposed to reactor coolant through water chemistry and inservice inspections. The scope of the program includes beltline instrumentation nozzles and other instrumentation nozzles; except for the Standby Liquid Control/core plate differential pressure (dP) nozzle and the jet pumps instrumentation nozzles, which are in the scope of program B.2.1.1, ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD. The BWR Penetrations aging management program incorporates the inspection and evaluation recommendations BWRVIP-49-A, "Instrument Penetration Inspection and Flaw Evaluation Guidelines," as well as the water chemistry recommendations of BWRVIP-130, "BWR Vessel and Internals Project BWR Water Chemistry Guidelines."

BWRVIP-27-A addresses the Standby Liquid Control (SLC) system nozzle or housing. The guidelines of BWRVIP-27-A are applicable to plants in which the SLC system injects sodium pentaborate into the bottom head region of the vessel. The SLC system at Hope Creek injects pentaborate into the vessel through the core spray system, not through a bottom head penetration. As stated in the BWRVIP document the guidelines of BWRVIP-27-A do not apply to plants such as Hope Creek where SLC injects through the Core Spray piping. Plants that inject SLC through a bottom head penetration also used this penetration for the core plate differential pressure (dP) instrumentation. At Hope Creek inspections of the core plate dP penetration is implemented through station ISI procedures, which incorporate the requirements of ASME Section XI. The requirements of ASME Section XI are implemented in accordance with 10 CFR 50.55(a).

A.2.1.9 BWR Vessel Internals

The Hope Creek BWR Vessel Internals program is an existing program that manages the effects of cracking and loss of material of reactor pressure vessel internals through condition monitoring activities that consist of examinations implemented through station procedures consistent with the recommendations of the BWRVIP guidelines, as well as the requirements of ASME Section XI. The program also mitigates these aging effects through water chemistry activities that are implemented through station procedures that implement the guidelines of BWRVIP-130: "BWR Vessel and Internals Project BWR Water Chemistry Guidelines."

Hope Creek is committed to following the BWRVIP guidelines for managing reactor internal components. Inspections and evaluations of the Hope Creek reactor internal components are consistent with the current BWRVIP guidelines, which include but are not limited to the following BWRVIP reports:

- BWRVIP-18-A, BWR Core Spray Internals Inspection and Evaluation Flaw Guidelines.
- BWRVIP-25, BWR Core Plate Inspection and Flaw Evaluation Guidelines.
- BWRVIP-26-A, BWR Top Guide Inspection and Flaw Evaluation Guidelines.
- BWRVIP-38, BWR Shroud Support Inspection and Flaw Evaluation guidelines.
- BWRVIP 41, Jet Pump Assembly Inspection and flaw Evaluation Guidelines.
- BWRVIP-42-A LPCI Coupling Inspection and flaw Evaluation Guidelines.
- BWRVIP-47-A, BWR Lower Plenum Inspection and Flaw Evaluation Guidelines.
- BWRVIP-76, BWR Core Shroud Inspection and Flaw Evaluation Guidelines.
- BWRVIP-139, BWR Vessel and Internals Project Steam Dryer Inspection and Flaw Evaluation Guidelines.
- BWRVIP-180, BWR Vessel and Internals Project, Access Hole Cover Inspection and Flaw Evaluation Guidelines.
- BWRVIP-183, BWR Top guide Grid Beam Inspection and Flaw Evaluation Guidelines

A.2.1.10 Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless steel (CASS) aging management program is a new program that will provide for aging management of CASS reactor internal components within the scope of license renewal. The program will include a component specific evaluation of the loss of fracture toughness in accordance with the specified criteria. For those components where loss of fracture toughness may affect function of the component, a supplemental inspection will be performed. This program will verify the integrity of the CASS components exposed to the high temperature and neutron fluence present in the reactor environment.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.11 Flow-Accelerated Corrosion

The Flow-Accelerated Corrosion (FAC) aging management program 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 and 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.2.1.12 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, air with steam or water leakage, raw water, soil, steam and treated water.

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.2.1.13 Open-Cycle Cooling Water System

The 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, other 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 Open-Cycle Cooling Water System 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 (PM), 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.2.1.14 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, and heat exchangers that are included in the scope of license renewal for stress corrosion cracking, loss of material and reduction of heat transfer and are exposed to a closed cooling water environment at Hope Creek. The Closed-Cycle Cooling Water System aging management program relies on preventive measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and

nondestructive examinations (NDEs) based on industry-recognized guidelines of EPRI 1007820 for closed-cycle cooling water systems. Station maintenance inspections and NDE 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. New recurring tasks will be established for enhancing the performance monitoring of the Closed Cycle Cooling Water System.

2. New recurring tasks will be established for enhancing the performance monitoring of the Chilled Water System.

3. 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.

4. 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.

5. The program will be enhanced such that the plant auxiliary building chilled water system, which is part of the Control Area Chilled Water System, will comply with the pure water control program in accordance with EPRI 1007820 prior to the period of extended operation.

6. A one-time inspection of selected Control Area Chilled Water System components, including the plant auxiliary building chilled water system, 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.

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.2.1.15 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.2.1.16 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 systems. The Compressed Air Monitoring aging management activities consist of preventive maintenance and condition-monitoring measures to manage the aging effects.

A.2.1.17 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 barrier penetration seals for signs of degradation such as change in material properties, loss of materials, cracking, 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 the 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 the NFPA Codes and Standards for guidance.

The Fire Protection aging management program will be enhanced to include:

1. The Hope Creek 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 Hope Creek 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.2.1.18 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. 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. 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 to 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 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 prior to 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.2.1.19 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 Water Storage Tanks, Fire Diesel Fuel Oil Tank and 17-Ton CO_2 Storage Tank). 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.

The Aboveground Steel Tanks program will be enhanced as follows:

1. The program will be enhanced to include internal UT measurements to measure the wall thickness on the bottom of the tanks supported on a fiber pad on top of the concrete foundation (Fire 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 will be maintained during the extended period of operation.

2. The program will be enhanced to provide routine visual inspections of the carbon steel tanks external surfaces (Fire Water Storage Tanks, Fire Diesel Fuel Oil Tank and17-Ton CO_2 Storage Tank), including removal of tank insulation from the Fire Water Storage Tank to detect degradation. These inspections will be performed to detect degraded paint and coatings, and any resulting metal degradation, prior to loss of the tank intended function.

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.2.1.20 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, to prevent loss of material. 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. Addition of biocides, stabilizers and inhibitors as determined by fuel oil sampling or inspection activities.

3. Internal inspection of the Diesel Fire Pump Fuel Oil 280-gallon tank (T-565) using visual inspections and ultrasonic thickness examination of tank bottom.

4. Quarterly water and sediment multilevel sampling on the Diesel Fuel Oil Storage 26,500-gallon Tanks (1A-T-403, 1B-T-403, 1C-T-403, 1D-T-403, 1E-T-403, 1F-T-403, 1G-T-403, 1H-T-403) in accordance with ASTM Standard D 2709.

5. Internal inspection of the Diesel Fuel Oil Storage 26,500-gallon Tanks (1A-T-403, 1B-T-403, 1C-T-403, 1D-T-403, 1E-T-403, 1F-T-403, 1G-T-403, 1H-T-403) using visual inspections and ultrasonic thickness examination of tank bottoms.

6. Quarterly particulate sampling of the Diesel Fire Pump Fuel Oil tank (T-565) in accordance with modified ASTM 2276-00, Method A.

7. 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.2.1.21 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 meets the requirements of 10 CFR 50, Appendix H. The program evaluates neutron embrittlement by projecting Upper Shelf Energy (USE) for reactor materials and impact on Adjusted Reference Temperature for the development of pressure-temperature limit curves. Embrittlement evaluations are performed in accordance with Regulatory Guide 1.99, Rev.2. The Hope Creek Reactor Vessel Surveillance Program is also part of the BWRVIP Integrated Surveillance Program (ISP) described in BWRVIP-86-A and BWRVIP-116, and approved by the NRC staff. The schedule for removing surveillance capsules is in accordance with the timetable specified in BWRVIP-86-A for the current operating term and in accordance with BWRVIP-116 for the period of extended operation.

Hope Creek is a host plant for the ISP and will remove one capsule in the current operating term as part of the ISP schedule. Hope Creek will also participate in the ISP during the period of extended operation [designated as the ISP(E)]. As described in BWRIP-116, Hope Creek's third and last capsule will be removed during the period of extended operation for testing as part of the ISP(E). If the capsule is withdrawn for some other reason, it will be stored in a manner that maintains it in a condition that would permit its future use.

The program monitors plant operating conditions to ensure appropriate steps are taken if reactor vessel exposure conditions are altered; such as the review and updating of 60-year fluence projections to support upper shelf energy calculations and pressure-temperature limit curves. The program also includes condition monitoring by removal and analysis of surveillance capsules as part of the BWRVIP ISP. These measures are effective in detecting the extent of embrittlement to prevent significant degradation of the reactor pressure vessel during the period of extended operation.

The Reactor Vessel Surveillance Program will be enhanced to include:

1. Hope Creek will implement the requirements of BWRVIP-116, "BWR Vessel and Internals Project Integrated Surveillance Program (ISP) Implementation for License Renewal," including the conditions specified by the NRC in its Safety Evaluation dated February 24, 2006.

2. If future plant operations exceed the limitations specified in RG 1.99, the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Similarly, if future plant operation exceeds the bounds established by surveillance data that are to determine Upper Shelf Energy or P-T limits, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Additionally, when all the surveillance capsules are removed, then operating restrictions will be established to ensure that the plant is operated within the conditions to which the surveillance capsules were exposed. If the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the projection to 60 years is reviewed; and, if deemed appropriate, a revised fluence projection is prepared and the effects of the revised fluence analysis on neutron embrittlement calculations will be evaluated. If necessary, an active surveillance program will be re-instituted for Hope Creek. The employment of additional surveillance specimens will be coordinated through the BWRVIP Integrated Surveillance Program (ISP). Any 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.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.22 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, reactor vessel and nozzles, 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, ductile cast iron, gray cast iron, nickel alloy, steel, stainless steel and cast austenitic stainless steel in treated water, steam, sodium pentaborate, and reactor coolant environments.

2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for copper alloy, steel, galvanized 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 copper alloy, gray cast iron, steel and stainless steel in a lubricating oil environment.

4. To confirm loss of material in carbon steel piping and fittings is insignificant in an air/gas-wetted (internal) 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 to manage the effects of aging for selected components within the scope of license renewal.

A.2.1.23 Selective Leaching of Materials

The Selective Leaching of Materials aging program is a new program that will include one-time inspections of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring. Components include valve bodies, heat exchanger components, pump casings, piping and fittings, strainer bodies, 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.2.1.24 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 (external) environment. The Hope Creek 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 (external) 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, galvanized 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 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.2.1.25 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. 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.2.1.26 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, tanks and ducting 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 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 primary containment surfaces and components, including its integral attachments, penetration sleeves, pressure retaining bolting, personnel airlock and equipment hatches, and other pressure retaining components for loss of material, loss of preload, and fretting or lockup.

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 program will be enhanced to include:

1. Install an internal moisture barrier at the junction of the drywell concrete floor and the steel drywell shell prior to the period of extended operation.

2. Revise the Hope Creek ASME Section XI, Subsection IWE implementing documents to require inspection of the moisture barrier for loss of sealing in accordance with IWE 2500, after it is installed. The original design for Hope Creek did not require an internal moisture barrier at the junction of the drywell concrete floor and steel drywell shell.

3. Verify that the reactor cavity seal rupture drain lines are clear from blockage once prior to the period of extended operation, and one additional time during the first 10 years of the period of extended operation.

4. Verify that drains at the bottom of the drywell air gap are clear from blockage once prior to the period of extended operation, and one additional time during the first 10 years of the period of extended operation.

5. Investigate the source of any leakage detected by the reactor cavity seal rupture drain line instrumentation and assess its impact on the drywell shell.

6. Monitor the drains at the bottom of the drywell air gap for leakage in the event leakage is detected by the reactor cavity seal rupture drain line instrumentation.

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 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, 3, and MC 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, 3, and MC piping and component supports are adequately managed.

A.2.1.30 10 CFR Part 50, Appendix J

The 10 CFR Part 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, cracking, or loss of preload in various systems penetrating containment. The 10 CFR Part 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 Part 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.2.1.31 Masonry Wall Program

The Masonry Wall aging management program is an existing program implemented as part of the Structures Monitoring Program. The Masonry Wall Program was developed to meet the regulatory requirements of 10 CFR 50.65, Maintenance Rule, USNRC Regulatory Guide 1.160, and NUMARC 93-01, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants. Hope Creek has no safety-related masonry walls or masonry walls whose failure during a seismic event could adversely impact a safety-related function. As a result, NRC IE Bulletin 80-11, "Masonry Wall Design", does not apply to Hope Creek. 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.

The Masonry Wall Program will be enhanced as follows:

1. Add buildings, and masonry walls that have been determined to be in the scope of license renewal.
   a. Auxiliary Boiler Building
   b. Fire Water Pump House
   c. Masonry Wall Fire Barriers
   d. Switchyard
   e. 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.2.1.32 Structures Monitoring Program

The Structures Monitoring aging management 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," Rev. 2, and Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Rev. 2. 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. Auxiliary Boiler Building
   b. Fire Water Pump House
   c. Shoreline Protection Dike, and Sheet piles (Reg. Guide 1.127)
   d. Switchyard
   e. Turbine Building
   f. Transmission towers
   g. Yard Structures (Foundations for fire water tanks, manholes, transformer foundations credited for SBO)
   h. Masonry walls, including fire barriers
   i. Building penetrations that perform flood barrier, pressure boundary, shelter and protection intended functions
   j. Miscellaneous steel (catwalks, vents, louvers, platforms, etc.)
   k. Pipe whip restraints, jet impingement and missile shields
   l. Ice barrier, trash rack (Reg. Guide 1.127)
   m. Panels, racks, cabinets, and other enclosures
   n. Metal-enclosed bus
   o. 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
   p. 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. Perform a one-time inspection of the external stainless steel surfaces of the expansion bellows at Condensate Storage Tank Dike for loss of material due to corrosion, within the ten-year period prior to the period of extended operation.

5. 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.

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.

12. Require supplemental inspections of the 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 the period of extended operation. The one-time inspection in enhancement 4 will be performed within the ten-year period prior to the period of extended operation.

A.2.1.33 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. 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 will be used to manage loss of material, cracking, and change in material properties for concrete components, loss of material and loss of preload for steel and metal components, 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. Shoreline Protection and Dike structures will be added to the program.
2. 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.
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.2.1.34 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 1 coatings inside the drywell and torus. Service Level 1 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 1 coatings to function as intended.

A.2.1.35 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.2.1.36 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 Leak Detection and Radiation Monitoring System, and the Neutron Monitoring 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 will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards for the in-scope portions of the Leak Detection and Radiation Monitoring System. Cable testing results will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards for the in-scope portions of the Neutron Monitoring System.

This new program will be implemented prior to the period of extended operation.

A.2.1.37 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 Hope Creek 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 approach to determining inspection frequency 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.2.1.38 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 Hope Creek.

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.2.1.39 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 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 aging management 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. The tank within the scope of this program is the stainless steel condensate storage tank. Periodic visual inspections will monitor for degradation of the tank external surface. Periodic visual inspections will also monitor for degradation of the seal at the interface between the tank bottom and the concrete foundation.

The Aboveground Non-Steel Tanks program will include a UT wall thickness inspection of the bottom of the tank. 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 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.2.2.4 Buried Non-Steel Piping Inspection

The Buried Non-Steel Piping Inspection aging management program is an existing condition monitoring program that manages the buried reinforced concrete piping and components in the 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. These aging effects will be identified through visual inspections of the external surfaces of the piping and components.

The Buried Non-Steel Piping Inspection aging management program also inspects the buried stainless steel piping and components in the Condensate Storage and Transfer System and the Fire Protection System for loss of material. These aging effects will be identified through visual inspections of the external surfaces of the 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 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 stainless steel piping and components 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 monitors the Boral test coupon inspection and/or testing results at other boiling water reactor (BWR) sites. If these results indicate a problem with Boral neutron absorbing material potentially affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons in the Hope Creek spent fuel pool (SFP).

A.2.2.6 Small-Bore Class 1 Piping Inspection

The Small-Bore Class 1 Piping Inspection program is a new program that will manage the aging effect of cracking in small-bore (greater than or equal to NPS 1 and less than NPS 4) Class 1 piping through the use of a combination of volumetric examinations and visual inspections. This new program is comprised of the existing ASME Section XI ISI (Risk Informed Inservice Inspection, RI-ISI) program that performs volumetric and visual examinations for selected Class 1 small-bore butt welds and other selected small-bore socket welds, and a 100% inspection of all accessible Class 1 socket welds in the recirculation system using volumetric or other industry approved techniques. The RI-ISI program provides a robust inspection selection process and is based upon the susceptibility to degradation and the consequences of a piping failure, which is founded on actual service experience with nuclear plant piping failure data. The RI-ISI program requires volumetric and VT-2 examinations on a frequency and number determined by ASME Code Case N-578-1 and the Hope Creek ISI Program Plan. These ongoing inspections combined with a 100% inspection of all accessible Class 1 socket welds in the recirculation system using volumetric or other industry approved techniques will be effective

in identifying any age related or underlying deficiencies. Any deficiencies identified are evaluated under the corrective action program.

The Small-Bore Class 1 Piping Inspection program will effectively manage the aging effect of cracking in small-bore (greater than or equal to NPS 1 and less than NPS 4) Class 1 piping by identifying and evaluating cracking prior to loss of intended function.

This new program will be implemented prior to the period of extended operation.

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 Analysis for metal fatigue of the reactor coolant pressure boundary, concrete containment tendon prestress, and environmental qualification (EQ) of electrical components. These programs, where applicable, are evaluated in this section.

A.3.1.1 Metal Fatigue of Reactor Coolant Pressure Boundary

The Metal Fatigue of Reactor Coolant Pressure Boundary Program is an existing program that manages cumulative fatigue damage in the selected reactor coolant components subject to the reactor coolant and treated water environments.

The Metal Fatigue of Reactor Coolant 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 pressure boundary 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, FatiguePro, 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 Neutron Embrittlement of the Reactor Pressure Vessel and Internals

The reactor vessel embrittlement calculations for Hope Creek that evaluated reduction of fracture toughness of the Hope Creek 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.

High energy neutron fluence for the welds and shells of the reactor pressure vessel beltline region was calculated using the RAMA fluence methodology. The RAMA methodology was developed for the Electric Power Research Institute and the Boiling Water Reactor Vessel and Internals Project and is approved by the NRC for use at Hope Creek. Use of this methodology for evaluations of fluence for Hope Creek was performed in accordance with guidelines presented in Regulatory Guide 1.190. The evaluations determined values for neutron fluence for extended power uprate (EPU) conditions and for extended operation out to 56 effective full power years (EFPY), i.e., at the end of 60 years of operation.

A.4.2.1 Reactor Pressure Vessel Materials Upper-Shelf Energy Reduction Due to Neutron Embrittlement

The regulations governing reactor pressure vessel integrity are in 10 CFR 50. 10 CFR 50.60 requires that all light-water reactors meet the fracture toughness, pressure-temperature limits, and material surveillance program requirements for the reactor coolant pressure boundary as set forth in 10 CFR 50 Appendices G and H. The Hope Creek current licensing basis analyses evaluating reduction of fracture toughness of the reactor pressure vessel for 40 years are TLAAs. 10 CFR 50 Appendix G requires the predicted end-of-life Charpy impact test USE for reactor pressure vessel materials to be at least 50 ft-lb (absorbed energy), unless an approved analysis supports a lower value. The predicted USE drop is determined in accordance with RG 1.99. Predicted USE drop for each reactor pressure vessel material in the beltline region exposed to fluence greater than 1.0×10^{17} n/cm^2 for 56 EFPY was determined in accordance with RG 1.99, Revision 2.

The 50 ft-lb criterion was met for all materials evaluated and therefore, the analyses are projected for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.2 Adjusted Reference Temperature for Reactor Pressure Vessel Materials Due to Neutron Embrittlement

The adjusted reference temperature (ART) of the limiting beltline material is used to adjust the beltline P-T curves to account for irradiation effects. RG 1.99 Revision 2 provides the methods for determining the ART. The initial nil-ductility reference temperature, RT_{NDT}, is the temperature at which a non-irradiated metal (ferritic steel) changes in fracture characteristics going from ductile to brittle behavior. RT_{NDT} is evaluated according to the procedures in the ASME Code, Section III. 10 CFR 50 Appendix G defines the fracture toughness requirements for the life of the vessel. The ART is defined as Initial RT_{NDT} + ΔRT_{NDT} + Margin. The Margin term is defined in RG 1.99 Revision 2. The current P-T curves are developed from limiting ART values for the vessel materials and are valid for 32 EFPY. Since the ART values are determined by adding the unirradiated RT_{NDT} and the ΔRT_{NDT} values for the 40-year licensed operating period, these ART calculations meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

56 EFPY fluence values were calculated for the Hope Creek reactor pressure vessel for the extended 60-year licensed operating period, using the RAMA Fluence Methodology software package. The 56 EFPY ΔRT_{NDT} values for all beltline materials (i.e., those materials with a fluence exposure greater than $1x10^{17}$ n/cm^2) were calculated based on the embrittlement correlation found in RG 1.99. Hope Creek will re-project, as necessary, the 56 EFPY ΔRT_{NDT} and ART values in conjunction with the surveillance capsule results from the BWRVIP Integrated Surveillance Program (ISP) as described in reports BWRVIP-86 and BWRVIP-116.

The analysis for the adjusted reference temperature has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.3 Reactor Pressure Vessel Analyses: Pressure – Temperature Limits

10 CFR Part 50 Appendix G requires reactor pressure vessel analyses to determine operating P-T limits for boltup, hydrotest, pressure tests and normal operating and anticipated operational occurrences. The ART of the limiting beltline material is used to adjust the beltline P-T limits to account for irradiation effects. Operating limits for pressure and temperature are required for three categories of operation: 1) hydrostatic pressure tests and leak tests, referred to as Curve A; 2) non-nuclear heat-up / cooldown and low-level physics tests, referred to as Curve B; and 3) core critical operation, referred to as Curve C. P-T limits are developed for three bounding vessel regions: the upper vessel region (non-beltline, including the head flange region), the core beltline region, and the vessel bottom head region. The calculations associated with generation of the P-T curves satisfy the criteria of 10 CFR 54.3(a). As such, these calculations are a TLAA.

The current HCGS Technical Specifications contain P-T curves for hydrostatic pressure and leak tests, non-nuclear heat-up/cooldown and low-level physics tests, and critical operation. Technical Specifications also limit the maximum rate of change of the reactor coolant temperature. These P-T curves provide limits up to 32 EFPY. The P-T curves were developed to present steam dome pressure versus minimum vessel metal temperature, incorporating appropriate non-beltline limits and irradiation embrittlement effects in the beltline. Because of the relationship between the P-T limits and the fracture toughness transition of the HCGS reactor pressure vessel, new P-T limits are required to be calculated and will be submitted as updates to the NRC, in compliance with 10 CFR Part 50, Appendix G.

HCGS will re-project the P-T curves using approved fluence calculations when there are changes in power or significant changes in core design in conjunction with surveillance capsule results from the BWRVIP Integrated Surveillance Program (ISP) (BWRVIP -86-A and BWRVIP-116).

Reactor Pressure Vessel Analyses for P-T limits, considering the effects of aging on the intended function will be adequately managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.2.4 Reactor Pressure Vessel Circumferential Weld Examination Relief

ASME Code, Section XI governs inspection of the reactor pressure vessel circumferential welds, as implemented by the Hope Creek In-service Inspection Program. These welds are required to be inspected at regular intervals described in Table IWB-2500-1, Examination Category B-A of ASME Code, Section XI. Hope Creek has received inspection relief for the circumferential welds for the time remaining in the current 40 year licensed operating period. This inspection relief is based upon NRC Generic Letter 98-05, which is based on probabilistic assessments that predict an acceptably low probability of failure per reactor operating year.

The analysis is based on reactor pressure vessel metallurgical conditions as well as flaw indication sizes and frequencies of occurrence that are expected through the end of the current licensed operating period. The basis for this relief request was an analysis that satisfied the limiting conditional failure probability for the circumferential welds at the expiration of the current license, based on BWRVIP-05 and the extent of neutron embrittlement expected through 40 years of operation. The anticipated metallurgical effects due to increased fluence expected during the period of extended operation require evaluation for 56 EFPY (corresponding to 60 years) and approval by the NRC to extend this relief request. The circumferential volumetric weld examination relief analysis meets the requirements of 10CFR54.3(a) and is a TLAA.

The failure frequency of circumferential welds for Hope Creek was calculated for Hope Creek for the period of extended operation and was projected to be less than the criteria established in the NRC's SER for BWRVIP-05. A request for extension of this relief for Hope Creek for the extended operating period will be submitted to the NRC, in accordance with 10 CFR 50.55(a), prior to the period of extended operation.

The analysis for the circumferential weld examination relief has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.5 Reactor Pressure Vessel Axial Weld Failure Probability

The BWRVIP recommendations for inspection of reactor pressure vessel shell welds in BWRVIP-05 contain generic analyses supporting a conclusion in the NRC SER that the generic-plant axial weld failure rate is no more than 5×10^{-6} per reactor year.

The probability of a failure event, PoF, calculated by the NRC in the BWRVIP-05 SER and its supplements depends in part on an assumption that essentially 100% (≥90%) of axial welds can be inspected. At Hope Creek, greater than 90% of the axial welds can be examined.

The anticipated changes in metallurgical conditions expected over the extended licensed operating period require an additional analysis for 56 EFPY. As such, this analysis meets the requirements of 10 CFR 54.3(a) and has been identified as a TLAA requiring evaluation for the period of extended operation.

Since the comparison of neutron fluence, initial RT_{NDT}, chemistry factor amounts of copper and nickel, delta RT_{NDT}, and the projected mean RT_{NDT} of the limiting axial weld at the end of the period of extended operation has been projected to be less than that found in the reference case in the BWRVIP and NRC analyses, the axial weld failure probability continues to be bounded by the previously approved value of less than 5E-6 per reactor year.

The analysis for the axial weld failure probability has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.6 Reactor Pressure Vessel Core Reflood Thermal Shock Analysis

General Electric Report No. NEDO-10029 addressed the concern for brittle fracture of the reactor pressure vessel due to reflood following a postulated Loss of Coolant Accident (LOCA). The thermal shock analysis documented in the report assumed a design basis LOCA followed by a low pressure coolant injection accounting for the full effects of neutron embrittlement at the end of 40 years. This analysis bounded only 40 years of operation. Therefore, reflood thermal shock of the reactor pressure vessel is considered a TLAA for the Hope Creek.

Since the time of the NEDO-10029 analysis, another analysis has been performed for BWR-6 vessels in "Fracture Mechanics Evaluation of a Boiling Water Vessel Following a Postulated Loss of Coolant Accident". The more recent BWR-6 analysis was reevaluated for the Hope Creek BWR-4 reactor pressure vessel and found to be bounding for the period of extended operation. Because the available fracture toughness was found to be greater than the peak stress intensity calculated for the event evaluated, brittle fracture of the Hope Creek reactor pressure vessel due to vessel reflood following a design basis LOCA is not possible during the period of extended operation.

The core reflood thermal shock analysis relief has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.7 Reactor Internals Components

A number of the reactor internals components are subject to high fluence because of their proximity to the core. This high fluence can lead to stress relaxation for bolting. Stress relaxation of the core plate rim hold-down bolts is a TLAA issue.

A plant specific analysis demonstrates that the pre-load of the core plate rim hold-down bolts is sufficient to prevent lateral motion of the core plate until the plant reaches 43.9 EFPY. Prior to the period of extended operation, which is prior to the analyzed limit of 43.9 EFPY, the plant will either; (1) install core plate wedges or (2) perform an analysis that demonstrates the component function is maintained.

The core plate rim hold-down bolts TLAA will be dispositioned in accordance with 10 CFR 54.21(c)(1)(iii), by managing the aging effects with the analysis that projects loss of preload at 43.9 EFPY and taking action as described above, prior to the period of extended operation.

A.4.3 Metal Fatigue of the Reactor Pressure Vessel, Internals, and Reactor Coolant Pressure Boundary Piping and Components

Metal fatigue was considered explicitly in the design process for pressure boundary components designed in accordance with ASME Section III, Class A or Class 1 requirements. Metal fatigue was evaluated implicitly for components designed in accordance with ASME Section III, Class 2 or 3 requirements or ANSI B31.1 requirements. Each of these fatigue analyses and evaluations are considered to be Time-Limited Aging Analyses (TLAAs) requiring evaluation for the period of extended operation in accordance with 10 CFR 54.21(c).

A.4.3.1 Reactor Pressure Vessel Fatigue Analyses

Reactor pressure vessel fatigue analyses depend on the assumed numbers and the severity of normal and upset event pressure and thermal operating cycles to predict end-of-life fatigue usage factors in accordance with Section III of the ASME Code. These assumed cycle counts used to determine fatigue usage factors are based on the 40-year life of the plant. The calculation of fatigue usage factors is part of the current licensing basis and is used to support safety determinations. As such the reactor pressure vessel fatigue analyses meet the requirements of 10 CFR 54.3(a) for a TLAA.

The original Hope Creek reactor pressure vessel stress report included fatigue analyses for the reactor pressure vessel components based on a set of design basis duty cycles. The original 40-year analyses demonstrated that the cumulative usage factors (CUFs) for all critical components would remain below the allowable fatigue usage value of 1.0 specified in Section III of the ASME Code.

Revised CUF evaluations were also performed to assess the impact of Extended Power Uprate (EPU) on the reactor pressure vessel for Hope Creek. These evaluations revised the CUF values for some reactor pressure vessel components based on the change in reactor operating conditions resulting from EPU. The revised CUF evaluations were approved by the NRC as a part of the EPU approval process.

In addition, revised fatigue evaluations were performed for the recirculation inlet nozzle for containment or "new" loads in 1988, for the top head and vessel flanges for asymmetric head spray cooling in 1990, for the main closure region to support reduced-pass stud tensioning in 2000, for the reactor pressure vessel support skirt to evaluate cumulative fatigue loadings in 1996, and for the core spray nozzles to evaluate the impact of additional High Pressure Coolant Injection (HPCI) injections in 2008.

The list of design transients used in the reactor pressure vessel fatigue analyses was intended to envelope all anticipated thermal and pressure cycles that could be expected to occur within a nominal 40-year operating period for the plant. The number of transients experienced to-date for the reactor pressure vessel and other analyzed components was compiled from the Hope Creek Cycle Counting Program. The numbers of occurrences expected for 40 and 60 years of operation were obtained by extrapolating the numbers of occurrences actually incurred to-date, and using the rate of occurrence experienced during the last twelve years of operation (nine operating cycles). Conservatism was added beyond the mathematically projected number of cycles to accommodate potential variation in plant performance late in plant life, as well as to allow for additional events where the projected number of cycles was very low and the likelihood of additional events could not be ruled out.

The CUFs of the reactor pressure vessel, including the vessel support skirt, shell, upper and lower heads, closure flanges, nozzles and penetrations, nozzle safe ends, refueling bellows support, and closure studs will be managed by the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program. The program includes monitoring and recording transient events and periodic updating to current and projected CUF values.

All locations with CUF ratios (i.e., CUF/allowable) predicted to exceed 0.4 (or 40% of allowable) in the original design basis fatigue analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects have been included in the program.

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for critical reactor pressure vessel components. All necessary plant transient events will be tracked to ensure that the CUF remains less than the allowable CUF limit for all monitored components. In the event the monitored CUF is predicted to exceed the allowable value for any component prior to 60 years of operation, appropriate corrective action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded.

The Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the reactor pressure vessel in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.2 Reactor Pressure Vessel Internals Fatigue Analyses

The Hope Creek reactor pressure vessel internals were not designed in accordance with the codes for the reactor pressure vessel. However, the Hope Creek UFSAR reports CUF values for three reactor pressure vessel internals components as follows:

(1) 0.111 for the core support plate (at stud),

(2) 0.435 for the top guide (at beam slot), and

(3) Less than 0.05 for the core differential pressure sensing line (at elbow).

As such, the reactor pressure vessel internals fatigue analyses have been identified as TLAAs that meet the requirements of 10 CFR 54.3(a).

The reactor pressure vessel internals are not a part of the Class 1 pressure boundary. The above calculated fatigue usage factors when extrapolated to 60 years indicate acceptable fatigue performance for the period of extended operation.

The analysis has been projected through the period of extended operation and found to be acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.3.3 Reactor Coolant Pressure Boundary Piping and Component Fatigue Analyses

The Hope Creek reactor coolant pressure boundary (RCPB) piping was designed in accordance with ASME Code, Section III, Class 1, as stated in Section 3.2.2 of the Hope Creek UFSAR.

The Hope Creek piping systems in the scope of license renewal designed to ASME Code, Section III, Class 1 requirements were explicitly analyzed for fatigue. The analyses demonstrated that the 40-year CUFs for the limiting components in the affected systems were below the ASME Code Section III allowable value of 1.0.

High energy line breaks (HELB) in the Hope Creek piping have been postulated, and based on analyses performed for these breaks, means for avoiding damage to surrounding equipment and systems have been incorporated in the plant. Potential damage could arise from fluid jet impingement, flooding, compartment pressurization, environmental effects, and pipe whip. It is noted that cumulative fatigue usage factors (CUF <0.1) for the high energy lines are included in the criteria to determine postulated breaks. The CUFs, as calculated in the design fatigue analyses, account for the design transients assumed for the original 40-year life of the plant. The CUF calculations used in the selection of postulated high energy line break locations are TLAAs.

Since these breaks are postulated to occur only once in the lifetime of the plant, and restraints were installed appropriately to mitigate these potential breaks, the results of analyses for the potential breaks and the restraints installed in the plant remain unchanged for the extended life of 60 years. However, it is possible that other locations that had 40-year CUFs below the criteria for postulated breaks could exceed the CUF criteria in 60 years. The possibility of these additional postulated breaks will need to be managed based on the actual fatigue accumulation encountered as the plant ages.

The Hope Creek RCPB piping stress reports include fatigue analyses for all Class 1 piping components based on a set of design basis duty cycles. The original 40-year analyses demonstrated that the CUFs for all critical piping components would remain below the allowable fatigue usage value of 1.0 specified in Section III of the ASME Code.

The HELB locations were considered as a part of the Class 1 piping screening evaluation for identifying locations to monitor in the Hope Creek Metal Fatigue of Reactor Coolant Pressure Boundary program. As such, all critical HELB locations are encompassed by the Hope Creek Metal Fatigue of Reactor Coolant Pressure Boundary program. Revised CUF evaluations have been performed on the piping since the time of original plant construction. These evaluations revised the CUF values for some piping components based on the change in piping configuration or the change in reactor and piping operating conditions. The CUFs of the piping will be managed by the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program. This program will monitor critical piping component cycle based fatigue (CBF) through the use of a fatigue monitoring software application, using CBF monitoring versus the allowable value. All bounding Class 1 piping locations with CUF ratios (i.e., CUF/allowable) predicted to exceed 0.4 (or 40% of allowable) in the original design basis fatigue analysis will be included in the program. In addition, the locations identified in NUREG/CR-6260 for the newer-vintage General Electric plant, which have been evaluated for environmental fatigue effects have been included in the program.

The Metal Fatigue of Reactor Coolant Pressure Boundary program will monitor the numbers of cycles of the design transients and the corresponding CUF for critical Class 1 piping components including high energy line break limiting locations. In the event the monitored CUF is predicted to exceed the allowable value for any component prior to 60 years of operation, appropriate corrective

action will be taken in accordance with the corrective action process prior to the allowable limits being exceeded. As such, the Metal Fatigue of Reactor Coolant Pressure Boundary program will manage the effects of aging due to fatigue on the RCPB piping in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.4 Non-Class 1 Component Fatigue Analyses

Non-Class 1 components include pipe, tubing, fittings, tanks, vessels, heat exchangers, valve bodies, pump casings, and miscellaneous process components. These components were generally designed in accordance with appropriate ASME Section III subsections or American National Standards Institute (ANSI) B31.1, or B31.7, depending on their function.

Calculation of cumulative fatigue usage is not required for non-Class 1 components. For non-Class 1 components, stresses due to thermal expansion and anchor movement, which are important for fatigue evaluations, are analyzed using stress intensification factors and stress allowables. Allowable stresses are defined for 7,000 full temperature cycles with reductions in allowable stresses as cycles increase beyond 7,000.

For the Hope Creek piping systems in the scope of license renewal designed to B31.1, or ASME Code, Section III, Class 2 and 3, the assumed thermal cycle count can conservatively be approximated by the thermal cycles expected for the reactor pressure vessel, which is less than 2,700 for 60 years of plant operation. This is a fraction of the 7,000-cycle threshold. Therefore, the existing piping analyses designed to B31.1, or ASME Code, Section III, Class 2 and 3 within the scope of license renewal are valid for the period of extended operation in accordance 10 CFR 54.21(c)(1)(i).

A.4.3.5 Effects of Reactor Coolant Environment on Fatigue Life of Components and Piping (Generic Safety Issue 190)

The NRC concluded that licensees who apply for license renewal should address the effects of coolant environment on component fatigue life as part of their aging management programs. 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 Section X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," requires detailed, vintage-specific, fatigue calculations for plants applying for license renewal for the locations identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components". Since such calculations do not form a part of the Hope Creek current licensing basis and therefore do not satisfy the requirements of 10 CFR 54.3, they are not TLAA.

From NUREG/CR-6260 for the newer-vintage General Electric plant, the following locations require evaluation:

- Reactor pressure vessel shell and lower head
- Reactor pressure vessel feedwater nozzle

- Reactor recirculation piping (including reactor pressure vessel inlet and outlet nozzles)
- Core spray line reactor pressure vessel nozzle and associated Class 1 piping
- Residual heat removal nozzles and associated Class 1 piping
- Feedwater Class 1 piping

The cumulative usage factors (CUF) were calculated for each of these locations, accounting using the appropriate environmental fatigue multiplier, or F_{en}, relationships from NUREG/CR-6583 for carbon/low alloy steels, and NUREG/CR-5704 for stainless steels, as appropriate for the material for each location. The results demonstrate that CUF values, including appropriate environmental effects, are less than 1.0 for 60 years of plant operation for all locations except for the reactor pressure vessel feedwater nozzle safe end. Corrective action will be taken prior to exceeding the environmental assisted fatigue CUF value of 1.0.

All of the locations discussed will be included in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program, and the CUF for these locations will be tracked in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.4 Environmental Qualification of Electrical Equipment

Thermal, radiation, and cyclical aging analyses of plant electrical and I&C equipment, developed to meet 10 CFR 50.49 requirements, have been identified as time-limited aging analyses (TLAAs) for Hope Creek. 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. The qualification evaluations of electrical equipment with a qualified life of at least 40 years are considered TLAA for license renewal.

The Hope Creek Environmental Qualification (EQ) of Electric Components program will manage the effects of aging effects for the components associated with the environmental qualification TLAA. The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism 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 Hope Creek Environmental Qualification (EQ) of Electrical Components program. 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).

Under the Hope Creek 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. The effects of aging on the intended function(s) will be adequately managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.5 Loss of Prestress in Concrete Containment Tendons

The Hope Creek containment does not have pre-stressed tendons, therefore this topic is not a TLAA for Hope Creek.

A.4.6 Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analyses

A.4.6.1 Fatigue Analyses of Primary Containment, Attached Piping, and Components

The Hope Creek containment vessel is a Mark I design with a drywell and toroidal suppression chamber. The Hope Creek primary containment was designed in accordance with the ASME Code, Section III. The Mark I analyses are detailed in the Hope Creek Plant Unique Analysis Report (PUAR) and assume 370 multiple SRV lifts and 596 single SRV lifts. Since these analyses include fatigue evaluations based on the occurrence of a limited number of transient cycles during the current licensed term of operation (40 years), they satisfy the requirements of 10 CFR 54.3 and are TLAAs.

Using historical information and projecting the results for 60 years provided a projected number of 592 single SRV lifts for 60 years, and a projected number of 26 multiple lifts for 60 years. Both of these numbers are below the values assumed in the Mark I analyses. Even though the projected number of cycles and the associated cumulative usage factor (CUF) are projected to be within the original design assumptions, all relevant plant transient events will be tracked to ensure that the CUF remains less than 1.0 for all monitored components. Validation for primary containment locations will be performed by monitoring the high CUF limiting containment locations.

All governing fatigue analyses have been reviewed to establish a comprehensive and bounding set of primary containment locations for inclusion in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.2 Primary Containment Process Penetrations and Bellows Fatigue Analysis

The primary containment process piping penetrations use flued heads to connect the process piping to the drywell sleeves. The flued heads for the ASME Section III, Class 1 process piping systems have been analyzed for fatigue. These Class 1 fatigue analyses are based upon thermal cycles specified for the 40-year life for the plant and have therefore been identified as TLAAs requiring evaluation for the period of extended operation. The primary containment process piping penetrations with triple flued heads are anchored to the concrete shield wall around the drywell. As a result, the penetration design includes a flexible bellows to seal the triple flued head to the drywell penetration sleeve. The single and double flued heads are sealed directly to the drywell sleeves, without a flexible bellows. The flexible bellows were designed in accordance with ASME Section III, Class 2 requirements, but this included CUF analyses that have also been identified as TLAA's requiring evaluation for 60 years. The drywell penetration sleeves were evaluated for cyclic loads under the ASME Section III, Class II requirements, and it was determined that the penetration sleeves were exempt from a detailed fatigue evaluation.

For the Containment Process Penetrations, the maximum 40-year CUF ratio (CUF/allowable) identified for any of these penetrations is 0.957 for feedwater penetrations P-2A and P-2B. All other governing penetration fatigue analyses have been reviewed, and the CUF ratios for all other penetrations are well less than 0.4 (maximum value of 0.057).

The fatigue usage experienced by the flexible bellows was bounded by the corresponding attached triple flued head, therefore, monitoring of the fatigue usage for the triple flued heads will provide assurance that no flexible bellows will exceed its allowable value.

The Metal Fatigue of Reactor Coolant Pressure Boundary Program will manage the effects of aging due to fatigue on the containment process penetrations and the flexible bellows in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.3 Vent Line Bellows

Fatigue was evaluated for the vent line bellows that seal the drywell shell to the vent lines, which connect to the torus. The fatigue evaluation for these bellows is based on the number of cycles assumed for the 40-year life of the plant; therefore these analyses satisfy the criteria 10CFR54.3(a) and are evaluated as TLAA in accordance with 10CFR54.21(c).

The maximum differential displacements of the vent line bellows are determined using the results of the torus reanalysis. The displacements at the attachment points of the bellows to the drywell side of the vent line and to the torus side of the vent line are determined for each load case. The differential displacement is computed from these values. The results of each load case are combined to determine the total differential displacements for the controlling load combinations. The results are compared to the allowable bellows displacements. The loads that cause the highest number of displacement cycles at the vent line bellows are seismic loads, SRV loads, and LOCA related loads such as pool swell, condensation oscillation, and chugging. The bellows displacements for these loads are small compared to the maximum allowable displacement and their effect on fatigue is negligible. The thermal loads and internal pressure loads are the largest contributors to bellows displacements. The bellows have a rated capacity of cycles at maximum displacements for normal operating conditions greater than the originally specified (allowable) number of thermal load and internal pressure cycles.

The allowable number of cycles, at maximum displacements for normal operating conditions, are greater than those projected for 60 years, therefore the fatigue evaluation for the vent line bellows remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7 Other Plant–Specific Time Limited Aging Analyses

A.4.7.1 Crane Load Cycle Limit

The load cycle limits for cranes was identified as a potential TLAA. The method of review applicable to the crane cyclic load limit TLAA involves (1) reviewing the existing 40-year design basis to determine the number of load cycles considered in the design of each of the cranes in the scope of license renewal, (2) developing 60-year projections for load cycles for each of the cranes in the scope of license renewal and compare with the number of design cycles for 40 years.

Reactor Building Polar Crane

The Reactor Building Polar Crane at Hope Creek is designed to meet or exceed the design fatigue requirements of the Crane Manufacturers Association of America (CMAA) Specification 70. This evaluation of cycles over the 40-year life is the basis of a safety determination and is therefore a TLAA Analysis.

The Reactor Building Polar Crane is designed in accordance with CMAA Specification 70 for a minimum of 100,000 load cycles. A review of Reactor Building Polar Crane operation during the current life of the plant, including an estimated 200 lifts during original construction, indicates that the total number of lifts above 25 tons to date is less than 800. Using an average rate of 42 lifts per year over the course of 60 years results in the Polar Crane experiencing 2,520 lifts. Additionally, the Polar Crane will be used in the handling of casks, which are projected to be less than 200 lifts from campaign initiation through the period of extended operation. Therefore, the total number of lifts for the Polar Crane has been estimated to be 2,720 for the total life of plant, including the extended period of operation associated with license renewal. This is less than the minimum allowable design value of 100,000 cycles and is therefore acceptable. Therefore, the Reactor Building Polar Crane load cycle fatigue analysis remains valid for 60 years of plant operation in accordance with 10 CFR 54.21(c)(1)(i).

Service Water Intake Structure Gantry Crane

A review of Service Water Intake Structure Gantry Crane operation during the current life of the plant, including an estimated 200 lifts during original construction, indicates that the total number of lifts is less than 600. Using an average rate of 32 lifts per year over the course of 60 years results in the Service Water Intake Structure Gantry Crane experiencing 1,920 lifts. This is less than the minimum allowable design value of 100,000 cycles, and is therefore acceptable. Therefore, the Service Water Intake Structure Gantry Crane load cycle fatigue analysis remains valid for 60 years of plant operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7.2 Refueling Bellows Fatigue

A fatigue analysis was performed for each of the two bellows that seal the drywell bulkhead and reactor vessel and the drywell bulkhead and drywell shell for refueling operations. The fatigue analysis for each of these bellows is based on the number of cycles assumed for the 40-year life of the plant; therefore these analyses satisfy the criteria 10 CFR 54.3(a) and are evaluated as TLAA in accordance with 10 CFR 54.21(c).

The bulkhead-to-drywell bellows exhibited the highest calculated fatigue usage. The fatigue usage for both bellows was determined by the number of cycles of startup and shutdown and the number of flood-up events at each refueling outage. The fatigue analysis assumed 360 cycles for startup and shutdown and reflood over the life of the plant. The maximum number of startup and shutdown cycles expected for 60 years of operations at Hope Creek is 180 for startup and shutdown and 55 for refueling operations, for a total of 235 cycles. Since the number of cycles used in the analyses for these events are greater than those projected for 60 years, the fatigue analyses for the refueling bellows remain valid for the period of extended operation.

The fatigue analysis for the refueling bellows remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7.3 Neutron Fluence-Induced Stress Relaxation - Jet Pump Auxiliary Spring Wedges and Slip Joint Clamp

Auxiliary Spring Wedges and a Slip Joint Clamp have been installed on jet pumps at the Hope Creek. Structural analysis of the repair devices evaluated the loss of preload for structural bolting due to exposure to neutron fluence during 40 years of operation. The analysis for each of these devices is based on the fluence assumed for the 40-year life of the device; therefore these analyses satisfy the criteria 10 CFR 54.3(a) and are evaluated as a TLAA in accordance with 10 CFR54.21(c).

Auxiliary Spring Wedges Bolts

Based on an analysis, the auxiliary spring wedge bolts were determined to not experience a fluence level above the analyzed value. Since the fluence bounds that which would be experienced within the period of extended operation, the analysis has been successfully projected for 60 years of plant operation. The current analysis for the auxiliary spring wedges remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Slip Joint Clamp Bolt

The fluence analysis for the slip joint clamp bolt determined a fluence value greater than that previously evaluated prior to reaching 35.4 Effective Full Power Years (EFPY). Prior to the period of extended operation, or prior to reaching the analyzed limit of 35.4 EFPY, whichever comes first, the plant will either; (1) replace the slip joint clamp or (2) perform an analysis that demonstrates the component function is maintained. The slip joint clamp TLAA will be dispositioned in accordance with 10 CFR 54.21(c)(1)(iii) by managing the aging effects with the analysis and taking action as described above prior to the period of extended operation, or prior to reaching the analyzed limit of 35.4 EFPY, whichever comes first.

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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	BWR Vessel ID Attachment Welds	Existing program is credited.	A.2.1.4	Ongoing	Section B.2.1.4
5	BWR Feedwater Nozzle	Existing program is credited.	A.2.1.5	Ongoing	Section B.2.1.5
6	BWR Control Rod Drive Return Line Nozzle	Existing program is credited.	A.2.1.6	Ongoing	Section B.2.1.6
7	BWR Stress Corrosion Cracking	BWR Stress Corrosion Cracking is an existing program that will be enhanced to include: 1. For the components within the scope of the BWR Stress Corrosion Cracking program, resistant materials will be used for new and replacement components. This includes low carbon stainless piping and stainless steel weld material limited to a maximum carbon content 0.035 wt.% and a minimum ferrite content of 7.5%.	A.2.1.7	Program to be enhanced prior to the period of extended operation.	Section B.2.1.7
8	BWR Penetrations	Existing program is credited.	A.2.1.8	Ongoing	Section B.2.1.8

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
9	BWR Vessel Internals	Existing program is credited. PSEG is committed to implement the BWRVIP guidelines for Hope Creek as follows: • PSEG will inform the NRC staff of any decision to not fully implement a BWRVIP guideline approved by the staff. • PSEG will notify the staff if changes are made to the RPV and its internals' programs that affect the implementation of the BWRVIP guideline. • PSEG will submit any deviation from the existing flaw evaluation guidelines that are specified in the BWRVIP guideline.	A.2.1.9	Ongoing	Section B.2.1.9
10	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless steel (CASS) is a new program that will provide for aging management of CASS reactor internal components within the scope of license renewal. The program will include a component specific evaluation of the loss of fracture toughness in accordance with the specified criteria. For those components where loss of fracture toughness may affect function of the component, a supplemental inspection will be performed.	A.2.1.10	Program to be implemented prior to the period of extended operation.	Section B.2.1.10
11	Flow-Accelerated Corrosion	Existing program is credited.	A.2.1.11	Ongoing	Section B.2.1.11

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
12	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.2.1.12	Program to be enhanced prior to the period of extended operation.	Section B.2.1.12
13	Open-Cycle Cooling Water System	Existing program is credited.	A.2.1.13	Ongoing	Section B.2.1.13
14	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System is an existing program that will be enhanced to include: 1. New recurring tasks will be established for enhancing the performance monitoring of the Closed Cycle Cooling Water System. 2. New recurring tasks will be established for enhancing the performance monitoring of the Chilled Water System. 3. 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. 4. A one-time inspection of selected Closed-Cycle Cooling Water program chemical mixing tanks and associated	A.2.1.14	Program to be enhanced and one-time inspections to be performed prior to the period of extended operation.	Section B.2.1.14

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		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. 5. The program will be enhanced such that the plant auxiliary building chilled water system, which is part of the Control Area Chilled Water System, will comply with the pure water control program in accordance with EPRI 1007820 prior to the period of extended operation. 6. A one-time inspection of selected Control Area Chilled Water System components, including the plant auxiliary building chilled water system, will be conducted to confirm the effectiveness of the Closed-Cycle Cooling Water program.			
15	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.2.1.15	Program to be enhanced prior to the period of extended operation.	Section B.2.1.15

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.			
16	Compressed Air Monitoring	Existing program is credited	A.2.1.16	Ongoing	Section B.2.1.16
17	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.2.1.17	Program to be enhanced 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
18	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 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 prior to the 50-year in-service date and every 10-years thereafter.	A.2.1.18	Program to be enhanced prior to the period of extended operation. Inspection schedule identified in commitment.	Section B.2.1.18

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
19	Aboveground Steel Tanks	Aboveground Steel Tanks is an existing program that will be enhanced to include: 1. The program will be enhanced to include internal UT measurements to measure the wall thickness on the bottom of the tanks supported on a fiber pad on top of the concrete foundation (Fire 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 will be maintained during the extended period of operation. 2. The program will be enhanced to provide routine visual inspections of the carbon steel tanks external surfaces (Fire Water Storage Tanks, Fire Diesel Fuel Oil Tank and 17-Ton CO2 Storage Tank), including removal of tank insulation from the Fire Water Storage tank to detect degradation. These inspections will be performed to detect degraded paint and coatings, and any resulting metal degradation, prior to loss of the tank intended function.	A.2.1.19	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.2.1.19

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
20	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. Addition of biocides, stabilizers and corrosion inhibitors as determined by fuel oil sampling or inspection activities. 3. Internal inspection of Diesel Fire Pump Fuel Oil 280-gallon tank (T-565) using visual inspections and ultrasonic thickness examination of tank bottom. 4. Quarterly water and sediment multilevel sampling on the Diesel Fuel Oil Storage Tanks identified in A.2.1.20 5. Internal inspection of the Diesel Fuel Oil Storage Tanks identified in A.2.1.20 using visual inspections and ultrasonic thickness examination of tank bottoms. 6. Quarterly particulate sampling of Diesel Fire Pump Fuel Oil 280-gallon tank (T-565). 7. 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.	A.2.1.20	Program to be enhanced and one-time inspections to be performed 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	Reactor Vessel Surveillance	Reactor Vessel Surveillance is an existing program that will be enhanced to include: 1. Implement the requirements of BWRVIP-116, "BWR Vessel and Internals Project Integrated Surveillance Program (ISP) Implementation for License Renewal," including the conditions specified by the NRC in its Safety Evaluation dated February 24, 2006. 2. If future plant operations exceed the limitations specified in RG 1.99, the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Similarly, if future plant operation exceeds the bounds established by surveillance data that are to determine Upper Shelf Energy or P-T limits, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Additionally, when all the surveillance capsules are removed, then operating restrictions will be established to ensure that the plant is operated within the conditions to which the surveillance capsules were exposed. If the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the	A.2.1.21	Program to be enhanced prior to the period of extended operation.	Section B.2.1.21

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		projection to 60 years is reviewed; and, if deemed appropriate, a revised fluence projection is prepared and the effects of the revised fluence analysis on neutron embrittlement calculations will be evaluated. If necessary an active surveillance program will be re-instituted for Hope Creek. The employment of additional surveillance specimens will be coordinated through the BWRVIP Integrated Surveillance Program (ISP). Any 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.			
22	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, ductile cast iron, gray cast iron, nickel alloy, steel, stainless steel, and cast austenitic stainless steel in treated water, steam, sodium pentaborate and reactor coolant environments.	A.2.1.22	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.2.1.22

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for copper alloy, steel, galvanized 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 copper alloy, gray cast iron, steel and stainless steel in a lubricating oil environment. 4. To confirm loss of material in carbon steel piping and fittings is insignificant in an air/gas-wetted (internal) environment.			
23	Selective Leaching of Materials	Selective Leaching of Materials is a new program that will include one-time inspections of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring.	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
24	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, galvanized steel, ductile cast iron and gray cast iron piping and components within ten years prior to entering the period of extended	A.2.1.24	Program to be enhanced prior to the period of extended operation. Inspection schedule identified in commitment.	Section B.2.1.24

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		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.			
25	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.2.1.25	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 and piping elements, tanks and ducting 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. Install an internal moisture barrier at the junction of the drywell concrete floor and the steel drywell shell prior to the period of extended operation. 2. Require inspection of the moisture barrier for loss of sealing in accordance with IWE 2500 after it is installed.	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
		3. Verify that the reactor cavity seal rupture drain lines are clear from blockage once prior to the period of extended operation, and one additional time during the first ten years of the period of extended operation. 4. Verify that drains at the bottom of the drywell air gap are clear from blockage once prior to the period of extended operation, and one additional time during the first ten years of the period of extended operation. 5. Investigate the source of any leakage detected by the reactor cavity seal rupture drain line instrumentation and assess its impact on the drywell shell. 6. Monitor the drains at the bottom of the drywell air gap for leakage in the event leakage is detected by the reactor cavity seal rupture drain line instrumentation.			
29	ASME Section XI, Subsection IWF	Existing program is credited.	A.2.1.29	Ongoing	Section B.2.1.29
30	10 CFR Part 50, Appendix J	Existing program is credited.	A.2.1.30	Ongoing	Section B.2.1.30

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
31	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.2.1.31. 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.2.1.31	Program to be enhanced prior to the period of extended operation.	Section B.2.1.31
32	Structures Monitoring Program	Structures Monitoring is an existing program that will be enhanced to include: 1. Additional structures and components as described in A.2.1.32 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 inspection criteria 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. Perform a one-time inspection of the external stainless steel surfaces of the expansion bellows at Condensate Storage Tank Dike for loss of material due to corrosion, within the ten-year	A.2.1.32	Program to be enhanced prior to the period of extended operation. One-time inspection to be performed within the ten-year period prior to the period of extended operation.	Section B.2.1.32

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		period prior to the period of extended operation. 5. 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. 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.			

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
		11. Perform periodic sampling, testing, and analysis of ground water chemistry for pH, chlorides, and sulfates on a frequency of 5 years. 12. Require supplemental inspections of the 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.			
33	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. Shoreline Protection and Dike structures will be added to the program. 2. Parameters monitored for wooden components will be enhanced to	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
		include change in material properties and loss of material due to insect damage and moisture damage. 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).			
34	Protective Coating Monitoring and Maintenance Program	Existing program is credited.	A.2.1.34	Ongoing	Section B.2.1.34
35	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.2.1.35	Program and initial inspections to be implemented prior to the period of extended operation.	Section B.2.1.35

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
36	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 Leak Detection and Radiation Monitoring System, and the Neutron Monitoring System.	A.2.1.36	Program and initial assessment of testing and calibration results to be implemented prior to the period of extended operation.	Section B.2.1.36
37	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.2.1.37.	A.2.1.37	Program and initial cable tests and manhole inspections to be implemented prior to the period of extended operation.	Section B.2.1.37
38	Metal-Enclosed Bus	Metal Enclosed Bus is a new program that will manage the aging of in-scope metal enclosed busses.	A.2.1.38	Program and initial inspections to be implemented prior to the period of extended operation.	Section B.2.1.38

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
39	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 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.2.1.39	Program and one-time testing to be implemented prior to the period of extended operation.	Section B.2.1.39
40	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
41	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
42	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 only tank in the program, which is the stainless steel condensate storage tank. 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

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
43	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 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 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 stainless steel piping and components 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.	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
44	Boral Monitoring Program	Existing program is credited.	A.2.2.5	Ongoing	Section B.2.2.5
45	Small-Bore Class 1 Piping Inspection	Small-Bore Class 1 Piping is a new program that will manage the aging effects of cracking in small-bore (greater than or equal to NPS 1 and less than NPS 4) Class 1 piping through the use of a combination of volumetric examinations and visual inspections.	A.2.2.6	Program to be implemented prior to the period of extended operation.	Section B.2.2.6
46	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 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.	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
		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.			
47	Environmental Qualification of Electric Components (EQ)	Existing program is credited.	A.3.1.2	Ongoing	Section B.3.1.2
48	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.4.2.3	Ongoing	Section 4.2.3
49	RPV Circumferential Weld Examination Relief	PSEG will request relief from the requirement to perform volumetric examinations of the Reactor Pressure Vessel Circumferential Welds, in accordance with 10 CFR 50.55(a)	A.4.2.4	Prior to the period of extended operation.	Section 4.2.4
50	Operating Experience Review	PSEG will perform an evaluation of operating experience at extended power uprate (EPU) levels prior to the period of extended operation to ensure that operating experience at EPU levels is properly addressed by the aging management programs. The evaluation will include Hope Creek and other BWR plants operating at EPU levels.	N/A	Prior to the period of extended operation.	NUREG-1800 Section 3.0.2

NO.	PROGRAM OR TOPIC	COMMITMENT	UFSAR SUPPLEMENT LOCATION (LRA APP. A)	ENHANCEMENT OR IMPLEMENTATION SCHEDULE	SOURCE
51	Reactor Internals Components – Core Plate Rim Hold-Down Bolts	PSEG will perform one of the following: 1. Install core plate wedges, or 2. Perform an analysis that demonstrates the component function is maintained.	A.4.2.7	Prior to the period of extended operation.	Section 4.2.7 and Appendix C
52	Jet Pump Slip Joint Clamp	PSEG will replace the slip joint clamp or perform an analysis that demonstrates the component function is maintained.	A.4.7.3	Prior to the period of extended operation, or prior to reaching the analyzed limit of 35.4 EFPY, whichever comes first.	Section 4.7.3

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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, rather 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 nonsafety 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. This term is 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 Hope Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Hope Creek. The first way in which operating experience is used is through the Hope Creek 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 process.

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. BWR Vessel ID Attachment Welds (Section B.2.1.4) [Existing]
5. BWR Feedwater Nozzle (Section B.2.1.5) [Existing]
6. BWR Control Rod Drive Return Line Nozzle (Section B.2.1.6) [Existing]
7. BWR Stress Corrosion Cracking (Section B.2.1.7) [Existing]
8. BWR Penetrations (Section B.2.1.8) [Existing]
9. BWR Vessel Internals (Section B.2.1.9) [Existing]
10. Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.10) [New]
11. Flow Accelerated Corrosion (Section B.2.1.11) [Existing]
12. Bolting Integrity (Section B.2.1.12) [Existing]
13. Open-Cycle Cooling Water System (Section B.2.1.13) [Existing]
14. Closed-Cycle Cooling Water System (Section B.2.1.14) [Existing]
15. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section B.2.1.15) [Existing]
16. Compressed Air Monitoring (Section B.2.1.16) [Existing]
17. Fire Protection (Section B.2.1.17) [Existing]
18. Fire Water System (Section B.2.1.18) [Existing]
19. Aboveground Steel Tanks (Section B.2.1.19) [Existing]
20. Fuel Oil Chemistry (Section B.2.1.20) [Existing]
21. Reactor Vessel Surveillance (Section B.2.1.21) [Existing]
22. One-Time Inspection (Section B.2.1.22) [New]
23. Selective Leaching of Materials (Section B.2.1.23) [New]

24. Buried Piping Inspection (Section B.2.1.24) [Existing]
25. External Surfaces Monitoring (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 IWF (Section B.2.1.29) [Existing]
30. 10 CFR Part 50, Appendix J (Section B.2.1.30) [Existing]
31. Masonry Wall Program (Section B.2.1.31) [Existing]
32. Structures Monitoring Program (Section B.2.1.32) [Existing]
33. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section B.2.1.33) [Existing]
34. Protective Coating Monitoring and Maintenance Program (Section B.2.1.34) [Existing]
35. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.35) [New]
36. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section B.2.1.36) [New]
37. Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.37) [New]
38. Metal Enclosed Bus (Section B.2.1.38) [New]
39. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.39) [New]
40. High Voltage Insulators (Section B.2.2.1) [New]
41. Periodic Inspection (Section B.2.2.2) [New]
42. Aboveground Non-Steel Tanks (Section B.2.2.3) [New]
43. Buried Non-Steel Piping Inspection (Section B.2.2.4) [Existing]
44. Boral Monitoring Program (Section B.2.2.5) [Existing]
45. Small-Bore Class 1 Piping Inspection (Section B.2.2.6) [New]

B.1.6 NUREG-1801 Chapter X Aging Management Programs

The following NUREG-1801 Chapter X AMPs are described in Section B.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 Electric 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 Hope Creek Aging Management Programs (AMPs) is shown below. Links to the sections describing the Hope Creek NUREG-1801 programs are provided.

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	HOPE CREEK 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	BWR Vessel ID Attachment Welds (Section B.2.1.4)
XI.M5	BWR Feedwater Nozzle	BWR Feedwater Nozzle (Section B.2.1.5)
XI.M6	BWR Control Rod Drive Return Line Nozzle	BWR Control Rod Drive Return Line Nozzle (Section B.2.1.6)
XI.M7	BWR Stress Corrosion Cracking	BWR Stress Corrosion Cracking (Section B.2.1.7)
XI.M8	BWR Penetrations	BWR Penetrations (Section B.2.1.8)
XI.M9	BWR Vessel Internals	BWR Vessel Internals (Section B.2.1.9)
XI.M10	Boric Acid Corrosion	Not Applicable (Hope Creek is a BWR)
XI.M11	Nickel-Alloy Nozzles and Penetrations	Not Applicable (Hope Creek is a BWR)
XI.M11A	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Not Applicable (Hope Creek is a BWR)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	HOPE CREEK PROGRAM
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Not used. See XI.M13. Aging effects managed by Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.10).
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.10)
XI.M14	Loose Part Monitoring	Not used. Not credited for aging management.
XI.M15	Neutron Noise Monitoring	Not Applicable (Hope Creek is a BWR)
XI.M16	PWR Vessel Internals	Not Applicable (Hope Creek is a BWR)
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (Section B.2.1.11)
XI.M18	Bolting Integrity	Bolting Integrity (Section B.2.1.12)
XI.M19	Steam Generator Tube Integrity	Not Applicable (Hope Creek is a BWR)
XI.M20	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System (Section B.2.1.13)
XI.M21	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System (Section B.2.1.14)
XI.M22	Boraflex Monitoring	Not used. Not credited for aging management. This material is not used in the spent fuel pool racks.
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.2.1.15)
XI.M24	Compressed Air Monitoring	Compressed Air Monitoring (Section B.2.1.16)
XI.M25	BWR Reactor Water Cleanup System	Not used. Not credited for aging management. Hope Creek will not be implementing a BWR Reactor Water Cleanup System program. All three of the screening criteria as specified in XI.M25 BWR Reactor Water Cleanup System have been satisfied at Hope Creek. Refer to relevant discussion in Table 3.3.1, Item 3.3.1-37.
XI.M26	Fire Protection	Fire Protection (Section B.2.1.17)
XI.M27	Fire Water System	Fire Water System (Section B.2.1.18)
XI.M28	Buried Piping and Tanks Surveillance	Not Used. See XI.M34. The aging effects associated with buried piping and tanks are managed by the Buried Piping Inspection program (Section B.2.1.24).
XI.M29	Aboveground Steel Tanks	Aboveground Steel Tanks (Section B.2.1.19)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	HOPE CREEK PROGRAM
XI.M30	Fuel Oil Chemistry	Fuel Oil Chemistry (Section B.2.1.20)
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Surveillance (Section B.2.1.21)
XI.M32	One-Time Inspection	One-Time Inspection (Section B.2.1.22)
XI.M33	Selective Leaching of Materials	Selective Leaching of Materials (Section B.2.1.23)
XI.M34	Buried Piping and Tanks Inspection	Buried Piping Inspection (Section B.2.1.24)
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore-Piping	Not used. Plant specific program, Small-Bore Class 1 Piping Inspection, is used (Section B.2.2.6)
XI.M36	External Surfaces Monitoring	External Surfaces Monitoring (Section B.2.1.25)
XI.M37	Flux Thimble Tube Inspection	Not Applicable (Hope Creek is a BWR).
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	Not Applicable. Hope Creek is a BWR with a Mark I steel containment. ASME Section XI, Subsection IWL applies to inspections (or ISI) of reinforced concrete containments, and is therefore not applicable to Hope Creek.
XI.S3	ASME Section XI, Subsection IWF	ASME Section XI, Subsection IWF (Section B.2.1.29)
XI.S4	10 CFR Part 50, Appendix J	10 CFR Part 50, Appendix J (Section B.2.1.30)
XI.S5	Masonry Wall Program	Masonry Wall Program (Section B.2.1.31)
XI.S6	Structures Monitoring Program	Structures Monitoring Program (Section B.2.1.32)
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.2.1.33)
XI.S8	Protective Coating Monitoring and Maintenance Program	Protective Coating Monitoring and Maintenance Program (Section B.2.1.34)
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.2.1.35)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	HOPE CREEK 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.2.1.36)
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.2.1.37)
XI.E4	Metal Enclosed Bus	Metal Enclosed Bus (Section B.2.1.38)
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.2.1.39)
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Metal Fatigue of Reactor Coolant Pressure Boundary (Section B.3.1.1)
X.S1	Concrete Containment Tendon Prestress	Not Applicable (Hope Creek is a BWR with steel containment)
X.E1	Environmental Qualification (EQ) of Electrical Components	Environmental Qualification (EQ) of Electrical Components (Section B.3.1.2)
N/A	Hope Creek plant specific program	High Voltage Insulators (Section B.2.2.1)
N/A	Hope Creek plant specific program	Periodic Inspection (Section B.2.2.2)
N/A	Hope Creek plant specific program	Aboveground Non-Steel Tanks (Section B.2.2.3)
N/A	Hope Creek plant specific program	Buried Non-Steel Piping Inspection (Section B.2.2.4)
N/A	Hope Creek plant specific program	Boral Monitoring Program (Section B.2.2.5)
N/A	Hope Creek plant specific program	Small-Bore Class 1 Piping Inspection (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 Hope Creek 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 reactor coolant, steam and treated 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, valve bodies, integral attachments, and pressure-retaining bolting.

The Hope Creek ASME Section XI program includes the requirements of ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 2001 edition through 2003 addenda, augmented by Generic Letter 88-01, BWRVIP-75, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules," NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," and NUREG-0619, "BWR Feedwater Nozzle and CRD Return Line Nozzle Cracking." The Hope Creek ASME Section XI program also includes a Risk-Informed Inservice Inspection (RISI) program. The program includes periodic visual, surface, and volumetric examination and leakage test of Class 1, 2, and 3 pressure-retaining components and their integral attachments in the scope of license renewal. Hope Creek programs include, "BWR Feedwater Nozzles", "BWR Control Rod Drive Return Line Nozzle", and "BWR Stress Corrosion Cracking." In accordance with 10 CFR 50.55a(g)(4)(ii), the Hope Creek 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.

Hope Creek has experienced an occurrence of cracking of ASME Code Class 1 small-bore piping resulting from thermal and mechanical cyclic loading. Because of this, a plant-specific program, Small-Bore Class 1 Piping Inspection, is credited with the aging management of ASME Code Class 1 small-bore piping in lieu of the NUREG-1801 program XI.M35, "One Time Inspection of ASME Code Class 1 Small-Bore Piping."

The Hope Creek ASME inservice inspection program is to be augmented as identified in the GALL Report to manage effects by other programs including, "Water Chemistry."

The Hope Creek 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 Hope Creek ASME inservice inspection 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 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 Hope Creek 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 Hope Creek ISI program plan provides 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 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 Hope Creek ISI program uses three types of examination: visual, surface, and volumetric, in accordance with the general requirements of Subsection IWA-2000.

At Hope Creek the in-vessel examination procedures are consistent with the requirements of BWRVIP-03 and other appropriate BWRVIP guidelines, as well as the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Hope Creek does not currently apply inspection relief for vessel internal components with hydrogen water chemistry in accordance with BWRVIP-62.

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 Hope Creek plan.

In accordance with the ASME Section XI Code requirements, the Hope Creek 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 Hope Creek ISI program.

In the event that weld repair of nickel alloy or welding of irradiated structural components of the reactor vessel or internals are performed, the guidance of BWRVIP-44 and BWRVIP-45 would be met. All BWR vessel and internal repairs performed meet the applicable BWRVIP guidelines and ASME code requirements.

NUREG-1801 Consistency

The Hope Creek ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD 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 general, pitting and crevice corrosion are being adequately managed. The following examples of operating experience provide objective evidence that the Hope Creek 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. An unacceptable linear indication was detected on "A" Reactor Recirculation inlet weld RPV1-N2KSE (RPV nozzle to safe end weld) during the 2004 refueling outage. The flaw was axially oriented and located in the RPV nozzle weld. The flaw was detected by an ultrasonic examination, which was being conducted to meet the requirements of Generic Letter 88-01 and NUREG-0313 for IGSCC. The indication was detected using an automated Performance Demonstration Initiative (PDI)-qualified UT detection technique, and an approximate flaw size of 0.75" long by 0.35" deep was obtained using a manual UT sizing technique. The results of the examination was entered into the plant corrective action process. The ISI inspections during this refueling outage was the first-time use of the PDI ultrasonic inspection technique, which was demonstrated to have significantly better flaw detection capabilities than the ultrasonic inspection techniques previously qualified and used for IGSCC inspections. A cause and effect analysis and review of operating experience relative to BWR pipe cracking was used to determine the apparent cause. The N2K weld flaw was attributed to stress corrosion cracking. Corrective actions consisted of a weld overlay for repair of the flaw. Extent of condition review and requirements of GL 88-01 resulted in an expanded inspection scope of two additional recirculation inlet nozzles. No flaws were detected as a result of these expanded inspections. An extent of cause review and additional corrective actions for contributing factors was also performed as part of the evaluation. Follow-up actions as a result of this event and new industry related operating experience from another nuclear plant and a BWR Vessel Internals Project letter during the year 2007 led to a review of past UT data and weld configurations that prompted additional inspections to be performed during the 2007 refueling outage, when another indication was found in a recirculation inlet weld (RPV nozzle to safe end). The characteristics of the flaw found in 2007 were consistent with Intergranular Stress Corrosion Cracking (IGSCC). An approximate flaw size of 13.2-inches long (ID length) by 1.311-inches deep was obtained using a PDI-qualified automated UT sizing technique. The maximum depth of the flaw (89% through wall) was recorded for approximately 1-inch of the flaw length and the remaining length of the flaw the depth was observed to be approximately 40% through wall. This example provides objective evidence that the program provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate actions for extent of condition and cause are taken as

necessary to ensure effective condition monitoring of piping and components within the scope of license renewal.

2. An unacceptable linear indication was detected on Hope Creek Reactor Recirculation inlet weld RPV1-N2ASE (RPV nozzle to safe end weld) during the 2007 refueling outage. The flaw was circumferentially oriented and located in the RPV nozzle side of the weld. The indication was detected using an automated Performance Demonstration Initiative (PDI)-qualified UT detection technique, which has been demonstrated to have significantly better flaw detection capabilities than the ultrasonic inspection techniques previously qualified and used for IGSCC inspections. The inspection was being conducted in response to recent operating experience (OE) from another nuclear plant and a subsequent re-examination analysis of past Hope Creek automated UT data as recommended by the Boiling Water Reactor Vessel and Internals Project (BWRVIP), and as followup inspections resulting from an unacceptable indication discovered during the 2004 refueling outage. The characteristics of the flaw were consistent with Intergranular Stress Corrosion Cracking (IGSCC). An approximate flaw size of 13.2-inches long (ID length) by 1.311-inches deep was obtained using a PDI-qualified automated UT sizing technique. The maximum depth of the flaw (89% through wall) was recorded for approximately 1-inch of the flaw length and for the remaining length of the flaw the depth was observed to be approximately 40% through wall. The condition was entered into the corrective action program where cause and corrective actions were determined. An Apparent Cause Evaluation was performed and determined the inherent susceptibility of Alloy 82 and 182 weld metal to stress corrosion cracking (SCC) in the BWR primary coolant, particularly in the presence of aggravating factors such as previous machining on the ID surface of the weld root, was the apparent cause for this flaw. Corrective actions consisted of a weld overlay for repair of the flaw and an expanded inspection scope to examine two (2) additional nozzle to vessel dissimilar metal (DM) welds during the 2007 outage. The two additional welds examined were the N2D Recirculation inlet nozzle to safe end weld and the N9 CRD return nozzle DM weld. The two welds were screened due to having the highest IGSCC susceptibility ranking. No unacceptable flaws were found. An extent of cause and additional corrective actions for contributing factors was also performed as part of the evaluation. This example provides objective evidence that the program provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate action (expansion of scope due to observed conditions) is taken as necessary to ensure effective condition monitoring of piping and components within the scope of license renewal.

3. During the 2003 refueling outage, a VT-2 in-service leak test was performed on Class 1 systems. During the inspections the following discrepancies were noted and entered into the corrective action process for appropriate corrective action. A packing leak of 26 drops per minute was noted on valve AB-F016B, a packing leak of 3 drops per minute was noted on valve 1FCV-002, a leak of 35 drops per minute was noted on the "B" recirculation pump seal, a small through seat leak was noted on solenoid

valve 1HB-HV-5228, and seven leaks were identified ranging from 5 to 50 drops per minute from control rod drive flange joints. All of the above identified leaks were either repaired or dispositioned utilizing the corrective action process. Although none of the leaks constituted a loss or degradation of the Class 1 pressure boundary, the inspection techniques and sensitivity to reporting these types of leaks demonstrates a high level of assurance that the program provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate action is taken as necessary to ensure effective condition monitoring of piping and components within the scope of license renewal.

A review of approximately five years of inservice inspection results revealed that one thousand and twenty one inspections have been performed with only four unacceptable conditions noted. Two of those conditions have been discussed above, and the other two are related to misalignments of pipe supports. 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 Hope Creek 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 Hope Creek Water Chemistry aging management program is an existing program whose activities consist of monitoring and controlling the chemical environments of those systems that are exposed to reactor water, steam, condensate and feedwater, control rod drive water, demineralized water storage tank (DWST) water, condensate storage tank (CST) water, torus water, and spent fuel pool water, 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. Chemical control of the Hope Creek water systems minimizes contaminant concentration; mitigates loss of material due to general, crevice, and pitting corrosion; and mitigates cracking caused by corrosion and stress corrosion cracking (SCC) in addition to other aging mechanisms. Major component types include the reactor vessel, reactor internals, piping, piping elements and piping components, heat exchangers and tanks. Reactor water, condensate, control rod drive water, feedwater, demineralized water storage tank water, condensate tank water, torus water and spent fuel pool water are classified as treated water for aging management. The water chemistry program is also credited for mitigating loss of material and cracking for components exposed to sodium pentaborate, steam and reactor coolant environments. The Standby Liquid Control system contains a demineralized water and sodium pentaborate solution controlled in accordance with plant procedures and Technical Specifications.

The Hope Creek Water Chemistry aging management program activities are implemented using station procedures and processes. Chemical control strategies for the Hope Creek water chemistry program are defined in the BWR Chemistry Optimization procedure. The Hope Creek water chemistry program follows the guidance set forth in EPRI 1008192 "BWRVIP-130: BWR Vessel and Internals Project; BWR Water Chemistry Guidelines – 2004 Revision", which is a later revision to the guidelines referenced above in NUREG-1801, XI.M2 (BWRVIP-29). However, NUREG-1801, XI.M2 states that later revisions are acceptable.

Hope Creek has chosen a strategy that uses ECP or the measured molar ratio of hydrogen to oxygen as the primary indicator of IGSCC mitigation with proof of sufficient catalyst loading. Hope Creek monitors ECP via a standard GE Mitigation Monitoring System (MMS). It is connected to the common discharge of the RWCU pumps and flow is returned to the common suction of the RWCU pump. If ECP is unavailable, the measured molar ratio of hydrogen to oxygen can be used as an alternate indicator of protection. BWRVIP-118 and BWRVIP-62 both recommend that the hydrogen injection rate should be set to maintain a molar ratio of 3:1 at the location to be protected. The target injection rate for each BWR is a molar ration of 3:1, and Hope Creek achieves this ratio. In addition Hope Creek has a coupon mitigation monitoring system in accordance with BWRVIP-130. The coupons are removed and analyzed approximately twice per cycle to ensure a proper noble metal application. The

EPRI guidelines in BWRVIP-130 for BWR feedwater, condensate, and control rod drive water recommend that conductivity, dissolved oxygen level, and concentrations of iron and copper (feedwater only) are monitored and kept below the recommended levels to mitigate SCC. The EPRI guidelines in BWRVIP-130 also include recommendations for controlling water chemistry in auxiliary systems: torus/pressure suppression chamber, condensate storage tank, and spent fuel pool.

Hope Creek chemistry monitors and controls known detrimental contaminants such as chlorides and sulfates for the Condensate Storage Tank (CST), Demineralized Water Storage Tank (DWST), Spent Fuel Pool, Torus, Condensate & Feedwater in accordance with BWRVIP-130.

Hope Creek chemistry monitors conductivity of the Condensate Storage Tank (CST), Demineralized Water Storage Tank (DWST) and Torus water in accordance with BWRVIP-130.

Control Rod Drive chemistry monitors and controls conductivity and dissolved oxygen in accordance with BWRVIP-130.

The managing of aging effects on Standby Liquid Control (SBLC) system components subject to the sodium pentaborate environment relies on monitoring and control of SBLC poison storage tank makeup water chemistry. The makeup water is monitored in lieu of the sodium pentaborate solution in the storage tank, because the sodium pentaborate would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of selected SBLC system components as part of the One-Time Inspection aging management program.

The Hope Creek procedures set goal values that meet values set by EPRI BWRVIP-130. When a monitored parameter exceeds the goal values, the procedure requires that the values be confirmed, corrective action be taken to return the parameter to the desired range. The sampling frequencies are specified in station procedures in accordance with EPRI water chemistry guidelines. Whenever corrective actions are taken to address an abnormal chemistry condition, increased sampling is utilized to verify the effectiveness of these actions.

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 such areas at Hope Creek will receive a one-time inspection prior to the period of extended operation. This inspection will be performed as part of the Hope Creek 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 Hope Creek components.

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 aging management program is consistent with the ten elements of aging management program XI.M2, "Water Chemistry," specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 indicates that hydrogen peroxide is monitored to mitigate degradation of structural materials. The Hope Creek program does not monitor for hydrogen peroxide. **Program Elements Affected: Scope of Program (Element 1) and Parameters Monitored or Inspected (Element 3).**

Justification for Exception

Rapid decomposition of hydrogen peroxide makes reliable data difficult to obtain and BWRVIP-130 Section 6.3.3, "Water Chemistry Guidelines for Power Operation," does not address monitoring for hydrogen peroxide. Noble metal chemical application and hydrogen addition to feedwater has been applied in order to mitigate occurrence of IGSCC of structural materials by suppressing the formation of hydrogen peroxide. The hydrogen addition has accomplished an Electrochemical Corrosion Potential (ECP) value less than -230mV, SHE (Standard Hydrogen Electrode). By maintaining a low ECP less than -230mV, SHE, the reactor water chemistry minimizes the effects from hydrogen peroxide below the threshold that prompted the issue raised in NUREG 1801. Hope Creek uses the ISI program to investigate whether structural degradation in potentially affected locations is ongoing. The Hope Creek ISI program provides for condition monitoring of the reactor vessel, reactor internal components and ASME Class 1 pressure retaining components in accordance with ASME Section XI, Subsection IWB. Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI Articles IWB-3000, for Class 1.

2. NUREG-1801 indicates that dissolved oxygen is monitored. The condensate storage tank water, demineralized water storage tank water, spent fuel pool water and torus water are not sampled for dissolved oxygen. **Program Elements Affected: Scope of Program (Element 1) and Parameters Monitored or Inspected (Element 3).**

Justification for Exception

This is consistent with the guidance provided in BWRVIP-130. The Hope Creek chemistry procedures require monitoring of conductivity, chlorides, sulfates and total organic carbon (TOC) in accordance with limits set by BWRVIP-130 as an alternate method for ensuring component integrity.

3. NUREG-1801 indicates that water quality (pH and conductivity) is maintained in accordance with established guidance. The pH is not monitored for torus water. **Program Elements Affected: Scope of Program (Element 1) and Parameters Monitored or Inspected (Element 3).**

Justification for Exception

BWRVIP-130, "BWR Water Chemistry Guidelines," Section 8.2.1.11, indicates pH measurement accuracy in most BWR streams is unreliable because of the dependence of the instrument reading on ionic strength of the sample solution. In addition, the monitoring of pH is not discussed in BWRVIP-130, Appendix B for condensate storage tank, demineralized water storage tank, or torus water. Hope Creek monitors pH in the Condensate Storage Tank & Demineralized Water Storage Tank. Alternate methods are applied to monitor the water chemistry of the torus in lieu of direct pH measurements. The Hope Creek chemistry procedures require monitoring of conductivity, chlorides and sulfates in accordance with limits set by BWRVIP-130.

4. Aging of Standby Liquid Control system components subject to the sodium pentaborate environment relies on control of SBLC poison storage tank water chemistry. The sodium pentaborate solution is not monitored. The makeup water to the tank is monitored in lieu of the sodium pentaborate solution in the storage tank. **Program Elements Affected: Scope of Program (Element 1) and Detection of Aging Effects (Element 4).**

Justification for Exception

The makeup water to the tank is monitored in lieu of the sodium pentaborate solution in the storage tank because the sodium pentaborate would mask most of the monitored water chemistry parameters. The effectiveness of the water chemistry program will be verified by a one-time inspection of selected Standby Liquid Control system components as part of the One-Time Inspection aging management program.

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 Hope Creek 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. Hope Creek began service of full flow condensate pre-filters in June 1999 in response to a long-standing plant issue, high feedwater iron concentration. Feedwater iron typically ran 6 to 8 ppb with desired levels at less than 2 ppb. Within a week of going in service, feedwater iron concentration dropped to below 0.1 ppb prompting chemistry personnel to begin iron oxide addition through the active zinc injection system. Prior to pre-filters,

deep bed condensate demineralizers were removed from service at the frequency of one vessel per week. The resin was removed from the vessel and rinsed with 60,000 to 80,000 gallons of water to remove entrained insoluble iron. This cleaning process prevented Hope Creek from using anion underlays for enhanced sulfate removal, a secondary seasonal issue for reactor water. Typical summer sulfate values were above 3 ppb with desired level less than 2 ppb. Following pre-filter service, iron buildup in the condensate polishers was no longer a problem allowing the chemistry staff to implement anion underlays. From that point on, condensate demineralizer beds were no longer cleaned and reactor sulfates dropped to less than 1 ppb year round. Allowing the resins to sit static drastically improved reactor water chemistry and lengthened resin bed life from approximately 2 years to over 4 years. This demonstrates the Water Chemistry program's ability to initiate and implement corrective actions based on elevated chemistry parameters. The installation of the pre-filters not only allowed the Water Chemistry program to bring the feedwater iron concentrations to desired levels, it also enabled the chemistry department to implement other improvements to the program.

2. Condensate demineralizer influent (CDI) conductivity showed a very small increase on 03/28/06 from an average of 0.0555 to an average of 0.0565 uS/cm. The increase remained constant into 03/29/06. CDI chloride was measured on 03/29/06 at 0.46 and 0.49 ppb. Chloride should be at the limit of detection of <0.22 ppb. A review of hotwell and driptray conductivities showed a single increase in the B-North driptray from 0.11933 to 0.21940 uS/cm on 03/28/06, therefore continued trending was performed. CDI conductivity reached 0.058 uS/cm on 04/03/06; this is the Action Level 1 value, which invoked increased monitoring and implementation of long term corrective action planning. Upon isolation of the B-North waterbox in preparation for the April 2006 refueling outage (RF13), CDI conductivity returned to 0.055 uS/cm. During startup from RF13, chemistry personnel utilized leak check dimple plugs in the B-North inlet waterbox. Two leaking tubes were identified and plugged. No further leak indications were seen in the B-North waterbox. This example illustrates that the Hope Creek water chemistry program is effective in monitoring and detecting unexpected parameters as well as investigating and resolving the reason for the unanticipated chemistry value.

3. During the October 2004 refueling outage (RF12) Hope Creek replaced the low-pressure turbine rotors and shells, and moisture separator internals. During startup from the outage chemistry identified an increase in condensate conductivity when the turbine was synchronized with the grid. Samples showed the presence of both inorganic and organic chloride species. Reactor water was sampled within 15 minutes and showed an increasing chloride concentration. Reactor vessel increased to a maximum of 3.44 ppb chloride (Action Level 1 is 5ppb). As a result of the increase, the chemistry department performed increased sampling. The chlorides remained elevated for approximately 10 days while it was determined that the intrusion had poisoned the two condensate demineralizers that were in service at the time. When these two beds were finally removed from service, reactor water chlorides returned to normal levels of <0.22 ppb. The

cause of the increase chloride levels was theorized to be remnants of an organic lubricant / solvent used during the manufacturing process of the replaced low-pressure turbine and moisture separator. When steam flow increased it "flushed out" the remains of the lubricant on the replaced components, which resulted in the increased chloride levels. Chemistry detected the increased levels immediately and was able to monitor the changing parameters. This monitoring was useful in determining the source of the contaminants and later determining that the condensate demineralizers in service at the time of the event were exhausted because the condensate demineralizers were poisoned by the organic lubricant /solvent. This is another illustration that the Hope Creek water chemistry program is effective in monitoring and detecting unexpected parameters as well as aiding in the investigation and resolution of the unanticipated chemistry value.

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. Over the past five years Hope Creek has not exceeded an Action Level 1 limit, except for reactor water conductivity. However, each time the limit was exceeded it was caused by a non-deleterious condition, specifically a loss of hydrogen water chemistry. Currently there are no indications of intergranular stress corrosion cracking (IGSCC) at Hope Creek. Additionally, there have been three indications of IGSCC identified and repaired from 1997 thru 2007.

Additionally, assessments of the Water Chemistry program are performed to identify the areas that need improvement to maintain the quality performance of the program. The information above provides objective evidence that the current Water Chemistry aging management program is effective in mitigating the aging effect of cracking at Hope Creek.

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 will be managed such that the systems and components with the scope of the program will continue to perform their intended functions consistent with the current licensing basis for 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 due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC), loss of material due to wear, and coolant leakage from reactor vessel closure stud bolting. The Reactor Head Closure Studs program is a condition based monitoring program that effectively monitors and detects the applicable aging effects. 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 due to wear, 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 Hope Creek 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:

1. All reactor head closure studs were examined by the UT method during the spring, 2006 outage (RFO13). All reactor head closure studs, nuts washers were examined by the VT-1 method during the spring, 2006 outage (RFO13). Note: Closure nut number 66 exhibited gouge marks on the outside of the top surface of the nut. This was previously identified, documented, and evaluated as acceptable in the corrective action program. No other recordable indications were identified.

2. All reactor head closure studs were examined by the UT method during the 1995 extended outage (RFO6). All reactor head closure studs and nuts were examined by the fluorescent magnetic particle method, and all closure washers were examined by the VT-1 method during the 1994 refueling outage (RFO5). The results of these examinations were all acceptable.

The operating experience of the Reactor Head Closure Studs program shows there are no signs of age related degradation. This has been demonstrated by 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 degradation. 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. The problem identified above which was not age related would not cause a significant impact to the safe operation of the plant. There is sufficient confidence that the continued 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 BWR Vessel ID Attachment Welds

Program Description

The BWR Vessel ID Attachment Welds aging management program is an existing program that manages the effects of cracking of reactor vessel internal attachment welds exposed to reactor coolant through water chemistry and ASME Section XI Inservice Inspections (ISI). The program incorporates the inspection and evaluation recommendations of BWRVIP-48-A, as well as the water chemistry recommendations of BWRVIP-130. The program is implemented through station procedures that provide for mitigation of cracking through water chemistry and condition monitoring through in-vessel examinations of the reactor vessel internal attachment welds. The scope of the programs includes the steam dryer support and hold down brackets, guide rod wall bracket, feedwater sparger bracket, jet pump riser braces, core spray piping brackets, and surveillance sample holder brackets.

Hope Creek station mitigates the potential for SCC and IGSCC by maintaining high water purity through the water chemistry program. The reactor water chemistry program monitors and controls known detrimental contaminants in accordance with the recommendations of BWRVIP-130 (EPRI TR-1008192). The program description and the evaluation and technical basis of monitoring and maintaining reactor water chemistry are presented in the B.2.1.2, Water Chemistry Program. As is described in the Water Chemistry program, BWRVIP-130 replaced BWRVIP-29 as the BWR water chemistry standard. A revision later than BWRVIP-29 is permitted by NUREG-1801, Program XI.M1.

The program monitors the effects of SCC and IGSCC on the intended function of vessel attachment welds by the detection and sizing of cracks by ISI in accordance with the guidelines of NRC approved BWRVIP-48-A and the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, Table IWB-2500-1. The jet pump riser brace and core spray piping bracket attachment welds are inspected in accordance with the frequency and methods described in BWRVIP-48-A. The dryer support bracket and feedwater sparger bracket attachment welds are inspected using EVT-1 techniques while maintaining the inspection frequency per ASME Section XI Examination Category for B-N-2 components. The remaining attachment welds are inspected in accordance with ASME Section XI, Table IWB 2500-1.

Evaluation of indications is conducted consistent with IWB-3500 and IWB-3600 of Section XI of the ASME Code and the additional guidance provided in BWRVIP-48-A.

Flaw evaluations for the vessel ID attachment welds, if needed, utilize the guidance of BWRVIP-14, BWRVIP-59, and BWRVIP-60 guidelines for evaluation of crack growth in stainless steels, nickel alloys, and low-alloy steels, respectively as applicable.

If flaws are found, the scope of the inspection is expanded in accordance with ASME Section XI and guidance provided in BWRVIP-48-A. The initial expansion of examinations will comply with the requirements of IWB-2430(a) or alternatives approved by the NRC. If the examinations reveal additional indications exceeding the standards of IWB-3500, then a second expansion of scope is required during the outage. This second expansion will comply with the requirements of IWB-2430(b) or alternatives approved by the NRC.

Repair and replacement procedures comply with the requirements of the ASME Section XI. If the flaw exceeds the requirements of IWB-3600, repair and replacement is performed consistent with the requirements of ASME Section XI Subsection IWA-4000. In the 1995 edition of ASME Section XI, Sections IWB-4000 and IWB-7000 have been deleted and their requirements placed in IWA-4000.

NUREG-1801 Consistency

The BWR Vessel ID Attachment Welds aging management program is consistent with the ten elements of aging management program XI.M4, "BWR Vessel ID Attachment Welds," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Cracking due to SCC or IGSCC has occurred in BWR components made of austenitic stainless steel and nickel alloy, which is documented in industry documents, such as Generic Letter 88-01 and NUREG-0313. The Hope Creek BWR Vessel ID Attachment Welds program is based on the guidelines provided by BWRVIP-48-A. This BWRVIP guideline has evaluated available operating experience to determine which welds are susceptible to cracking from SCC and IGSCC and provide recommendations for inspection and evaluation of results for these welds. Implementation of the Hope Creek program provides reasonable assurance that cracking will be adequately managed so the intended functions of the vessel attachment welds will be maintained consistent with the current licensing basis CLB for the period of extended operation.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking due to SCC and IGSCC are being adequately managed. The following examples of operating experience provide objective evidence that the BWR Vessel ID Attachment Welds 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 inspection requirements for BWR Vessel ID Attachment Welds are implemented through the station BWR Vessel Internals Program, which incorporate the requirements of Section XI of the ASME Code as well as those from BWRVIP-48-A. Visual inspections (EVT-1, VT-1, VT-3, as applicable) of these welds have been performed since the plant has been in operation. To date, the Hope Creek inspections have not detected cracks in the vessel ID attachment welds.

   This example illustrates how condition monitoring in accordance with BWRVIP and ASME Section XI inspection guidelines is used to manage the effects of cracking in the vessel internal attachment welds. The lack of indications can be attributed in part to effective water chemistry, suitable design, and effective installation practices.

   The inspection of the vessel ID attachment welds is performed as part of the in-vessel internals inspection activities. The results of reactor internals component inspections discussed below provide meaningful examples of operating experience that are applicable to the Hope Creek BWR Vessel Internals program.

2. During a scheduled core shroud examination in 2007 (refueling outage RF14), small indications were found in a number of the horizontal welds. Inspection of the horizontal weld (H4) near the core midplane revealed five indications, all of which were less than 2 inches in length and with a depth less than 15% through wall. These indications represent a small fraction of the total weld length. The core shroud had been previously inspected in 1997 and no indications were found. The inspections results were entered into the corrective action program and evaluated to determine what further actions needed to be taken. The evaluations used the guidelines provided in BWRVIP-76, "BWR Core Shroud Inspection and Flaw Evaluation Guidelines". The BWRVIP-76 guidelines consider several factors in determining the plant specific inspection requirements, including the amount of cracking observed, the water quality to which the shroud has been exposed, years of operation, materials of construction, and whether repairs have been made to the shroud. The Hope Creek shroud is made from 304L stainless steel, had been in operation for more than eight years, was exposed to good water chemistry since the previous inspection in 1997, and was un-repaired. Considering these factors and the relatively small amount of cracking compared to the criteria specified in BWRVIP-76 led to the determination that no further inspection of the shroud was necessary in refueling outage RF14. It was also determined that the 10-year inspection interval for the next inspection was still appropriate.

3. An inspection of the jet pumps setscrew tack welds was performed in 2007 (refueling outage RF14). Cracks were found on the shroud setscrew tack welds of Jet pump 9. Additionally, a small gap of 0.009 inch was found on the vessel side setscrew.

The setscrew tack weld cracks were evaluated by the NSSS vendor (General Electric) as part of the station's corrective action program. The cause of the tack weld cracking was determined to be high cycle fatigue from jet pump vibration. Vibratory loads from the inlet-mixer can be transmitted to the restrainer bracket through the setscrews threads, if the setscrews are not properly seated and a gap exists. The screws were mechanically staked to prevent the existing setscrew gap from increasing and creating new gaps. During the 2009 refueling outage, an auxiliary spring wedge was installed to replace the function of the setscrew to prevent the creation of a gap.

The above examples illustrate how the Hope Creek vessel inspection programs monitor for cracking in accordance with BWRVIP guidelines. The examples also demonstrate that, when deficiencies are found, appropriate corrective actions are taken through the corrective action program, including actions to determine the cause and extent of the condition.

The reactor vessel internal attachment welds have been inspected for cracking due to SCC or IGSCC since the plant has been in operation. Inspections were conducted in accordance with the guidelines of NRC approved BWRVIP-48-A and the requirements of the ASME Code, Section XI Table IWB-2500-1, as required by Hope Creek BWR Vessel ID Attachment Welds aging management program. The inspections have not detected cracks in the reactor vessel attachment welds.

As demonstrated in examples 2 and 3 the inspections, conducted in accordance with approved BWRVIP documents and the requirements of the ASME Code, Section XI Table IWB-2500-1, were able to detect cracks that exist in other reactor vessel internal components. This provides reasonable assurance that implementation of the BWR Vessel ID Attachment Welds aging management program, which uses these inspection techniques, will effectively identify cracking of the attachment welds prior to a loss of an intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the BWR Vessel ID Attachment Welds program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing BWR Vessel ID Attachment Welds aging management program provides reasonable assurance that the aging effects of cracking are adequately managed so that the intended functions of vessel ID attachment welds will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.5 BWR Feedwater Nozzle

Program Description

The BWR Feedwater Nozzle aging management program is an existing program that manages the effects of cracking in the reactor vessel feedwater nozzles exposed to reactor coolant. The program provides for monitoring of feedwater nozzles for cracking through station procedures in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, Subsection IWB, Table IWB-2500-1 and recommendations of the BWR Owners Group Licensing Topical Report General Electric (GE) NE-523-A71-0594-A, Revision 1. The program is implemented through the plant ISI program and specifies periodic ultrasonic (UT) inspections of critical regions of the feedwater nozzle. The inspections are performed at intervals not exceeding ten years.

In response to NUREG-0619, design changes were made to the feedwater nozzles prior to initial plant operation to mitigate or prevent thermally induced fatigue cracking. Design changes included eliminating the cladding on nozzle inner diameter and the use of a triple sleeve feedwater sparger design.

Mitigation of cracking in the feedwater nozzle is also accomplished through the use of a feedwater level control system that utilizes a startup level control valve for low power operation to decrease flow fluctuations. As recommended in NUREG-0619, the RWCU return flow is injected in both feedwater loops. Both of these measures help to decrease the frequency and magnitude of temperature fluctuations at the feedwater nozzle during low power operation. Hope Creek does not have a thermal sleeve bypass leakage detection system and the inspection interval has not been modified based on leakage data.

The aging management program monitors the effects of cracking on the intended function of the component by detection and sizing of cracks by enhanced ISI in accordance with ASME Section XI, Subsection IWB and the recommendation of GE NE-523-A71-0594. Inspection results that do not satisfy the acceptance standards of IWB-3500 are documented in a corrective action report in accordance with plant corrective action program.

NUREG-1801 Consistency

The BWR Feedwater Nozzle aging management program is consistent with the ten elements of aging management program XI.M5, BWR Feedwater Nozzle, 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 BWR Feedwater Nozzle 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 the industry operating experience, as summarized in NUREG-0619, reveals that several BWR plants have experienced cracking in the feedwater nozzles and connecting feedwater spargers. Plants designed before 1980 were particularly susceptible. NUREG-0619 provided several recommendations for inspections and design improvements. Hope Creek started operation in 1986 with the important design features recommendations in NUREG-0619 incorporated into the plant's design, including eliminating the cladding on nozzle inner diameter and the use of a low leakage triple sleeve feedwater sparger. These design features significantly reduce thermal fatigue and the likelihood of cracking in the feedwater nozzles.

   The feedwater nozzles have been inspected for cracking as part of the Augmented Inspections of the Hope Creek ISI Program in accordance with NUREG-0619 in 1987, 1992, 1997, and 2004 using UT techniques. No flaws (indication of cracking) in the feedwater nozzles have been detected. In 2001 the program performed fracture mechanics analysis in accordance with GE-NE-523-A71-0594-A, Rev. 1 to demonstrate that a 10-year interval is sufficient to provide timely indication of detection of cracking.

This example provides objective evidence that condition monitoring is used to manage the effects of cracking in the vessel feedwater nozzles using the guidance of approved industry standards. The example also illustrates that industry experience has been incorporated to improve the program. The lack of indications to date can be attributed in part to implementing the design recommendations defined in NUREG-0619.

The Hope Creek ISI inspections of other reactor vessel nozzles discussed below provide additional examples of operating experience that are applicable to the Hope Creek BWR Feedwater Nozzle program. The examples illustrate how ISI inspection activities, conducted by qualified personnel, are able to detect flaws. The examples also illustrate that appropriate and timely disposition is provided through the corrective action program. The BWR Feedwater Nozzle program uses similar processes to effectively manage the effects of cracking in the feedwater nozzles.

2. In 2004, during refueling outage RF12, an unacceptable flaw, that is, a crack indication, was detected on "A" Reactor Recirculation inlet weld RPV1-N2KSE (RPV nozzle to safe end weld). The flaw was detected by ultrasonic examination, which was being conducted to meet the requirements of Generic Letter 88-01 and NUREG 0313 for IGSCC. The flaw was detected using an automated Performance Demonstration Initiative (PDI)-qualified UT detection technique.

As part of the corrective action process a technical evaluation was performed to determine the root cause of the crack indication. Using industry-operating experience relative to cracking in BWR piping welds the cause of the N2K weld flaw was determined to be IGSCC. The corrective action consisted of performing a weld overlay to repair the flaw. Additionally, the inspection scope was expanded to examine two additional recirculation inlet nozzles. No additional flaws were detected as a result of these added inspections. The corrective actions also specified a follow up inspection in the next refueling outage. The follow up inspection in 2007 (refueling outage RF14) did not detect any flaws in the overlay.

This example illustrates that ISI inspections by qualified personnel are capable of detecting crack indications in reactor pressure vessel components. The example also demonstrates that deficiencies are entered into the corrective action process and appropriate actions are taken to determine the cause and extent of the condition, and to correct deficiencies in an appropriate and timely manner.

3. In response to industry operating experience from another nuclear power station where a flaw was found in a recirculation nozzle weld, Hope Creek performed an ultrasonic inspection of the recirculation (N2A) nozzle-to-safe end weld in 2007 refueling outage (RF14). The N2A nozzle was selected based on an evaluation of past inspection results and a comparison of the N2A nozzle inspection results to that of the repaired nozzle at another nuclear power station. Following surface preparation, the ultrasonic inspection of the N2A nozzle weld indicated a flaw in the nozzle-to-safe end weld, which was repaired by a weld overlay repair similar to that performed previously on Hope Creek's N2K nozzle.

   As part of the corrective action process, an evaluation recommended that the Hope Creek N9 and the N2D vessel nozzles also be examined. The recommendation was based on conservative engineering judgment and not on a regulatory or other industry requirement to perform inspections of these two nozzles. The N9 and N2D nozzles were inspected by the same ultrasonic techniques that were used on the N2A nozzle and no indication of cracking was found.

These examples provide objective evidence that the inservice inspection activities, of which the BWR Feedwater Nozzle program is part, perform appropriate inspections to detect indication of cracking in RPV nozzles. The examples illustrate that industry operating experience is utilized to improve the effectiveness of the inspection process. The examples also demonstrate that, when deficiencies are found, appropriate corrective actions are taken through the corrective action program, including actions to determine the cause and extent of condition.

The Hope Creek feedwater nozzles have been inspected in 1987, 1992, 1997, and 2004 for cracking in accordance with the BWR Feedwater Nozzle aging management program. The inspections identified no cracking of the feedwater nozzles.

As demonstrated in examples 2 and 3 inspection of other reactor vessel nozzles conducted using examination methods specified by the BWR Feedwater Nozzle aging management program were able to detect cracking. This provides sufficient confidence that the implementation of the BWR Feedwater Nozzle program will effectively identify cracking of the feedwater nozzles prior to a loss of an intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where cracking is found. Assessments of the BWR Feedwater Nozzle program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing BWR Feedwater Nozzle aging management program provides reasonable assurance that the aging effects of cracking are adequately managed so that the intended functions of the feedwater nozzles will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.6 BWR Control Rod Drive Return Line Nozzle

Program Description

The BWR Control Rod Drive Return Line Nozzle aging management program is an existing program that provides for condition monitoring of the N9 nozzle (originally intended to be used as the CRD Return Line Nozzle) for cracking through station ISI procedures based on the ASME Section XI requirements. To mitigate cracking in the N9 nozzle Hope Creek completed the requirements of NUREG-0619 by capping the designated CRD return line nozzle (N9) and deleting the return line as part of the original plant design. The program performs in-service inspections to monitor the effects of cracking on the N9 nozzle. Augmented inspections of the nozzle-to-cap weld are included in the Hope Creek ISI program. The N9 nozzle is exposed to the environment of reactor coolant.

The program performs inspections of the capped N9 nozzle in accordance with requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, Subsection IWB, Table IWB 2500-1. ISI examinations include ultrasonic inspection of the nozzle inside radius section and nozzle-to-vessel weld. Future inspections of the Inside radius of the N9 nozzle will be performed using EVT-1 in accordance with NRC accepted Code case N648-1, subject to the conditions specified in Regulatory Guide 1.147.

Hope Creek also conducts UT examinations of the CRD return line nozzle-to-cap weld in accordance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) document BWRVIP-75-A as part of the BWR Stress Corrosion Cracking Program. The inspection methods used in the program have been proven effective in detecting cracking in RPV nozzles.

The extent and schedule of inspection of the N9 nozzle are determined by the approved Hope Creek ISI program. The Hope Creek ISI Program assures detection of cracks before the loss of intended function of the N9 nozzle.

As noted above, Hope Creek completed the requirements of NUREG-0619 by capping the N9 nozzle prior to plant operation. As a result, continued inspection of the nozzle as required by NUREG-0619 is not applicable to Hope Creek

Hope Creek procedures require use of ASME Section XI for evaluating flaw indications. Flaw indications are evaluated in accordance with the guidelines of ASME Section XI IWB-3100, using the acceptance standards of IWB-3512 as directed by IWB-3410.

Removing cracks by mechanical means such as grinding is acceptable per ASME Section XI. However, current industry practice is to repair detected cracks by weld overlay, using NRC approved methods. Hope Creek does not anticipate cracks to develop in the N9 nozzle welds; however, should a flaw be detected and a repair be required, all available repair techniques would be evaluated. If Hope Creek should decide to a repair method not previously approved by the NRC, a relief request would be submitted for NRC review and approval.

If the flaw exceeds the requirements of IWB-3600, repair and replacement is performed consistent with the requirements of ASME Section XI Subsection IWA-4000. In the 1995 edition of ASME Section XI Sections IWB-4000 and IWB-7000 have been deleted and their requirements placed in IWA-4000.

NUREG-1801 Consistency

The BWR Control Rod Drive Return Line Nozzle aging management program described below is consistent with the ten elements of aging management program XI.M6, BWR CRD Return Line Nozzle, 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 BWR Control Rod Drive Return Line Nozzle 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 the operating experience reveals that cracking in the CRD Return Line nozzle has occurred in several BWR plants as delineated in NUREG-0619 and Information Notice 2004-08. Plants placed in operation before 1980 were especially susceptible. In response to the concerns described in NUREG-0619 the Hope Creek design eliminated the use of a CRD return line. Additionally the N9 nozzle, originally intended to be used for the CRD Return Line, is capped. These design features significantly reduce thermal fatigue and the likelihood of cracking in the nozzle.

   The N9 nozzle has been examined several times since the plant started operation in 1986 with no flaws detected. The UT inspections of the inside radius and nozzle-to-vessel weld of the N9 nozzle were conducted in 1992 and 2000 in accordance with ASME Section XI, Table IWB 2500-1. In addition in response to the IGSCC concerns delineated in GL 88-01 the nozzle-to-cap weld was UT inspected in 1989, 1992, 1995, 1997, 1999, and

2007 with no indications detected. This last inspection was performed using a Performance Demonstration Initiative (PDI)-qualified UT detection technique.

This example illustrates how BWR CRD Return Line Nozzle program inspects the N9 nozzle in accordance with the requirements of ASME Section XI. The lack of indications can be attributed in part to implementing the design recommendations defined in NUREG-0619.

2. The Hope Creek ISI inspections of other vessel nozzles provide additional meaningful examples of operating experience that are applicable to the BWR CRD Return Line Nozzle program. The following examples demonstrate how ISI inspection activities, conducted by qualified personnel, are able to detect flaws. The examples also illustrate that appropriate and timely disposition of discrepancies is provided through the corrective action program. Similar processes would be used by the BWR CRD Return Line Nozzle program to effectively manage the effects of cracking in the N9 nozzle.

   In 2004 during refueling outage RF12 an unacceptable flaw or crack indication was detected in the N2K nozzle weld (RPV recirculation inlet nozzle-to-safe end weld). The flaw was detected by ultrasonic examination, which was conducted to meet the requirements of Generic Letter 88-01 and NUREG 0313 for IGSCC. The indication was detected using an automated Performance Demonstration Initiative (PDI)-qualified UT detection technique.

   As part of the corrective action process a technical evaluation was performed to determine the cause of the flaw. Using industry operating experience relative to BWR piping, the apparent cause of the N2K weld flaw was attributed to stress corrosion cracking. The corrective action consisted of performing a weld overlay to repair the flaw. Additionally, the inspection scope was expanded to examine two additional recirculation inlet nozzles. No additional flaws were detected as a result of these added inspections. The weld overlay was inspected again in the next refueling outage and no flaw indications were detected.

3. In response to operating experience from another nuclear power station where a flaw was found in a recirculation nozzle weld, Hope Creek performed an inspection of the N2A recirculation nozzle-to-safe end weld in the 2007 refueling outage (RF14). The N2A nozzle was selected based on an evaluation of past inspection results and a comparison of the N2A nozzle inspection results to that of the repaired nozzle at another nuclear power station. In both cases past inspections had shown similar irregular UT readings that were not classified as flaws. Following surface preparation, the UT inspection of the Hope Creek N2A nozzle weld in 2007 indicated a flaw in the nozzle-to-safe end weld. The flaw was repaired by a weld overlay similar to that performed previously on the Hope Creek N2K nozzle.

As part of the corrective action process, an evaluation recommended that the Hope Creek N9 and the N2D vessel nozzles also be examined. The recommendation was based on conservative engineering judgment and not on a regulatory or other industry requirement to perform inspections of these two nozzles. The N9 and N2D nozzles were inspected by the same ultrasonic techniques used on the N2A nozzle and no flaw indications were found. No further action during RF14 refueling outage was required for the N9 or N2D nozzles.

These examples provide objective evidence that the inservice inspection activities, which is used by the BWR CRD return Line Nozzle program, perform appropriate inspections to detect flaws in RPV nozzles. The examples also demonstrate that through the corrective action process appropriate actions are taken to determine the cause and extent of condition, if deficiencies are found. The example also illustrates that industry operating experience is utilized to improve the effectiveness of the inspection process.

The CRD return line nozzle has never been in service because it was capped prior to startup. The nozzle has been inspected seven (7) times between 1989 and 2007 and no indications have been identified. The inspections used non-destructive examination (NDE) techniques that have detected indications in other reactor vessel nozzles. There is sufficient confidence that the implementation of the BWR CRD return Line Nozzle program will effectively identify cracking prior to a loss of an intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the BWR CRD return Line Nozzle program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing BWR Control Rod Drive Return Line Nozzle aging management 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.2.1.7 BWR Stress Corrosion Cracking

Program Description

The program is an existing program that manages intergranular stress corrosion cracking (IGSCC) in reactor coolant pressure boundary piping and piping components made of stainless steel (SS) and nickel based alloy components as delineated in NUREG-0313, Rev. 2, and Generic Letter (GL) 88-01 and its Supplement 1. The program includes preventive measures to mitigate IGSCC, inspection, and flaw evaluation to monitor IGSCC and its effects.

The program includes preventive measures to mitigate the effects of IGSCC. Reactor coolant water chemistry is monitored in accordance with the guidelines in BWRVIP-130 to maintain high water purity to reduce susceptibility to SCC or IGSCC. Hope Creek implemented Hydrogen Water Chemistry and Noble Metals Chemical Addition to further reduce susceptibility of the piping systems exposed to reactor coolant to SCC or IGSCC. Additionally, Hope Creek has applied Mechanical Stress Improvement (MSIP) to several reactor vessel nozzle welds to reduce the susceptibility of these welds to IGSCC.

The program addresses the management of crack initiation and growth due to IGSCC in the reactor coolant pressure boundary (RCPB) piping, welds and components through the implementation of the ISI program in accordance with ASME Section XI. Inservice inspections, which are performed as an augmentation of the Section XI ISI program, are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the components. The inspection scope identified in GL 88-01 has been modified for the Hope Creek IGSCC inspection program to reflect the guidance defined in the staff-approved BWRVIP-75-A, "BWR Vessel and Internals Project Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules."

Inspection and flaw evaluation is conducted in accordance with the Hope Creek ISI Program Plan. When a flaw exceeds the applicable acceptance standards of IWB-3500 an analytical evaluation is performed in accordance with IWB-3600 to determine its acceptability for continued service without repair or replacement. Evaluations are performed using the applicable crack growth rate given in ASME Section XI. BWRVIP-14-A, BWRVIP-59-A, BWRVIP-60-A, and BWRVIP-62 also provide approved guidelines that could be used for evaluating crack growth in stainless, nickel alloys, and low-alloy steels. In accordance with GL 88-01, an evaluation performed to accept an IGSCC flaw must be approved by the NRC before resumption of operation.

The guidance for weld overlay repair and stress improvement or replacement is provided in several industry documents, including Generic Letter 88-01, ASME Section XI, Subsection IWA-4000 and specific code cases. (Note: In the 1995 edition of ASME Section XI, Sections IWB-4000 and IWB-7000 were deleted and their requirements placed in IWA-4000.) Hope Creek has performed stress improvement and weld overlay repairs. These actions were in accordance with ASME Section XI, IWA-4000, consistent with the guidelines provided in GL 88-01. For repair of stainless steel piping the Hope Creek program recognizes ASME Section XI code Case N-504-3 as an NRC-approved repair alternative methodology.

The program will be enhanced, as noted below, to provide reasonable assurance that the BWR Stress Corrosion Cracking program aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The BWR Stress Corrosion Cracking aging management program is consistent with the ten elements of aging management program XI.M7, BWR Stress Corrosion Cracking, specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation the following enhancement will be implemented in the following program element(s).

1. The program will be enhanced to clarify that, for the components within the scope of the BWR Stress Corrosion Cracking program, resistant materials will be used for new and replacement components. This includes low carbon stainless piping and stainless steel weld material limited to a maximum carbon content 0.035 wt. % and a minimum ferrite content of 7.5%. **Program Element affected: Preventive Actions (Element 2)**

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 BWR Stress Corrosion Cracking program will be effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation.

Intergranular stress corrosion cracking has occurred in BWR piping made of austenitic stainless steel and nickel-base alloys. Cracking has occurred in recirculation, core spray, residual heat removal (RHR), control rod drive (CRD) return line penetrations, and reactor water cleanup (RWCU) system piping welds. Some of the history is recorded in NUREG-0313, Generic Letter 88-01 and BWRVIP-75-A. NRC Information Notices 82-39, 84-41, and 04-08 provide additional information. NUREG-0313, first issued in 1977 and revised in 1980, provided guidelines for mitigating the effects of IGSCC.

From the time of initial plant design and construction Hope Creek has aggressively pursued actions to reduce the effect of IGSCC within the reactor coolant pressure boundary. The Hope Creek plant design incorporated the recommendations of NUREG-0313, Rev 1 at the time of construction. For example, corrosion resistant materials were used for the RPV safe ends and extensions. The vessel design eliminates thermal sleeves that were part of the pressure boundary and formed cervices. Corrosion resistant cladding was applied to field welds for 304 stainless steel piping connections and all of the shop welds were furnace solution heat treated before installation. These measures are described in Chapter 5 of the Hope Creek UFSAR. Hope Creek has also applied mechanical stress improvement process (MSIP) to several reactor pressure vessel nozzle welds to reduce the effects of IGSCC. Similarly, Hope Creek has implemented Hydrogen Water Chemistry (HWC) and Noble Metals Chemical Addition (NMCA) to mitigate the environment that promotes IGSCC. To continue to improve the management of IGSCC, Hope Creek actively participates in industry forums that are combating IGSCC, such as the BWR Vessel and Internals Project (BWRVIP) and the ASME Section XI Performance Demonstration Initiative (PDI) working group.

Hope Creek has performed inspections of the IGSCC susceptible components and welds as delineated in NUREG-0313, and latter modified by Generic Letter 88-01 and more recently by BWRVIP-75-A as part of the ASME Section XI ISI program. The Hope Creek ISI program identifies 386 augmented components that are inspected in accordance with GL 88-01. These inspections have not detected flaws, except for the three instances described below.

1. In 1997 during refueling outage RF07, personnel performing a routine tour of the drywell observed water dripping down from the area near the N5B nozzle of the reactor pressure vessel (RPV). Analysis of the water revealed the fluid was reactor coolant water. Further investigation revealed the presence of a through wall leak from three pinholes at the top of the core spray nozzle-to-safe end weld. The N5B nozzle is associated with the A loop of Core Spray.

   The observations were immediately entered in the correction action process and a thorough investigation was conducted to determine the cause, extent, impact, and the appropriate corrective actions. Because the leak involved an emergency core cooling system the condition was reported to the NRC in LER 97-023. Additionally, the finding was disseminated to the nuclear industry via Nuclear Network.

The N5B nozzle-to-safe-end weld was examined using UT technology to characterize the defect in accordance with ASME Section XI requirements. A review of the UT data by several expert organizations, including General Electrical, PSEG personnel, and EPRI experts determined that the cracking was a result of IGSCC in the Alloy 182 weld metal.

As part of the corrective action process the extent of the condition was investigated by inspecting other similar welds. Following the guidance of NUREG-0313 and GL 88-01 two other welds were inspected, the other core spray nozzle (N5A) and recirculation outlet nozzle N2D. In each case the nozzle-to-safe-end was examined using UT. No flaws were detected in these welds. An NRC-approved weld overlay repair was performed during the 1997 refueling outage. Subsequent inspections of the weld overlay in 1999, 2000, and 2003 have not detected flaws. The through-wall leak found in N5B in 1997 and other incidences of IGSCC through the BWR fleet prompted Hope Creek to apply Mechanical Stress Improvement Process (MSIP) for nineteen (19) RPV nozzle welds. The majority of this work was performed in 1999 and the remainder completed in 2003.

This example demonstrates that deficiencies are entered into the corrective action process and appropriate actions are taken to correct deficiencies in an appropriate and timely manner. This example also demonstrates that the corrective action process is effective in determining the cause and extent of the condition for defects that are found. The example illustrates that corrective actions are performed using established and approved industry guidelines and that Hope Creek aggressively pursues means to mitigate the effects of IGSCC. These actions are utilized in the BWR Stress Corrosion Cracking program to assure that the intended function(s) will be maintained consistent with the CLB for the period of extended operation.

2. In 2004 during refueling outage RF12 an unacceptable flaw or crack indication was detected in the N2K nozzle weld (RPV recirculation inlet nozzle-to-safe end weld). The flaw was detected by ultrasonic examination, which was conducted to meet the requirements of Generic Letter 88-01 and NUREG 0313 for IGSCC. The indication was detected using an automated Performance Demonstration Initiative (PDI)-qualified UT detection technique.

   As part of the corrective action process a technical evaluation was performed to determine the cause of the flaw. Using industry operating experience relative to BWR piping, the apparent cause of the N2K weld flaw was attributed to intergranular stress corrosion cracking. The corrective action consisted of performing a weld overlay to repair the flaw. Additionally the inspection scope was expanded to examine two additional recirculation inlet nozzles. No additional flaws were detected as a result of these added inspections. The weld overlay was inspected again in the next refueling outage and no flaw indications were detected.

3. In response to operating experience from another nuclear plant where a flaw was found in a recirculation nozzle weld, Hope Creek performed an inspection of the N2A recirculation nozzle-to-safe end weld in the 2007 refueling outage (RF14). The N2A nozzle was selected based on an evaluation of past inspection results and a comparison of the N2A nozzle inspection results to that of the repaired nozzle at another nuclear power station. In both cases past inspections had shown similar irregular UT readings that were not classified as flaws. Following surface preparation, the UT inspection of the Hope Creek N2A nozzle weld in 2007 indicated a flaw in the nozzle-to-safe end weld. The flaw was repaired by a weld overlay similar to that performed previously on the Hope Creek N2K nozzle.

   As part of the corrective action process, an engineering evaluation recommended that the Hope Creek capped CRD return line nozzle (N9) and the N2D vessel nozzles also be examined. The recommendation was based on conservative engineering judgment and not on a regulatory or other industry requirement to perform inspections of these two nozzles. The N9 and N2D nozzles were inspected by the same ultrasonic techniques used on the N2A nozzle and no flaw indications were found. No further action during RF14 refueling outage was required for the N9 or N2D nozzles.

These examples provide objective evidence that the inservice inspection (ISI) activities are used in the Stress Corrosion Cracking program perform appropriate inspections to detect flaws in RPV nozzles. The examples also demonstrate that, through the corrective action process, appropriate actions are taken to determine the cause and extent of condition if deficiencies are found. The examples also illustrate that industry operating experience is utilized to improve the effectiveness of the inspection process.

Conclusion

The existing BWR Stress Corrosion Cracking aging management 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.2.1.8 BWR Penetrations

The BWR Penetrations aging management program is an existing program that manages the effects of cracking of the reactor vessel instrumentation penetrations (nozzles) exposed to reactor coolant through water chemistry and inservice inspections. The scope of the program includes beltline instrumentation nozzles and other instrumentation nozzles; except for the Standby Liquid Control/core plate differential pressure (dP) nozzle and the jet pumps instrumentation nozzles, which are in the scope of program B.2.1.1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD. The BWR Penetrations aging management program incorporates the inspection and evaluation recommendations of BWRVIP-49-A, "Instrument Penetration Inspection and Flaw Evaluation Guidelines", as well as the water chemistry recommendations of BWRVIP-130, "BWR Vessel and Internals Project BWR Water Chemistry Guidelines". The program is implemented through station procedures that provide for mitigation of cracking through water chemistry and condition monitoring through examinations of reactor vessel instrument penetrations welds.

Hope Creek mitigates the potential for SCC and IGSCC by maintaining high water purity through the water chemistry program. The reactor water chemistry program monitors and controls known detrimental contaminants in accordance with the recommendations of BWRVIP-130 (EPRI TR-1008192). The program description and the evaluation and technical basis of monitoring and maintaining reactor water chemistry are presented in the B.2.1.2, Water Chemistry Program. As is described in the Water Chemistry program, BWRVIP-130 replaced BWRVIP-29 as the BWR water chemistry standard. A revision later than BWRVIP-29 is permitted by NUREG-1801, Program XI.M1.

The Hope Creek program monitors the effects of SCC and IGSCC by the detection of cracks by performing inspections as part of the ISI program, in accordance with the guidelines of BWRVIP-49-A, as well as the requirements of American Society of Mechanical Engineers (ASME) Code, Section XI, Table IWB-2500-1. Description of the Hope Creek ISI program, including the controlling edition of ASME Section XI, is provided in B.2.1.1, ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD. During each refueling outage a VT-2 inspection of the penetration weld is performed during the reactor coolant pressure boundary leak test. The guidelines of BWRVIP-49-A provide information on the type of instrument penetration, evaluate their susceptibility and consequences of failure, and define the inspection strategy to assure safe operation.

The nondestructive examination (NDE) techniques used for inspection of the Hope Creek vessel instrument penetrations, including the uncertainties inherent and executing NDE techniques in a BWR, are defined in BWRVIP-03.

The Hope Creek BWR Penetrations aging management program allows for inspection relief based on BWRVIP-62; however, no relief request has been made for Hope Creek. Any relief request from the requirement of ASME XI will be submitted to the NRC for approval in accordance 10 CFR 50.55a.BWRVIP-27-A addresses the Standby Liquid Control (SLC) system nozzle. The guidelines of BWRVIP-27-A are applicable to plants in which the SLC system injects sodium pentaborate into the bottom head region of the vessel. The SLC system at Hope Creek injects pentaborate into the vessel through the core spray system, not through a bottom head penetration. As stated in the BWRVIP document the guidelines of BWRVIP-27-A do not apply to plants such as Hope Creek where SLC injects via the Core Spray piping. Plants that inject SLC through a bottom head penetration also use this penetration for the core plate differential pressure (dP) instrumentation. At Hope Creek the penetration for the core plate dP instrumentation penetration (N10) is inspected in accordance with ASME Section XI, Table IWB-2500-1 requirements.

Since the inspections are performed using VT-2 during a system pressure test, defects in the penetration are discovered only if leakage is detected. The leakage would be documented and processed through the corrective action program to determine the need for any expansion of examinations and reinspection. Repairs would be completed in accordance with ASME Section XI requirements, and a subsequent pressure test conducted.

Flaw evaluations are not applicable to the Hope Creek Vessel Penetrations program because cracking is detected by leakage, which must be repaired before returning the component to service.

NUREG-1801 Consistency

The BWR Penetrations aging management program is consistent with the ten elements of aging management program XI.M8, "BWR Penetrations," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Cracking due to SCC or IGSCC has occurred in BWR components made of austenitic stainless steel and nickel alloy, as is documented in Generic Letter 88-01 and NUREG-0313. The Hope Creek BWR Penetrations program factors in this industry experience, because it is based on the guidelines provided by BWRVIP-27-A and BWRVIP-49-A. These BWRVIP guidelines have evaluated available operating experience to determine which welds are susceptible to cracking from SCC and IGSCC and provide recommendations to inspection and evaluation of results for these welds. Implementation of the Hope Creek program provides reasonable assurance that cracking will be adequately managed so the intended functions of the instrument penetrations will be maintained consistent with the current licensing basis CLB for 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 managed. The following examples of operating experience provide objective evidence that the Hope Creek BWR Penetrations program will be effective in assuring that intended function(s) are maintained consistent with the CLB for the period of extended operation:

1. The inspection requirements for reactor vessel instrumentation penetrations are implemented as part of the vessel ASME Section XI ISI activities, which is consistent with the recommendations of BWRVIP-49-A. As required by ASME Section XI, at each refueling a reactor coolant boundary leakage is performed as part of the Hope Creek ISI Program. A VT-2 test by qualified personnel is performed for all reactor coolant pressure retaining components, including the reactor vessel instrument penetrations, within the scope of this program. Throughout the operating life of the plant no leaks have been found in the penetrations managed by this program. This example illustrates how BWR Penetrations program implements the inspection requirements using the methods and inspection frequency recommended in the appropriate BWRVIP guidelines. The lack of indications can be attributed in part to effective water chemistry, suitable design, and appropriate installation practices.

2. During each refueling outage VT-2 inspections are performed during the pressure boundary leakage test. A review of the inspection results for Hope Creek did not reveal a case in which a VT-2 inspection found cracking in a Class 1 component. However, VT-2 inspections have detected leaks at mechanical interfaces such as flanges and valve packing. In each case the discrepancy is entered in to the corrective action program and appropriate action, such as repair, is taken. Although none of the leaks constituted a loss or degradation of the Class 1 pressure boundary, this example demonstrates the inspection techniques and qualified personnel are capable of detecting small leaks in Class 1 components. This provides reasonable assurance that the inspection techniques used in the BWR Penetrations aging management program is capable of detecting leaks before a loss of intended function.

Hope Creek has conducted VT-2 inspections of the reactor vessel instrument penetrations during each past refueling outage in accordance with the BWR Penetrations aging management program. The VT-2 inspections were conducted during the reactor coolant pressure boundary hydrostatic test to detect leakage that could be attributed to potential SCC and ISGCC of instrument penetrations. To date, no leakage of the reactor vessel instrument penetrations has been identified. The VT-2 inspections have detected leaks at mechanical interfaces such as flanges and valve packing. In each case the leakage did not result in a loss of the pressure boundary intended function. The leaks were entered in the corrective action process and appropriate action, such as repair, was taken. This provides reasonable assurance that inspection techniques used in the BWR Penetrations aging management program are capable of detecting leaks before a loss of an intended function. There is sufficient confidence that the implementation of the Hope Creek BWR Penetrations aging management program will effectively identify degradation prior to failure. Appropriate guidance for repair, or replacement is provided for locations where degradation is found. Assessments of the Hope Creek BWR Penetrations aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing BWR Penetrations aging management program provides reasonable assurance that the aging effects of cracking are adequately managed so that the intended functions of instrument penetrations will be maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.9 BWR Vessel Internals

Program Description

The Hope Creek BWR Vessel Internals aging management program is an existing program that manages the effects of cracking and loss of material of reactor pressure vessel internals exposed to reactor coolant through water chemistry and inservice inspection. The program incorporates the inspection and evaluation recommendations of the applicable and approved BWRVIP guidelines and ASME Section XI, as well as the water chemistry recommendations of BWRVIP-130, "BWR Vessel and Internals Project BWR Water Chemistry Guidelines." The program is implemented through station procedures that provide for mitigation of cracking through water chemistry and condition monitoring through examinations of reactor internal components.

Hope Creek station mitigates the potential for stress corrosion cracking (SCC), intergranular stress corrosion cracking (IGSCC) and irradiation assisted stress corrosion cracking (IASCC) by maintaining high water purity through the water chemistry program. The reactor water chemistry program monitors and controls known detrimental contaminants in accordance with the recommendations of BWRVIP-130 (EPRI TR-1008192). The program description and the evaluation and technical basis of monitoring and maintaining reactor water chemistry are presented in the B.2.1.2, Water Chemistry Program. As is described in the Water Chemistry program, BWRVIP-130 replaced BWRVIP-29 as the BWR water chemistry standard. A revision later than BWRVIP-29 is permitted by NUREG-1801, Program XI.M1.

Hope Creek is committed to following the BWRVIP guidelines for managing reactor internal components. The Hope Creek Vessel Internals program includes the following BWRVIP guidelines for inspection, evaluation, and repair recommendations for the components listed.

Core Shroud: Inspections and flaw evaluations are performed in accordance with BWRVIP-76. BWRVIP-07 and BWRVIP-63 have been superceded by BWRVIP-76. The repair design criteria in BWRVIP-02-A would be utilized in preparing a repair plan for the core shroud.

Core Plate: Inspections and flaw evaluations are performed in accordance with BWRVIP-25. The repair design criteria in BWRVIP-50-A would be utilized in preparing a repair plan for the core plate.

Shroud Support: Inspections and evaluations are performed in accordance with BWRVIP-38. The repair design criteria in BWRVIP-52-A would be utilized in preparing a repair plan for the core shroud support.

LPCI Coupling: Inspections and flaw evaluations are performed in accordance with BWRVIP-42-A. The repair design criteria in BWRVIP-56-A would be utilized in preparing a repair plan.

Top Guide: Inspections and evaluations are performed in accordance with BWRVIP-26-A. The repair design criteria in BWRVIP-50-A would be utilized in preparing a repair plan. The current fluence at the Hope Creek grid beams exceeds the IASCC threshold of 5 x 10^{20} n/cm^2. The inspections and evaluations are performed in accordance with BWRVIP-183. The current Hope Creek BWR Vessel Internals Program specifies that 10% of the grids beam cells containing control rod blades are inspected every 12 years, with at least 5% inspected within 6 years. Inspections are performed using EVT-1 methods. The program also allows for inspections to be performed using UT once it becomes available. These inspections will be conducted prior to the period of extended operation and will continue through the period of extended operation.

Core Spray: Inspections and evaluations are performed in accordance with BWRVIP-18-A. The program utilizes the guidelines for replacement and repair contained in BWRVIP-16-A and BWRVIP-19-A.

Jet Pumps: Inspections and evaluations are performed in accordance with BWRVIP-41. The program utilizes the repair design criteria contained in BWRVIP-51-A.

Control Rod Drive Housings: Inspections and evaluations are performed in accordance with BWRVIP-47-A. The program utilizes the repair design criteria contained in BWRVIP-55-A and BWRVIP-58-A.

Lower Plenum: Inspections and evaluations are performed in accordance with BWRVIP-47-A. The program utilizes the repair design criteria contained in BWRVIP-55-A. For repair of instrumentation penetrations, BWRVIP-57-A provides repair design criteria for those penetrations not within the lower plenum.

Steam Dryer: Inspections and evaluations are performed in accordance with BWRVIP-139. The program utilizes the repair design criteria contained in BWRVIP-181.

Access Hole Covers: Inspections and evaluations are performed in accordance with BWRVIP-180.

Hope Creek has or will complete each of the license renewal applicant action items described in the NRC safety evaluations for the above BWRVIP reports prior to the period of extended operation. Refer to Appendix C for a listing of the action items described in the NRC safety evaluations for the above BWRVIP reports.

The program provides for monitoring the effects of cracking on the intended function of internals components through detection and sizing of cracks by inspections performed in accordance with the guidelines of applicable and BWRVIP documents, as well as the requirements of ASME Section XI. The inspections are performed consistent with the recommendations of applicable and approved BWRVIP guidelines, as well as the requirements of ASME Section XI, Table IWB-2500-1. Description of the Hope Creek ISI program, including the controlling edition is provided in B.2.1.1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program.

ASME Section XI specifies VT-1 examinations to detect surface discontinuities and imperfections, cracks, corrosion, wear, or erosion. VT-3 examinations are specified to determine the general condition of component supports by verifying parameters, such as clearances and displacements, and by detecting discontinuities and imperfections, such as loss of integrity of bolted or welded connections, or loose or missing parts, debris, corrosion, wear, or erosion. For each outage the Hope Creek BWR Vessel Internals Program determines the necessary inspections based on the BWRVIP guidelines and the ASME Code. The examination procedures also identify the type and location of examination (VT-1, EVT-1, VT-3) required for each component as well as the basis for the inspection (for example: BWRVIP, ASME Code or design requirement).

The BWRVIP guidelines often recommend more stringent inspections than those specified by ASME Section XI, such as the use of enhanced VT-1 or UT, in place of VT-1 or VT-3 for select components and locations. The Hope Creek BWR Vessel Program implements the more stringent inspections recommended in the BWRVIP guidelines. The nondestructive examination (NDE) techniques used for inspection of the Hope Creek vessel internals, including the uncertainties inherent in delivering and executing NDE techniques in a BWR, are defined in BWRVIP-03.

The Hope Creek BWR Vessel Internals aging management program implements the appropriate nondestructive examination (NDE) standards for inspection of BWR vessel internals that are specified in BWRVIP-03, including the uncertainties inherent in delivering and executing NDE techniques in a BWR.

The Hope Creek BWR Vessel Internals program allows for inspection relief based on BWRVIP-62. However, no relief has been taken for Hope Creek. Any relief request from the requirement of ASME Section XI will be submitted to the NRC for approval in accordance with 10 CFR 50.55a.

Evaluation of indications is conducted consistent with the applicable and approved BWRVIP guideline or ASME Section XI, as appropriate.

Flaws are evaluated in accordance with the guidance provided in the associated BWRVIP guidelines or ASME Section XI, as appropriate for a particular component. Additional general guidelines for flaw evaluation of crack growth in stainless steels (SS), nickel alloys, and low-alloy steels is found in BWRVIP-14-A, BWRVIP-59-A, and BWRVIP-60-A.

Repair and replacement activities, if needed, are performed in accordance with ASME Section XI requirements, consistent with the recommendations of the appropriate BWRVIP repair/replacement guidelines. For nickel alloy repairs, BWRVIP-44 would be used; for weld repairs of irradiated structural components, BWRVIP-45 would be utilized in developing a repair plan.

NUREG-1801 Consistency

The BWR Vessel Internals aging management program is consistent with the ten elements of aging management program XI.M9, "BWR Vessel Internals," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Cracking due to SCC, including IGSCC, has occurred in BWR reactor vessel internal components as reported in NRC generic documents (Generic Letters, Bulletins, Information Notices) and General Electric Service Information Letters (SIL). The review of the documents for applicability to Hope Creek and the actions taken by Hope Creek are discussed below. .

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that cracking due to stress corrosion cracking (SCC) and intergranular stress corrosion cracking (IGSCC) are being adequately managed. The following examples of operating experience provide objective evidence that the Hope Creek BWR Vessel Internals 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. Cracking has been observed in core shrouds at both horizontal and vertical welds. It has affected shrouds fabricated from both Type 304 and Type 304L SS. Type 304L SS is generally considered to be more resistant to SCC. Weld regions are most susceptible to SCC. This industry experience is documented in NRC Generic Letter 94-03, Information Notices 97-17, and 94-42.

   In response to the industry experience cited in GL 94-03 and IN 97-17, and 94-42, Hope Creek has inspected the core shroud at regular intervals, once in 1997 and again in 2007. The inspection performed in 1997 did not detect flaw indications. A second shroud inspection was performed in 2007 during refueling outage RF14. The inspection was performed by qualified NDE using UT techniques following the guidelines of BWRVIP-76. Small indications were found in a number of the horizontal welds. Inspection of the horizontal weld near the core midplane (H4) revealed five indications, all less than 2 inches in length, with a depth less than 15% through wall.

   As part of corrective action program these indications were evaluated using the guidelines provided in BWRVIP-76, BWR Core Shroud Inspection and Flaw Evaluation Guidelines. Because of the small amount of cracking observed and the good reactor water chemistry maintained during the operating life of the plant it was determined that no additional inspections

were required in RF14. It also determined that no change to the current ten-year inspection interval was necessary. The shroud welds are planned to be inspected again in 2016.

This example provides objective evidence that the BWR Vessel Internals program implements inspection requirements using the methods and inspection frequency recommended in the appropriate BWRVIP guidelines. This example also illustrates that ISI inspections by qualified personnel, are capable of detecting flaws in reactor vessel internal components. The example also demonstrates that deficiencies are entered into the corrective action process and appropriate actions are taken to correct any the deficiencies.

2. Cracking in shroud support plate access hole covers has been reported in other BWRs, as documented in NRC Information Notice IN 83-03 and IN 92-57. The original equipment manufacturer, General Electric, issued guidance for this issue in SIL 462. Hope Creek has performed inspection of the access hole covers in 1997, 2003, and 2006 following the guidance of SIL 462. The inspections identified no flaws.

   Starting in 2009 Hope Creek began to inspect the plate access hole covers in accordance with BWRVIP-180. For Hope Creek there is little difference between the requirements of SIL 462 and BWRVIP-180. The most significant difference is that BWRVIP-180 requires the use of EVT-1 instead of VT-1, if visual examinations are performed. The 2009 inspections identified no flaws. The next inspection of the shroud support plate access hole covers is planned for 2015.

3. Cracking in core spray spargers has occurred in some BWRs as discussed in NRC Bulletin 80-13. Hope Creek inspected the core spray sparger during refueling outages in 1997, 1999, 2001, 2004 and 2007. No indications have been detected to date. The core spray sparger is inspected in accordance with BWRVIP-18-A. The last three inspections were performed with NDE personnel using a combination VT-1 and EVT-1 exam methods. The next inspection of the spargers is planned for 2010.

4. Cracking of the core plate rim hold down bolts has not been reported in any BWR. A thorough inspection of the core plate is difficult. A technique has not been developed yet to access the underneath regions of the core plate needed to inspect the hold down bolts. Hope Creek inspected all 34 of the hold down bolts in1997 and 26 of the 34 hold down bolts in 1999. These inspections were of the portion of the hold down above the core plate using VT-3. No indication of cracking was observed. Hope Creek's inspection strategy for the core plate hold down rim bolts is in accordance with BWRVIP-25. However an inspection technique for performing UT inspections recommended in BWRVIP-25 is not currently available. Hope Creek will continue to inspect the core plate hold down rim bolts as described in Appendix C.

5. Cracking in the top guides grid beams has occurred in some BWRs as reported NRC IN 95-17. Hope Creek has performed several inspections since the started operation in 1986, namely in 1992, 1994, 1996, 1997, and 1999. No indications have been detected in any of these inspections using VT-1 and VT-3 examination techniques.

   Starting in 2009 Hope Creek began to inspect the top guides grid beams in accordance with the guidance of BWRVIP-183. The 2009 inspections identified no flaws.

6. Instances of cracking have occurred in the jet pump assembly, hold-down beam, and jet pump riser pipe elbows in BWRs. These have been reported in NRC Information Notices 80-07, 93-101, and 97-02, respectively. Hope Creek performs jet pump assembly inspections in every refueling outage. Starting in 1999, with Refueling Outage RF-08, the Vessel Internals Program performs the inspection of jet pumps has been in accordance with BWRVIP-41. No cracking has been observed in the jet pump assembly, hold down beams and jet pump elbows. Cracking was observed in jet pump setscrew tack welds and in jet pump sensing line brackets as discussed below.

   Jet Pump Setscrew Tack Welds

   During a scheduled inspection of the jet pumps in 2007 (RF14), all three setscrew tack welds on the shroud side of Jet Pump 9 (JP9) were found cracked. Both tack welds on the vessel side setscrew were inspected and no evidence of cracking was found. Also a small gap was found on the vessel side of the setscrew.

   As part of the corrective action process the condition was evaluated by the NSSS vendor (General Electric). The cause of the tack weld failures was determined to be high cycle fatigue from jet pump vibration. Vibratory loads from the inlet-mixer to restrainer bracket through the setscrews threads occurs, if the screws are not seated and a gap exists. Corrective actions included mechanically staking the setscrews to prevent the setscrew gap from increasing and creating new gaps at the screws. During the 2009 refueling outage, an auxiliary spring wedge was installed to replace the function of the setscrew to prevent the creation of a gap.

   Jet Pump Sensing Line Brackets

   During the 1997 refueling outage (RF-07), indications were found on three jet pump sensing line lower brackets welds. No cracks were observed on the sensing lines. The safety evaluation associated with this deficiency report justified operation with a repair to the brackets. The repair consisted of clamping the sensing lines to the lower support brackets in the original welded position, essentially restoring the lines to their original structural configuration. Subsequent inspections of the jet pump sensing lines have not revealed further cracking in the brackets.

7. Cracking of nuclear instrumentation dry tubes has been observed at several BWRs. The cracking is intergranular and has been observed in dry tubes without apparent sensitization, suggesting that IASCC may also play a role in the cracking. This is discussed in General Electric Service Information Letter (SIL) 409. In response to SIL 409 Hope Creek inspected the nuclear instrumentation dry tubes in 1999. Circumferential cracks were found in all 12 dry tubes. In the 2000 refueling outage (RF-09) all 12 dry tubes were replaced with a new dry tube design made of IASCC-resistant material. The next inspection of the nuclear instrumentation dry tubes is planned for 2015.

8. Failure of BWR/3 steam dryer cover plate during operation following extended power uprate (EPU) has been reported in the industry as documented in NRC Information Notices, IN 2002-26, IN 2002-26, Supplement 1, and IN 2002-26, Supplement 2. Failure of the cover plate was attributed to high cycle fatigue failure, due to flow induced vibration. Hope Creek performed a baseline inspection of the steam dryer, prior to EPU operating conditions, using guidance provided in BWRVIP-139, "Steam Dryer Inspection & Evaluation Guidelines." The inspections identified IGSCC type cracking and no fatigue cracking. The cracks were evaluated and found acceptable for continued operation.

   Following implementation of EPU, during 2009 refueling outage, Hope Creek conducted a re-baseline inspection of the steam dryer using the guidance in BWRVIP-139. The inspections identified no fatigue related cracking. The inspections identified additional stress corrosion cracking and a weld quality related crack. The cracks were entered in the corrective action process and evaluated and found acceptable for continued service.

   The lack of cracking may be a result of the following modifications made to the steam dryer prior to its initial operation to improve its structural integrity.

   - The 0.125-inch (in) thick outer hoods were replaced with 0.5-in hood, and outer hood welds were strengthened.
   - The 0.1875-in thick central steam outlet end plates were replaced with 0.5-in plates.
   - The 0.5 x 1-in tie bars were replaced with 2 x 2-in tie bars and the number of tie bars was increased.
   - The 0.187-in reinforcing strips were added to extend the effective weld lengths between the middle and inner hoods and end plates. The inside corners of these hoods to the end plates were back-welded to a minimum height of 50-in above the support ring

   Also the lack of cracking may be due to main steam line SRV piping configuration.

   This example demonstrates that industry operating experience (OE) information is reviewed for applicability to Hope Creek and incorporated in

BWR Vessel Internals aging management program to improve its effectiveness.

The operating experience of the Hope Creek BWR Vessel Internals aging management program has not identified cracking of vessel internal components to the extent reported in other BWR's. That is, inspections conducted in accordance with ASME Section XI and approved BWRVIP guidelines have not detected cracking in the shroud support plate access hole covers, core spray spargers, top guides grid beams, jet pumps assembly, jet pumps hold down beams, jet pumps riser pipe elbows, and no fatigue related cracking of the steam dryer. The inspections identified limited number of small cracks in the core shrouds welds, cracking in the nuclear instrumentation dry tubes, non-fatigue related cracks in the steam dryer, and cracks in the jet pump 9 setscrews tack welds and the jet pumps sensing line support brackets. The cracks were entered in the corrective action process and evaluated for acceptance or repair and replacement in accordance with associated BWRVIP guidelines or ASME Section XI as appropriate for the particular component. Cracks in the core shroud welds and those identified in the steam dryer were found acceptable for continued service. The nuclear instrumentation dry tubes were replaced with new design made of IASCC resistant material. The jet pump 9 setscrews tack welds and sensing lines support bracket welds were repaired.

Based on the above, there is sufficient confidence that the implementation of the Hope Creek BWR Vessel Internals 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 Hope Creek BWR Vessel Internals program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The existing BWR Vessel Internals aging management program provides reasonable assurance that cracking and the loss of material aging effects are adequately managed so that the intended functions of BWR vessel internals 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 Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)

Program Description

The aging management program for Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless steel (CASS) is a new program that will provide for aging management of CASS reactor internal components exposed to reactor coolant and neutron flux within the scope of license renewal. The program will be implemented prior to the period of extended operation.

The Hope Creek reactor vessel internals receive a visual inspection in accordance with the American Society of Mechanical Engineers (ASME) Code Section XI, Subsection IWB, Category B-N-1 and B-N-2 and the BWR Vessel Internals program. The BWR Vessel Internals program inspections will be supplemented to detect the effects of loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of cast austenitic stainless steel (CASS) reactor vessel internals determined to be susceptible to loss of fracture toughness.

The Hope Creek Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel aging management program will include a component specific evaluation to (a) identify the "susceptible components" determined to be limiting from the standpoint of thermal aging susceptibility (i.e., ferrite and molybdenum contents, casting process, and operating temperature) and/or neutron irradiation embrittlement (neutron fluence), and (b) for each "potentially susceptible" component, aging management will be accomplished through either a supplemental examination of the affected component based on the neutron fluence to which the component has been exposed as part of the BWR Vessel Internals program during the license renewal term, or a component-specific evaluation to determine its susceptibility to loss of fracture toughness.

The following CASS material components susceptible to thermal aging and neutron irradiation embrittlement and subject to loss of fracture toughness include:

- Control Rod Assemblies; guide tubes
- Core Spray Lines and Spargers; spray nozzles and elbows
- Fuel Supports
- Jet Pump Assemblies; transition piece, inlet, throat, and diffuser collar
- Steam Dryers; drain line fittings

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel aging management program will be a monitoring program that will effectively detect the applicable aging effects and the frequency of monitoring will be adequate to prevent significant degradation.

NUREG-1801 Consistency

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program is consistent with the ten elements of aging management program XI.M13, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS), 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 Hope Creek operating experience provides objective evidence that existing BWR Reactor Internal program inspections including CASS components effectively assure the intended functions are maintained consistent with the CLB for the period of extended operation. The new thermal aging and neutron irradiation embrittlement of CASS program will augment existing internal vessel inspection techniques.

1. In April 2006, during Hope Creek RF13 planned in-vessel internal inspections, wedge wear was observed on Jet Pump #2 (JP-2). The wear was reported at the interface between the inlet-mixer and the restrainer bracket pad. The inspection specifically found a 0.009" gap between the restrainer bracket set screw and the inlet-mixer on JP-2. As part of the corrective action program, an engineering evaluation was performed and the cause of the indications was found to be slip joint leakage induced vibration. A Slip Joint Clamp was installed to suppress the slip joint leakage vibration mechanism and a follow-up inspection was performed in the subsequent refuel outage (RF14) to ensure that no further wedge wear had occurred. In addition, the scope of the inspection was expanded to verify no additional indications were found in accordance with the requirements found in BWRVIP-41. The follow-up inspection verified the slip joint clamp effectively addressed the condition. The slip joint clamp was added to the vessel internals program for future re-inspections. This OE item shows existing in-vessel internal inspections are effective in identifying degradation and the corrective action and evaluation programs assure intended functions are maintained and follow-up actions are identified and planned.

2. During RF13 planned internal visual vessels inspections (IVVI) work in October 2006, three crack indications were identified in the JP 6 wedge stellite face below the restrainer bracket. The cracks were on the surface and had no impact on the function of the wedge. No further action was required since no significant degradation was occurring at the wedge. Further inspections have been scheduled at the next required ISI Long-Term Inspection Plan, as directed by BWRVIP-41 requirements. This OE item shows the current vessel inspection programs effectively identify cracked components and ensure intended functions are maintained.

3. During a planned RF14 inspection in October 2007, the jet pump set screw tack welds at jet pump 9, shroud side, were inspected for cracking and the original tack welds were found to have cracked. No movement of the setscrews was found during this inspection. The corrective action included mechanically staking the setscrews and installing an auxiliary spring wedge. The auxiliary spring wedge was not able to be installed; therefore a follow-up action item was initiated for RF15 to complete the installation of the auxiliary spring wedge. The condition was evaluated in accordance with BWRVIP-06 and found to be acceptable for the continued operation and did not constitute a safety concern. This OE item shows the current vessel inspection programs effectively identify degraded components and evaluate corrective action items required to ensure intended functions are maintained.

The operating experience of existing BWR Vessel Internals program found no adverse trends in performance. Problems identified would not cause a 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 Thermal Aging and Neutron Irradiation Embrittlement of CASS aging management program which will augment the existing BWR Vessel Internals program will effectively identify degradation of the CASS components found in the control rod assemblies, core spray lines and spargers, fuel supports, jet pump assemblies, and in the steam dryer prior to failure. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Thermal Aging and Neutron Irradiation Embrittlement of CASS aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Conclusion

The new Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless steel (CASS) aging management program will provide reasonable assurance that the effects of loss of fracture toughness will be adequately managed so that the intended functions of cast austenitic stainless steel (CASS) 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 Flow-Accelerated Corrosion

Program Description

The Flow-Accelerated Corrosion (FAC) aging management program at Hope Creek 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.

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. 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 Hope Creek 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 the 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. The Hope Creek FAC Program implemented a proactive replacement plan in September 2006, to mitigate wall thinning by upgrading to FAC resistant materials. Upgrading piping to a FAC resistant material is an industry best practice. EPRI's NSAC-202L-R3 (TR 1011838) "Recommendations for an Effective Flow-Accelerated Corrosion Program" states that upgrading the carbon steel piping to material containing chrome should alleviate FAC damage. Hope Creek has experienced FAC induced through-wall leaks with carbon steel piping. As a result of these piping leaks, Hope Creek has taken on a proactive replacement plan to upgrade the susceptible carbon

steel components with FAC resistant materials. Using plant and industry experience the FAC program manager determines what plant systems should be upgraded with FAC resistant materials.

The following plant systems have had portions of their piping upgraded: main steam drains, reactor water feed pump turbine steam supply drains, extraction steam lines, seal steam lines, feedwater heater vent lines, RCIC and HPCI steam supply drain lines, and plant heating system. Most of the upgrades have been with Chromium-Molybdenum alloy steel. None of the replaced piping has experienced any through-wall leakage due to FAC. This proactive material upgrading will continue to be evaluated by the FAC program manager and upgrades are considered for the remainder of the operating vent lines for all of the Feedwater Heaters, the main steam turbine control valve before seat drains and leak-off lines, the main steam lead drains, portions of reactor feed pump turbine steam drains, the steam jet air ejector runoff drain, portions of plant heating piping inside the turbine building steam tunnel, and the turbine bypass seal leak-off lines.

This example provides objective evidence that the FAC aging management program effectively monitors the aging effects of FAC on piping and components. In addition the program has taken corrective action to have a proactive replacement plan to upgrade the susceptible carbon steel components with FAC resistant material.

2. As result of feedwater heater shell failures at other nuclear plants (OE-9941), as well as Salem Unit 1 plant experience with feedwater heaters (OE11020), feedwater heater shell inspections were instituted at Hope Creek. In 2000, the #5A, B & C feedwater heater shell area was replaced in the vicinity of the extraction steam inlet nozzles. A shell area was cut out of the heaters, and was replaced with carbon steel plate roll-bonded with 0.125" stainless steel cladding on the inside diameter. The extraction steam inlet nozzle was also replaced with the same configuration. All feedwater heaters (except the #1 heaters) have been inspected at least once. The shell area around two of the four #1C feedwater heater extraction steam inlet nozzles were inspected in 2007, and no problem was identified. Inspection of the remaining two extraction steam inlet nozzles for the #1C, and all the #1A and #1B feedwater heaters extraction steam inlet nozzles are planned for 2010.

   As a part of the feedwater heater shell FAC inspection program, stress evaluations are performed to obtain the allowable minimum wall thickness. This minimum allowable thickness is the basis for trending wall thinning and tracking when the next inspection is scheduled. The scope of the feedwater heater shell inspection project is to inspect every feedwater heater shell at least once in the vicinity of the extraction steam inlet nozzle. Wear rates are determined and wall thinning on the feedwater heaters are trended, and analyses are performed to determine appropriate inspections, which are scheduled prior to the shell reaching its minimum allowable wall thickness.

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 this program takes corrective actions prior to loss of intended function, and the program uses industry operating experience to improve program implementation.

3. In 2004, the Hope Creek FAC program prompted a wall thickness inspection of feedwater heater nozzles in response to OE17919, "Inspection Identifies Holes in #2 Heater Extraction at LaSalle Unit 1". Based on ultrasonic testing (UT) and visual inspection, significant wall thinning downstream of the piping/nozzle weld for the #2A feedwater heater nozzles was discovered. Extent of condition evaluation determined that #2B and #2C feedwater heaters had experienced the same kind of wall thinning.

   During internal weld repairs in April 2006, it was discovered that the nozzle had a stainless steel liner, which started at about 1/4" downstream of the pipe/ nozzle weld, rather than being fully extended. The wall thinning was found to be caused by steam cutting of the nozzle between the inner liner and the outer diameter, indicating the degradation to the nozzle would have been less severe had the liner been fully extended to the top of the nozzle. So far eleven out of the twelve nozzles for the #2 feedwater heaters (FWHs) have been repaired by internal weld build-up. A re-evaluation of the twelfth nozzle's wall thickness concluded that repairs were not required until RF16 outage (October 2010). Replacement of all three #2 FWHs is planned for RF16 outage. The new FWHs will have extraction steam inlet nozzles fabricated with alloy steel, which is resistant to FAC. To correct the root cause of this problem, the Hope Creek FAC Program will continue to monitor FAC-susceptible feedwater heater nozzles and make repairs or replacements as warranted.

   This example provides objective evidence that the FAC aging management program uses industry operating experience to investigate FAC related concerns and the program takes corrective actions prior to loss of intended function.

4. Extended Power uprate (EPU) at Hope Creek was implemented in 2008. In advance of this power uprate, in 2002, Hope Creek performed a FAC evaluation on CHECWORKS at 20% power uprate. Comparing the predicted CHECWORKS wear rates at EPU with wear rates at normal power, this evaluation revealed that the power uprate operating conditions would have a minimal impact on FAC wear rates. Also, results showed that the average predicted wear rate would not cause an increased need for physical modifications or replacements of the systems that are vulnerable to FAC. In 2008, the CHECWORKS model at Hope Creek was revised to reflect the power uprate conditions, in compliance with the EPRI NSAC 202L-R3 Guidelines.

Hope Creek has benefited from FAC related experience of other nuclear plants that have gone through EPU. Hope Creek actively participates in the CHECWORKS User Group (CHUG) and stays informed of the industry experience on FAC. So far, no industry experience has indicated any FAC related issues because of EPU, that would have any impact on risk ranking by CHECWORKS. Hope Creek will enter its period of extended operation in 2026. This provides at least 18 years of additional plant experience at EPU conditions. In addition, it allows for monitoring experiences at other nuclear plants that have gone through EPU conditions.

This example provides objective evidence that operating experience is being used effectively to improve the program and lessons learned are implemented to make the FAC program effective at Hope Creek.

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.2.1.12 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 indoor and outdoor, raw water, soil and treated water.

The Hope Creek 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 at Hope Creek are currently performed in accordance with the ASME Section XI, 2001 Edition through the 2003 addenda, per the Hope Creek ISI program plans. Examinations for the period of extended operation will be in accordance with the appropriate code edition and addenda for the Hope Creek 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 pressure retaining bolted joints are evaluated by detection of visible leakage during maintenance or routine observation such as system walkdowns. MC component pressure retaining bolting is monitored in accordance with ASME Section XI, Subsection IWE, B.2.1.28, aging management program.

High strength bolts (actual yield strength ≥150 ksi) are not used on structural connections. The structural bolting and fasteners (actual yield strength <150 ksi) both inside and outside containment are inspected by visual inspection by the Structures Monitoring Program, B.2.1.32.

ASTM A490 bolts are used for NSSS Class 1 reactor pressure vessel supports. The bolts are installed with a preload that yields approximately 105 ksi tensile stress, which is less than the minimum yield strength of the bolt. Stress corrosion cracking (SCC) is not an applicable aging effect for these bolts since they are not subject to high sustained tensile stress. These bolts are inspected by the ASME Section XI, Subsection IWF, B.2.1.29, 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.2.1.29, aging management program addresses aging management of ASME Section Class 1, 2, 3 and MC 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.2.1.32. 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.2.1.15, aging management program. Aging Management of heating and ventilation bolted joints is addressed by the External Surfaces Monitoring, B.2.1.25, aging management program. These 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.2.1.24, aging mangement 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.2.1.29, aging management program addresses replacement of NSSS component support bolting. Corrective actions are addressed in accordance with 10 CFR Part 50, Appendix B.

The program will be enhanced, as noted below, to provide reasonable assurance that the Bolting Integrity program aging effects will be managed during the period of extended operation.

NUREG-1801 Consistency

The Bolting Integrity aging management program 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 bolting 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. Hope Creek uses the Corrective Action Program to determine an appropriate inspection frequency for identified leaks in bolting 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, Hope Creek 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. Hope Creek 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

Hope Creek 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 2004, an inspection of the torus lateral seismic restraint bolting washers showed scaling. After removal of scale, pitting was observed on the washers. The corrective action taken was to remove scaling from all washers and apply coating to protect the washers from future degradation issues. Follow up inspections of this area did not find rust or scaling. This example provides objective evidence that visual inspections identified scaling of washers prior to loss of intended function, and provided corrective action to resolve the degradation and preclude future degradation of similar components.

2. In 2004, during a system walkdown it was identified that a bolt was missing on a nonsafety-related pipe support base plate in the Safety Auxiliaries Cooling System (SACS) system. Further investigation determined that the bolt was in place but rusted. Engineering evaluation determined that operability of the SACS system was not affected. The hanger was repositioned, and new bolts were installed and properly torqued. This example provides objective evidence that system walkdown inspections identified a missing bolt and provided corrective action to resolve the degraded condition prior to loss of system intended function.

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 provides reasonable assurance that the identified aging effects will be 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.2.1.13 Open-Cycle Cooling Water System

Program Description

The Hope Creek 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 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, other 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 Hope Creek 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 NDE. 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 (PM), plant surveillance testing, ISI, 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 Hope Creek 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 Hope Creek 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 Hope Creek 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 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 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 several 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) are maintained consistent with the current licensing basis for the period of extended operation:

1. During the Hope Creek refueling outage in November 2004, technicians found excessive corrosion at the bell and spigot joints at several points on the "A" Station Service Water loop buried piping. There are approximately sixty joints on this service water loop between the intake structure and the Reactor Building. All the joints were examined using broadband scanning, which can detect degradation of the carbon steel piping enclosed in the reinforced concrete. Eight joints out of the sixty joints had some indication of corrosion. The original "A" loop joint had localized thinning of the carbon steel. The thickness was below the minimum acceptance criterion. The thickness of the other seven joints was less than nominal, but above the minimum acceptance criterion.

   Based on the operating experience at the Salem Generating Station with similar Service Water System piping, the decision was made to install a WEKO seal to correct the problem on the worst joint. Seven other joints received similar WEKO seal installations, and the remaining joints received a combination of cleaning and coating restorations to restore the joints to the original configuration. The corrosion of the carbon steel bell rings has been attributed to the blistering of the original epoxy coatings and subsequent attack on the metal surfaces by the brackish estuary water. Hope Creek considers different industry practices for monitoring the reinforced concrete joints, e.g., using broadband scanning. The remaining joints that were not modified with the WEKO seals are inspected every other outage.

This operating experience example provides objective evidence that the monitoring program for the Service Water System piping at the Hope Creek is effective in detecting the degradation of the system and then taking effective corrective action to ensure the long-term operability and reliability of the system.

2. In April 2006 during the refueling outage, three locations in the "B" Station Service Water piping header near the Reactor Building were found below the nominal piping thickness where the epoxy coating was worn away from the carbon steel piping. The technicians initially thought that two of the three areas were below the minimum wall thickness acceptance criterion (≥87.5% of nominal). These problems were discovered during the routine inspection of the Service Water header piping during the refueling outage. Subsequent evaluation of the three locations determined that the areas were not below the calculated design minimum wall thickness, and the areas were cleaned and recoated with epoxy. Subsequent inspection of the "A" loop during the following refueling outage found that one small area was corroded below the minimum wall requirements. The affected area was repaired with weld buildup and reapplication of the epoxy coating. These transition pipe sections are inspected every other outage as part of the GL 89-13 inspection program. This frequency was determined to be adequate to manage the aging effects and to identify degraded conditions prior to failure of intended function based on historical performance.

   This operating experience example provides objective evidence that the inspections are able to detect the degradation of the piping at various locations in the system prior to the actual failure of the equipment. Corrective actions are effective in returning the system to the proper condition for ensuring the long-term reliability of the system.

3. In February 2007, a through-wall leak was found on the "B" Station Service water lube water head tank by station mechanics. This tank provides bearing cooling water during certain design basis accidents until the Service Water pumps are sequenced onto the diesel generator. The investigation of the leak determined that several areas of the tank welds had experienced microbiologically-influenced corrosion attack. These tanks had initially been constructed of 304 stainless steel, but were upgraded to 316L stainless steel in order to lessen the impact of the microbiologically-influenced corrosion attack. However, subsequent inspections of these tanks found that the microbiologically-influenced corrosion was causing pitting in the tank weld areas. The tank welds were repaired using an epoxy coating until a final evaluation was conducted to abandon the tanks, and replace the piping with AL6X material to match the remainder of the service water intake structure piping.

   This operating experience example provides objective evidence that the OCCWS aging management program is effectively monitoring the equipment and taking appropriate corrective action to change the materials and configuration to ensure the long-term safe, reliable operation of the system.

Modifications to the Open-Cycle Cooling Water System as part of the Service Water Improvement project, completed in the 1990s, included replacement of most of the safety-related carbon steel piping with 6% molybdenum stainless steel. Similarly, the safety-related aluminum bronze and carbon 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.2.1.14 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 stress corrosion 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 program will be enhanced, as noted below, to provide reasonable assurance that the Closed-Cycle Cooling Water System program aging effects will be 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 exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 refers to EPRI TR-107396 1997 Revision. Hope Creek 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. Hope Creek has reviewed EPRI 1007820 and have 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. New recurring tasks will be established for enhancing the performance monitoring of the Closed Cycle Cooling Water System. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

2. New recurring tasks will be established for enhancing the performance monitoring of the Chilled Water System. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)**

3. 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)**

4. 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)**

5. The program will be enhanced such that the plant auxiliary building chilled water system, which is part of the Control Area Chilled Water System, will comply with the pure water control program 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)**

6. A one-time inspection of selected Control Area Chilled Water System components, including the plant auxiliary building chilled water system, 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 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. On July 31, 2006, during performance of the monthly surveillance tests, the equipment operators observed higher than normal lube oil temperatures on the 'B' Emergency Diesel Generator. An investigation was performed and it was concluded that the cause of the increased temperature trends was due to the mis-positioning of the associated throttle valve during a recent Safety Auxiliaries Cooling System flow balancing on the 'B' Emergency Diesel Generator. Additionally, during the investigation into the 'B' Emergency Diesel Generator increased lube oil temperatures, it was determined that the 'C' Emergency Diesel Generator was also having higher than expected SACS delta temperature trends. This too resulted from a mis-positioned throttle valve. The temperature trends on the other two diesel generators were within the expected temperature limits. Although the increased temperature trends did not result from a degraded material condition, this is an example of the effectiveness of the monthly surveillance tests and the use of temperature trending to identify unexpected conditions.

2. Several corrective action reports were generated at Hope Creek during 2001 and 2002 concerning the elevated metal contaminants in the jacket water of the diesel generators. In February of 2003 an evaluation determined that the reuse of the jacket water after draining for maintenance was contributing to the problem. The vendor of the corrosion inhibitor confirmed the long-term reuse of the jacket water could lead to the elevated metal contaminants in the jacket water. As a result the Closed Cycle Cooling Water program determined that the replacement of the current solution with demineralized water and new corrosion inhibitor would rectify this problem. By the end of 2003, all of the diesel generators had the new jacket water in service. Since then, there have been significantly fewer incidents of elevated metal contaminants in the jacket water of the diesel generators. This operating experience is an example of how the Closed Cycle Cooling Water program assesses their current program, and successfully implements corrective actions to remove elevated contaminants to restore the parameters within specifications.

Over the past five years Hope Creek has exceeded an Action Level 1 limit on the nitrite-control programs one time. In November of 2007 the emergency diesel generator exceeded Action Level 1 for NO_2. Levels were brought back into specification in accordance with the EPRI guidelines and station procedures. Additionally, Hope Creek has exceeded an Action Level 1 limit on the pure water systems six times in the past five years. In October of 2008 the safety auxiliary cooling system A loop exceeded Action Level 1 for dissolved oxygen, in September of 2008 the safety auxiliary cooling system B loop exceeded Action Level 1 for conductivity, in August of 2007 the turbine building chilled water exceeded Action Level 1 for dissolved oxygen, in July of 2005 the turbine building chilled water exceeded Action Level 1 for conductivity, in July of 2007 the auxiliary building chilled water exceeded Action Level 1 for dissolved oxygen and in July of 2008 the auxiliary building chilled water exceeded Action Level 1 for conductivity. In all six instances, the parameters were brought back into specification in accordance with the EPRI guidelines and station procedures. There have been no age-related failures identified in the corrective action program on the piping or components of these systems. The operating experiences discussed above are examples of abnormal

transients that were identified by routine monitoring activities and corrective actions were implemented. Additionally, the parameters that exceeded Action Level 1 values were isolated events, on independent systems or trains and different parameters. Therefore, no adverse trend can be concluded as a result of these excursions for the Closed-Cycle Cooling Water chemical control programs. This provides objective evidence that the current Closed-Cycle Cooling Water aging management program is effective in mitigating the aging effects at Hope Creek. The Chilled Water System is being enhanced to ensure the long-term reliability of the systems supplied by chilled water.

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 program will provide reasonable assurance that the identified aging effects will be 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.2.1.15 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 Hope Creek 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 Hope Creek. 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 Hope Creek.

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. Hope Creek 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 approximately 290 Hope Creek 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.

   In 2000, a corrective action report was issued to document, evaluate and repair a degraded condition with the refueling bridge trolley rail. During movement of the refueling bridge trolley from the east to west, there was a noticeable bump from trolley movement. Upon further inspection of the rail system, an indentation was identified in the rail. The indentation in the rail was repaired with a weld repair to restore the rail profile configuration. 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 corrective action report was issued to document, evaluate and repair a degraded condition with the Hope Creek polar crane. The HC polar crane rail was experiencing premature wheel bearing wear on the crane. An engineering investigation into the cause of the condition concluded that the existing rail configuration was slightly egg shaped and was not reported to be age related due to corrosion or wear. The rails were re-configured from the as found installed condition to remove existing gaps and align the rails to the correct span width. 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.2.1.16 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 due to general, pitting and crevice corrosion in the compressed air systems. The Hope Creek 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 Hope Creek 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.

Hope Creek 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 walk downs, 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. During a drain trap inspection at Hope Creek in 1999, rust particles were found in the aftercooler drain line and drain trap. The rust particles were clogging the drain trap, thereby causing it to fail. The drain piping and drain trap were replaced. As part of an extent of condition, a UT test was conducted on the upstream aftercooler shell with satisfactory results. This example provides objective evidence that Compressed Air Monitoring deficiencies are entered into the corrective action process to correct items discovered and to maintain intended functions.

2. During operator rounds at Hope Creek in 2003, an instrument airline was found worn due to vibration at a mounting point. A second worn line was found in the same vicinity. Both worn sections of copper piping were replaced. This example provides objective evidence that Compressed Air Monitoring deficiencies are found and entered into the corrective action process, and that appropriate actions are taken as necessary to ensure continued effective compressed air operation is ensured.

3. In 2007, a leak in the instrument airline was identified on an elbow joint at the exit of an air dryer. The leak was temporarily repaired and placed in the work management system. The repair requires an instrument air header outage and is scheduled for the fall 2009 refueling outage. This operating experience example provides objective evidence that compressed air deficiencies are found, evaluated and corrective actions are placed in the work management system to maintain system intended functions.

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. There is sufficient confidence that the implementation of the Compressed Air Monitoring program is effectively identifying 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.2.1.17 Fire Protection

Program Description

The Hope Creek 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, doors, dampers and fire barriers. The environments that the fire protection components are being managed are air/gas wetted, air-outdoor, and air-indoor.

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 barrier penetration seals for signs of degradation such as change in material properties, loss of materials, cracking, and hardening, through periodic inspection and functional testing. The program requires performance of visual inspections of at least 10% of each type of penetration seals at least once per refueling cycle (18-months). The program specifies visual examinations of the fire barrier walls, ceilings and floors in structures within the scope of license renewal at a frequency of once each refueling outage (18-months). Periodic visual and functional tests are used to manage the aging effects of fire doors and dampers. The inspection frequency for fire doors is 6-months. All fire dampers shall be verified to be functional by visual inspection at least once every refueling cycle (18-months). In addition, 10% of the readily accessible fire dampers shall be functionally tested every refueling cycle (18-months).

Operational tests of the diesel-driven fire pump are performed at least once every refueling cycle (18-months) 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 program will be enhanced, as noted below, to provide reasonable assurance that the Fire Protection program aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Fire Protection aging management program is consistent with the ten elements of aging management program XI.M26, "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) and will be maintained consistent with the CLB for the period of extended operation:

1. In October 2004, corrosion was found on the external surface of a fire door (1112A) and its door frame. During routine fire door inspections, using the existing surveillance procedures, rust and corrosion were found on the exterior door surface and lower door frame located in the condenser bay. This condition was entered into the corrective action program. The corrosion was attributed to the bottom of the door being in contact with moisture in the condenser bay. The door and frame were repaired and painted. This example provides objective evidence that this program effectively manages the aging effects of the fire doors and deficient conditions are entered into the corrective action program for evaluation and resolution of fire door deficiency. The Fire Protection program surveillance procedures in place for fire door inspection and testing along with the corrective action program will continue to be satisfactory through the period of extended operation.

2. In September 2006, Carbon Dioxide system fire dampers failed to reposition as required during a simulated functional test. The associated surveillance test was performed to ensure that the Carbon Dioxide flooding system would meet its intended design function to maintain Carbon Dioxide levels during an actual fire event. Troubleshooting of the system determined that an electronic signal was not being received preventing the electronic relay to latch, which would have allowed the fire dampers to reposition during this simulated actuation. The defective electronic control board was replaced. The system vendor was brought on site, and observed the retest that was satisfactory performed. This example provides objective evidence that the functional tests performed for the Carbon Dioxide flooding system are sufficient to identify conditions adverse to quality. It also demonstrates the effectiveness of the corrective action program in resolving equipment deficiencies.

3. In January 2006, a fire barrier was found degraded. The identified condition was similar to the conditions found at another nuclear station in 1998. Approximately 12 to 18 inches of structural steel fire proofing was found to be chipped off and was allowing the wire mesh on the steel beam to be visible and exposed. Additional areas in the vicinity where the damage was found were inspected to verify if any additional areas may be affected, none were found. The fireproofing material was repaired to acceptable conditions. The cause of the degraded fire barrier was not determined. This example demonstrates the Fire Protection program that visually inspects fire barriers for damage is capable in identifying deficient conditions. It also demonstrates that the corrective action program will be effective to correct deficient conditions when identified.

Hope Creek complies with NFPA codes, which require comprehensive fire barrier inspections, testing of fire pumps, and inspections and functional testing of fire protection systems (CO2, Halon) system components. NFPA code requirements are followed to ensure that the design features of the Fire Protection system equipment are properly inspected, maintained and functionally tested to ensure that these design features will be maintained. Deficiencies found during these inspections and functional tests are entered into the corrective action program, which return the equipment back to their intended design requirements. The examples above demonstrate that deficiencies are identified and are entered into the corrective action program for disposition. These problems identified do not indicate any adverse trend in performance. There is sufficient confidence that the implementation of the Fire Protection program will effectively identify degradation prior to failure.

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.2.1.18 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 preventive 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 the applicable guidance from NFPA codes and standards. The program applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, water storage tanks, and aboveground and underground piping and components. The environments that the fire components are being managed are, raw water, air/gas wetted, air-outdoor, and air-indoor. 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 due to corrosion, microbiologically influenced corrosion (MIC), or biofouling are 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 before the end of the current operating term and thereafter at a frequency of at least once every 10 years during the period of extended operation. 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 tank is internally inspected in accordance with NEIL requirements.

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 program will be enhanced, as noted below, to provide reasonable assurance that the Fire Water System program 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 August 2001, during routine monthly fire hydrant inspection, water was found in the barrel of the hydrant and could not be drained. Attempts to clear the water were unsuccessful. The hydrant was replace with a new unit. It was thought that the underground drain was blocked not allowing the hydrant to drain. No other hydrants were found to have a leaking barrel. This example provides objective evidence that condition monitoring and routine, inspections of fire protection equipment effectively identifies deficient conditions. The hydrant inspections that are routinely performed are sufficient to identify conditions that could adversely affect hydrant operation. This condition was entered into the corrective action process and the hydrant was subsequently replaced with a new unit. These inspections currently performed provide objective evidence that the program in place routinely verifies hydrant operation and will ensure degradation is discovered prior to loss of flow during the period of extended operation.

2. In May 2002, during routine capacity testing of the motor driven fire pump, discharge flows started to become unstable and degrade. The testing was terminated. Troubleshooting revealed that the temporary startup strainer was still installed in the suction line leading to the pump and had become fouled. Based on finding the startup strainer installed in the suction to the fire pump, all other fire pumps on site were inspected with no other startup strainers found installed. The strainer was removed from the pump suction and the pump performance test was successfully completed and placed back into service. This example provides objective evidence that condition monitoring currently in place to confirm pump performance, is satisfactory to monitor equipment conditions prior to loss of design function. The flow capacity testing currently performed will be continued during the period of extended operation. The performance monitoring methods being used will be capable of identifying satisfactory to identify deficient flow conditions due to aging effects during the period of extended operation.

3. In April 2004, during routine testing of the diesel driven fire pump, the capacity of the pump was met, but the diesel engine speed which is measured as part of the diesel driven fire pump test, did not meet the required speed specification. The diesel engine is required to perform within specific design parameters to ensure design flow from the pump is maintained. An engine overhaul was performed. Upon completion of this maintenance, the retest was performed and the capacity test with the required diesel speed condition was met. Review of the operating experience for pump performance has been found satisfactory. This example provides objective evidence that current performance and capacity testing will detect deficient conditions associated with the diesel driven fire pump. This testing currently performed will continue to be performed 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.

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 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.2.1.19 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 (Fire Water Storage Tanks, Fire Diesel Fuel Oil Tank and 17-Ton CO2 Storage Tank) that are subject to an outdoor air or soil environment. The Fire Water Storage Tanks are in contact with both air and soil environments (through their foundations), and are covered by this program. This program is a condition monitoring program and credits the application of paint as a corrosion preventive measure. The program also performs periodic visual inspections to monitor degradation of the paint and any resulting metal degradation for the carbon steel tanks. The program also credits the internal UT inspections that will be performed on the bottom of the Fire Water Storage Tanks, which are supported by concrete foundations. The Fire Diesel Fuel Oil Tank and 17-Ton CO2 Storage Tanks are not directly supported by an earthen or concrete foundation and will undergo external visual inspections without the necessity of bottom surface UT inspections.

The Fire Water Storage Tanks have external surface insulation. Removal of insulation will permit visual inspection of insulated tank surfaces. These tanks are supported on a cement foundation by a ½ inch thick seal pad around the perimeter of the tank.

The Fire Diesel Fuel Oil Tank and 17-Ton CO2 Storage Tank are raised tanks not directly supported by earthen or concrete foundations. The Fire Diesel Fuel Oil Tank has no insulation on the tank. The 17-Ton CO2 Storage Tank has permanently installed fiberglass on the exterior of the tank and it will be treated as a surface coating and not removed for steel tank surface inspections. The exterior painted surfaces of the tanks are inspected for signs 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.

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.

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 internal UT measurements to measure the wall thickness on the bottom of the tanks supported on a fiber pad on top of the concrete foundation (Fire 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 will 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 carbon steel tanks external surfaces (Fire Water Storage Tanks, Fire Diesel Fuel Oil Tank and 17-Ton CO2 Storage Tank), including removal of tank insulation from the Fire Water Storage Tank to detect degradation. These inspections will be performed to detect degraded paint and coatings, and any resulting metal degradation, prior to loss of the tank intended function. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6).**

A review of operating experience for the last 5-years identified few problems with tanks within the scope of the Aboveground Steel Tanks program. Of the operating experience reviewed only the two identified issues were determined to be age related degradation. The two issues identified would not have caused failure of the tanks intended functions. There was not 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 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.

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 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 2006, during semi-annual fire protection equipment inspections station personnel along with a NEIL inspector identified minor corrosion located at the bottom of the Fire Water Storage tank 0B-T565. There was no leakage associated with the rusting that was found. Flakes of metal could be removed by hand from the tank flange. The exposed base of the tank had some areas that were missing metal along the bottom edge of the base plate, but this loss did not impact the integrity of the tank. An engineering evaluation was performed of the tank and the foundation. Both of the Fire Water Storage Tank (0A-T508/0B-T508) lower protective insulation sheet metal bands were removed, the insulation was removed and the lower surface of the tanks along with the flanges were inspected and cleaned using wire brush/wheel, and repainted. This work order demonstrates that when deficient conditions are found, they are entered into the corrective action program for evaluation and resolution. This particular deficient condition was placed into the corrective action program, evaluated, and corrective actions taken to prevent the failure of the tank's intended function. The existing program monitors the condition of the tanks, ensuring that the intended function of the components is maintained.

2. In 2001, during routine equipment walkdowns, the diesel fire pump fuel oil day tank was noted to need exterior surface coating. There was no leakage found, but the surface coating was found to be degraded. This condition was entered into the corrective action program. The corrective actions performed were prepping the exterior surface of the storage tank, prime and re-paint of the exterior of the tank. As of this date, no material condition deficiencies on the exterior surfaces of the diesel fire pump fuel oil day tank have been noted. This example demonstrates that when deficient conditions associated with exterior tank coatings are found, corrective actions are taken to prevent surface degradation . This example also provides objective evidence that the Aboveground Steel Tanks program is effective in detecting loss of material/general corrosion, pitting and crevice corrosion, and implementing preventive measures to ensure protective paint and coating is intact on the exterior surface of the diesel fire pump fuel oil day tank.

The operating experience of the Aboveground Steel Tanks 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 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 program will provide reasonable assurance that the 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.2.1.20 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 Licensing 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 2709. Fuel oil sampling and analysis is performed in accordance with approved procedures for new fuel and stored fuel. Protective coatings are not credited for mitigating the loss of material due to general pitting, crevice and microbiologically influenced corrosion (MIC), and biological fouling in fuel oil tanks. 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 program will be enhanced, as noted below, to provide reasonable assurance that the Fuel Oil Chemistry program 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 sampling of tanks in accordance with the manual sampling standards of ASTM D 4057-95 (2000). The 280-gallon Diesel Fire Pump Fuel Oil Tank (T-565) samples are single point samples obtained from the tank drain line located off of the bottom of the tank. This sample is not in accordance with the manual sampling standards 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 280-gallon Fire Pump Day Tanks are 1.06 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. Additionally, the diesel is run weekly, taking suction from the bottom therefore significant stratification is unlikely in such a small tank that is mixed weekly.

2. 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 (1A-T-404, 1B-T-404, 1C-T-404 and 1D-T-404) is not periodically performed at Hope Creek. 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 Hope Creek 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 diesel fuel oil storage 26,500-gallon tanks (1A-T-403, 1B-T-403, 1C-T-403, 1D-T-403, 1E-T-403, 1F-T-403, 1G-T-403, 1H-T-403). The fuel oil within the 550-gallon diesel fuel oil day tanks is recirculated to the 26,500-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.

3. 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 Hope Creek fuel oil chemistry program does not currently include the addition of biocides, stabilizers or corrosion inhibitors. **Program Elements Affected: Scope of Program (Element 1), Preventative 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, Hope Creek 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 Hope Creek 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 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)**

3. The Fuel Oil Chemistry program does not currently open and inspect the diesel fire pump fuel oil 280-gallon tank (T-565). The program will be enhanced to perform visual inspections to detect potential degradation and ultrasonic thickness examination of tank bottom to ensure that significant degradation is not occurring. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

4. The Hope Creek Fuel Oil Chemistry program currently performs a visual inspection for water and sediment quarterly on the diesel fuel oil storage 26,500-gallon tanks (1A-T-403, 1B-T-403, 1C-T-403, 1D-T-403, 1E-T-403, 1F-T-403, 1G-T-403, 1H-T-403). The program will be enhanced to perform water and sediment sampling in accordance with ASTM Standard D 2709. Additionally, the current quarterly sample is single low-level sample. The quarterly sample will be enhanced to be a multilevel sample. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

5. The Hope Creek Fuel Oil Chemistry program will be enhanced to ensure the internal inspection of the diesel fuel oil storage 26,500-gallon tanks (1A-T-403, 1B-T-403, 1C-T-403, 1D-T-403, 1E-T-403, 1F-T-403, 1G-T-403, 1H-T-403) includes visual inspections to detect potential degradation and ultrasonic thickness examination of tank bottoms to ensure that significant degradation is not occurring. **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. The Hope Creek Fuel Oil Chemistry program will be enhanced to perform quarterly particulate sampling in accordance with modified ASTM 2276-00, Method A for the diesel fire pump fuel oil tank (T-565). 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)**

7. The Hope Creek 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. On 11/05/2003 during routine sampling of the diesel fuel oil tank (1G-T-403) sediment was observed in the purge volume prior to obtaining the fuel oil sample from the bottom drain valve. After performing the proper flushes, a sample was obtained and sent to an off-site laboratory for analysis. Additionally, 8-gallons were purged from the sample line, thus removing any remaining sediment from the bottom of the tank. After further investigation it was determined that there was a discrepancy in the 2 sampling techniques used during the routine task (bottom sample and a sample bomb, which is taken 6-12 inches from the tank bottom). Typically the bottom drain sample is placed in a glass bottle (to accommodate visual inspection) and the sample bomb is typically transferred to a poly bottle. In the case of the samples taken on 11/05/2003, the bottles used were reversed from those typically used. As a result, along with inadequate labeling of the sample point, the wrong analysis was performed on the samples. The sample drawn using the sample bomb (the one in the glass bottle) was visually inspected and there was no water or sediment observed. The sample drawn from the bottom drain (the one in the poly bottle) was being analyzed for particulate amount. This analysis result was likely to be unsatisfactory because the particulates settle at the bottom of the tank. This is why regular particulate sampling is done via the bomb method and not from the bottom of the tank. Additional samples were drawn on 11/06/2003 and were analyzed. For the bottom drain sample, no sediment and no water was observed. For the bomb sample, analysis results were <0.01 mg/L, which is well below the 10 mg/L specification. The sampling procedure was enhances to specify the type of bottle used and the expectations on sample labeling. This operating experience provides objective evidence that the fuel oil chemistry program identifies unsatisfactory results through routine sampling of the fuel oil tanks and provides timely investigation and resolution of the issue. Additionally, the fuel oil chemistry program initiates corrective actions to prevent reoccurrence of the similar events.

2. On 02/04/2004 it was identified that the particulate concentration of the 1H-T-403 diesel fuel oil tank increased from <0.01 mg/L to 3.86 mg/L. The sample that showed the increase to 3.86 mg/L was taken on 01/30/04. The previous sample of <0.01 mg/L was taken on 11/06/03. Sample results were verified with duplicate testing. However, further investigation revealed that the samples taken on 01/30/04 were processed incorrectly. This was due to a bad sampling technique. The procedure was then analyzed, and the chemistry department decided to add a pre-job brief prior to the sampling evolutions to enhance the quality of the testing. New samples were taken and particulate concentration was found to be <0.01 mg/L. This operating experience provides objective evidence that the fuel oil chemistry sampling activities identify abnormal test results due to improper techniques or procedures and puts barriers in place to prevent reoccurrence in the future.

3. In September of 2004 an inspection and cleaning of the Diesel Fire Pump Fuel Oil Tank (T-565) identified that the inside of the tank was corroded and that the liner was degraded. The Diesel Fire Pump Fuel Oil Tank was drained, steam cleaned and inspected. The inspection showed minor internal surface rust and scaling at some joints, but it was not excessive. The minor rust and scaling would in no way affect the structural integrity of the tank. The apparent cause of the rust was water in the bottom of the tank. Preventive maintenance actives were put into place to drain water and sediment from the bottom of the tank to prevent reoccurrence. This provides objective evidence that periodic inspection of the tanks identifies degradation prior to the loss of intended function. In addition, this example illustrates the implementation of corrective actions in order to prevent degraded conditions for occurring in the future.

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. Over the past five years the Hope Creek 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 Hope Creek. 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 Hope Creek 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.2.1.21 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 meets the requirements of 10 CFR 50, Appendix H. The program evaluates neutron embrittlement by projecting Upper Shelf Energy (USE) for reactor materials and impact on Adjusted Reference Temperature for the development of pressure-temperature limit curves. Embrittlement evaluations are performed in accordance with Regulatory Guide 1.99, Rev. 2. The Hope Creek Reactor Vessel Surveillance Program is also part of the BWRVIP Integrated Surveillance Program (ISP) described in BWRVIP-86-A and BWRVIP-116, and approved by the NRC. The schedule for removing surveillance capsules is in accordance with the timetable specified in BWRVIP-86-A for the current operating term and in accordance with BWRVIP-116 for the period of extended operation.

Hope Creek is a host plant for the ISP and will remove one capsule in the current operating term as part of the ISP schedule. Hope Creek will also participate in the ISP during the period of extended operation [designated as the ISP(E)]. As described in BWRVIP-116 Hope Creek's third and last capsule will be removed during the period of extended operations for testing as part of the ISP(E). If the capsule is withdrawn for some other reason, it will be stored in a manner that maintains it in a condition that would permit its future use.

The Hope Creek pressure vessel has LPCI safety injection nozzles in the beltline region of the reactor pressure vessel. The extent of embrittlement for these nozzles has been determined to be bounded by other beltline material. The fluence values at the inlet and outlet recirculation nozzles are also bounded by the beltline material.

The program monitors plant operating conditions to ensure appropriate steps are taken if reactor vessel exposure conditions are altered, such as the review and updating of 60-year fluence projections to support upper shelf energy calculations and pressure-temperature limit curves. The program also includes condition monitoring by removal and analysis of surveillance capsules as part of the BWRVIP ISP. These measures are effective in detecting the extent of embrittlement to prevent significant degradation of the reactor pressure vessel 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 enhancement will be implemented in the following program elements:

1. Hope Creek will implement the requirements of BWRVIP-116, "BWR Vessel and Internals Project Integrated Surveillance Program (ISP) Implementation for License Renewal," including the conditions specified by the NRC in its Safety Evaluation dated February 24, 2006. **Program Elements Affected: Element 6 and Element 8**

2. If future plant operations exceed the limitations specified in RG 1.99, the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Similarly, if future plant operations exceeds the bounds established by surveillance data that are to determine Upper Shelf Energy or P-T limits, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Additionally, if all the surveillance capsules are removed, then operating restrictions will be established to ensure that the plant is operated within the conditions to which the surveillance capsules were exposed. If the reactor vessel exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the projection to 60 years is reviewed; and, if deemed appropriate, a revised fluence projection is prepared and the effects of the revised fluence analysis on neutron embrittlement calculations will be evaluated. If necessary an active surveillance program will be re-instituted for Hope Creek. The employment of additional surveillance specimens will be coordinated through the BWRVIP Integrated Surveillance Program (ISP). Any 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 4 and Element 9**

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 are 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. Only one surveillance capsule has been removed from the Hope Creek reactor vessel. The 30° capsule was removed from the Hope Creek vessel in the spring of 1994 (refueling outage RF05) as part of the reactor surveillance program. General Electric performed the analysis of the capsule specimens. The results of the analysis indicated that the capsule received an average fast neutron fluence (E > 1.0 MeV) of 1.42×10^{17} n/cm^2 after 6.01 EFPY of plant operation. Using this measured value the fluence at the reactor vessel inner wall was then calculated to be 1.42×10^{17} n/cm^2, which projected to a 32 EFPY fluence of 7.5×10^{17} n/cm^2.

   Charpy tests of surveillance capsule materials exhibited a more than adequate USE for continued safe operation. The projected USE for 32 EPFY calculated from the measured RPV wall fluence using RG 1.99 methods demonstrated the bounding USE was greater than the 50 ft-lb criterion specified in RG 1.99. Additionally, The Adjusted Reference Temperature (ART) was calculated to be 72.5°F and 32.8°F for the limiting plate and weld, respectively. These values were used to generate new P-T limit curves for Hope Creek.

   This example provides objective evidence that the existing Reactor Vessel Surveillance program is 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. In accordance with the requirements of the Reactor Vessel Surveillance program the effects of neutron embrittlement are analyzed when plant operating conditions change. In 2004, as part of the license amendment to increase rated power to 3952 MWt (EPU), the effects of higher power in the form of increased fluence were evaluated. The fluence was calculated using a NRC approved methodology to account for the operating conditions of EPU.

   The new fluence at the limiting beltline material was calculated to be 1.1×10^{18} n/cm^2 at the inner surface of the pressure vessel. Using the new fluence values the impact on Upper Shelf Energy (USE) and plant P-T curves was evaluated. New Adjusted Reference Temperatures (ART) values were calculated in accordance with RG 1.99 Revision 2. Upper Shelf Energy calculations confirmed that the USE values remained above the 50 ft-lb criterion specified in RG 1.99 for the remainder of the current 40-year life of the plant. The output from this effort was a new set of P-T limit curves for the new EPU power conditions. This example illustrates that the program monitors for changes in plant operating conditions and when appropriate, reevaluates the effects of neutron embrittlement in accordance with the appropriate industry standards.

Hope Creek removed one surveillance capsule from the reactor vessel and tested it in accordance with ASTM E-185. The test results show that the shift in Charpy curves of the irradiated capsule was within the predictions of RG. 1.99 Revision 2. The projected upper shelf energy (USE) for 32 EPFY, calculated using data from the test and RG. 1.99 methods, indicated that the bounding USE is greater than 50 ft-lb criteria specified in RG. 1.99.

There is sufficient confidence that the implementation of the Reactor Vessel Surveillance aging management program will effectively identify degradation prior to failure. The program requires that, if future plant operations exceed the limitations specified in RG 1.99, the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. Similarly, if future plant operation exceeds the bounds established by surveillance data that are used to determine Upper Shelf Energy or P-T, then the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified. 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 aging management program will provide reasonable assurance that the aging effects and mechanisms 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 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 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, reactor vessel and nozzles, 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, ductile cast iron, gray cast iron, nickel alloy, steel, stainless steel and cast austenitic stainless steel in treated water, steam, sodium pentaborate, and reactor coolant environments.

2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for, copper alloy, steel, galvanized 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 copper alloy, gray cast iron, steel and stainless steel in a lubricating oil environment.

4. To confirm loss of material in carbon steel piping and fittings is insignificant in an air/gas-wetted (internal) 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, 2001 Edition, 2003 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. In April 2006 during refueling outage RF13 planned in vessel internal inspections (VT-1), indications were noted at four locations on the reactor vessel steam dryer assembly.

    a. At the first location, two indications were found above weld CH-7a. Weld CH-7a is on dryer bank C, on the 0-degree side, outside the steam outlet partition plate, near the bottom of the hood. Both indications were horizontal in the heat-affected zone of the weld on the 1/8-inch thick plate. The area of the indications was 4 inches wide.
    b. At the second location, an indication was found near the bottom of weld BV-5 on the 1/8-inch thick steam outlet partition plate. Weld BV-5 is the vertical weld between "B" dryer hood and the steam outlet partition plate on the 180-degree side of the dryer. The indication was vertical on the heat-affected zone of the weld and was located on the partition plate side of the weld. The indication was about 1.25 inches long and ended at the bottom of the plate.
    c. At the third location, an indication was found on the support ring at azimuth 230-degrees, top side, 5 inches in length in a circumferential orientation.
    d. At the fourth location, two indications were found on the threads near the tack welds on the lifting rod at 140 degrees. The indications were on the threads and stop before the root of the threads. The indications were in the heat-affected zone of the tack welds. The threads are used to connect the lifting rod to the lifting lug.

    All of this information was entered into the corrective action process for evaluation and corrective actions. Engineering performed an evaluation that included a review of these as well as other past-identified indications on the steam dryer assembly. The evaluation determined all of the steam dryer indications were IGSCC with the potential to continue to grow with slow crack growth rates. The evaluation concluded that there was no impact on the structural integrity of the dryer assembly and therefore no potential for loose parts being generated as a result of these indications.

    The evaluation also concluded there was insignificant impact to the lifting or hold-down function of the lifting assembly and therefore a use-as-is disposition was justified. The evaluation also concluded that there was no need to expand the inspection scope as the majority of the welds were already within the scope of the inspections being performed. The evaluation received several reviews including a third party independent review. Corrective actions consisted of adding the visual exam of these indications during every refueling outage until the indications are shown to be arrested. This action was captured in the ISI long term plan.

This example provides objective evidence that visual inspections (VT-1) similar to those that will be used as part of the One-Time Inspection program provide an effective method to identify degrading conditions such as cracking. This example also demonstrates that when degraded conditions are detected they are entered into the corrective action process where they are appropriately evaluated for cause and any required corrective actions. The inspections performed as part of the One-Time Inspection program will be performed similar to the above and any degraded conditions detected will be entered into the corrective action process. This will ensure effective condition monitoring of piping and components within the scope of license renewal.

2. On 4/25/2006 it was reported in the corrective action process that radiography (RT) performed on one of the service water pump lubrication water reservoirs (component H1EA-10-T-543) revealed several areas of the reservoir had experienced a loss of material due to microbiologically influenced corrosion (MIC). There were two service water pump lubrication water reservoirs at Hope Creek, which supply backup bearing and packing lubricating water for the service water pumps during initial pump starting operations. Both of these reservoirs had been experiencing loss of material due to MIC in the past, and recurring work orders were already in place to perform periodic RT monitoring so degradation could be detected and repairs made before any failures would occur.

   As a result of the reported problem a detailed repair plan was developed for the degraded reservoir. Consideration was given to replacing some of the materials with more corrosion resistant materials during the repairs, but ultimately a station decision was made not to repair, but to modify the design of the system to remove the reservoirs completely to eliminate the potential for continued MIC problems. Modifications were performed in October 2007 during refueling outage RF14 that consisted of a re-design of the pump lubrication subsystem eliminating all of the reservoirs and the replacement of piping with an AL-6XN alloy, which is a corrosion resistant, iron-base austenitic stainless steel alloy. The design changes have provided a simple and more reliable source of lubrication water to the service water pumps.

   This example provides objective evidence that appropriate inspection techniques 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. The One-Time Inspection program will utilize appropriate inspection techniques and will enter any degraded conditions identified into the corrective action process resolution. These actions will ensure effective condition monitoring of piping and components within the scope of license renewal.

3. On 03/09/2005 it was reported in the corrective action process that pipe wall thickness data (UT) taken on the extraction steam supply nozzle on the #2B feedwater heater indicated various degrees of loss of material. Additional inspections were performed and flow accelerated corrosion was determined to be the most probable cause of the loss of material. Corrective actions consisted of engineering evaluating the data to determine required corrective actions. Through trending analysis, FAC engineers predicted that the wall thickness at the end of cycle 13 would still have ample margin to support operations. Additional analysis was independently performed by the stress analysis group, which also concluded that the pipe was qualified for continued operation based upon calculations performed with a safety margin of four. Repairs were also specified and consisted of internal weld buildup of the affected nozzles. The scheduling of the repairs was based upon the degree of degradation of the nozzles with some repairs of the nozzles completed during refueling outage R13 (April 2006) and remaining to be completed during refueling outage R15 (April 2009).

   This example provides objective evidence that the inspection techniques to be utilized in the One-Time Inspection program will be capable of identifying degraded conditions such as loss of material and that deficiencies entered into the corrective action process are evaluated for appropriate corrective actions. These actions 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 those 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.2.1.23 Selective Leaching of Materials

Program Description

The Selective Leaching of Materials aging management program is a new program that consists of one-time inspections 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. Components include valve bodies, heat exchanger components, pump casings, piping and fittings, strainer bodies, and tanks. Susceptible materials at Hope Creek 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 (ground water), 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.

These one-time inspections will be performed in the last 10 years of the current term, prior to entering the period of extended operation.

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. Industry operating experience has identified that aluminum bronze is susceptible to selective leaching in a raw water environment. During the Hope Creek corrective action program review, it was identified through visual inspection of a valve that de-alloying of aluminum bronze valves in the Service Water System brackish water environment is occurring. A cross section of an aluminum bronze valve was cut out and acid etched to show the selective leaching. A sample cross section of the valve was sent to a laboratory for confirmation of selective leaching and assessment of material properties.

   In December of 2000, Service Water System aluminum bronze valves that are susceptible to de-alloying were placed into the Valve Material Condition Improvement Project. As part of this project, gradual replacement of the valves that are susceptible to selective leaching with new valves started back in 2000. So far, a large portion of these valves are replaced, and the final phase of this valve replacement is planned for 2010. The maintenance activities for these components are tracked in the Corrective Action Program, and so far no failures have been identified for them. This example provides objective evidence that operating experience is being used to assess the potential for selective leaching, and that the corrective actions are in place to proactively replace the valves that are susceptible to selective leaching.

2. Operating experience at Salem in December 2003 has identified graphitization of gray cast iron submerged pump components from long-term immersion in saltwater and brackish water environments. As a result, Hope Creek in 2004 evaluated potentially effected components. Although some portions of the Hope Creek circulating water pumps are gray cast iron and submerged in raw water, environment graphitization has not been observed in the Hope Creek Circulating Water System at the intake structure during maintenance inspections. The Hope Creek pumps are less susceptible to selective leaching due to the water being recirculated as a closed loop treated water system through the cooling tower vice straight from the river. As such, current inspections of these components are performed on a 6-year frequency to ensure their function will be maintained consistent with the current licensing basis. The circulating water pumps are not within the scope of License Renewal. This example provides objective evidence that operating experience at Salem is being used to assess the applicability at Hope Creek for the potential for

selective leaching and demonstrates corrective action to monitor material that is susceptible to selective leaching.

Once implemented, the Hope Creek 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 Hope Creek. 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 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.2.1.24 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 (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.

Hope Creek 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 buried carbon steel, galvanized steel, ductile cast iron, and 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 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 action 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, galvanized steel, ductile cast iron, and gray cast iron at Hope Creek will perform their intended function during the period of extended operation.

NUREG-1801 Consistency

There are no buried tanks at Hope Creek 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, galvanized 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 here is effective in managing corrosion of external surfaces of buried steel piping. However, because the inspection frequency is plant-specific and depends on the plant operating experience, the Hope Creek 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 2008, risk ranking of the Hope Creek buried piping revealed that the portions of the carbon steel Service Water piping were determined to be high risk. As a result, a plan was developed to conduct non-intrusive inspection of the coated carbon steel through-wall penetrations of the 36-inch service water underground spools at the Service Water Intake Structure and Reactor Building penetrations. Non-destructive examination of piping is to take place from the inside diameter of this piping to determine the external condition of the pipe and its external coating. This example provides objective evidence that an active 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.

2. In May 2005, water was bubbling up from beneath the asphalt, in front of the Fire Pump House. The 12-inch fire main was excavated to the elbow level and inspection found the leakage to be caused by a loose flange joint. Bolting on the flange was tightened and the leakage stopped. There was no need for further excavation since no deficiencies were identified on the excavated coated ductile cast iron piping. This example provides objective evidence that inspections are performed and buried piping is opportunistically inspected, whenever it is exposed, during any excavation for maintenance.

3. In 2003, the fire main appeared to be broken underground between Fire Hydrant FH-07 and FH-15 in front of the Fire Pump House. Excavation was conducted to the elbow level and found the flange joint to be loose. No deficiency was identified on the exposed portion of the coated cast iron piping. Bolting on the flange was tightened and the leakage stopped. This example provides objective evidence that corrective actions are taken prior to loss of intended function.

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 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.2.1.25 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. 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 due to general, pitting and crevice corrosion. 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.

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 External Surfaces Monitoring program is consistent with the ten elements of aging management program XI.M36, External Surfaces Monitoring, 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 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 June 2008, during a plant tour, two control area chilled water pipe flanges and associated bolts were found to have heavy rust. The pipe was not insulated and the rust was caused by condensation. The rust was identified as superficial. The areas that were found to have corrosion were cleaned and insulation installed on the piping.

2. In November 2007, Reactor Core Isolation Cooling valve was found to have surface rust due to exposure to overhead leaking. The overhead leak was fixed and the rusted valve was replaced. The areas that were found to have corrosion were cleaned and painted to prevent further degradation. Follow up walkdowns of the valve did not find surface rust.

3. In June 2002, Control Rod Drive SCRAM inlet valve top bonnet was found to have minor rust. The component was inspected, cleaned and returned to service. Follow up walkdowns of the valve did not find surface rust.

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 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.2.1.26 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

Program Description

The Hope Creek 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, tanks and ducting 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.

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.

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 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is consistent with the ten elements of aging management program XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components, specified in NUREG-1801.

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 2002 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. A review of the 2000 ten-year inspection work order on the HPCI pumps was performed. The pumps NDE sheet stated no indications. Also, no corrosion was documented. Interviews with HPCI system managers at the station confirmed that the HPCI pumps have not experienced loss of material or other aging degradation on the internal surfaces. This operating experience example provides objective evidence that existing inspection activities will identify internal degradation prior to loss of the component's intended functions.

3. In August 2008 during a routine walkdown of the Service Water Intake Structure, a thru-wall leak was identified at the equipment drain sump pump discharge header, which is not safety-related and is in the scope of license renewal because of potential spatial interaction with safety-related equipment. The leakage did not impact any safety-related system components, and the leakage was discovered prior to impacting the integrity of the floor structure in the affected areas beneath the leak. The cause was identified as silt accumulation and rust inside of the carbon steel piping due to the brackish water internal environment. The sump pump and a section of the discharge pipe were replaced. Past modifications to the drain system have included piping replacements and sections of the header were replaced with a more corrosion resistant stainless steel material. This operating experience example provides objective evidence that existing plant activities identify nonsafety-related failures prior to significant impact on adjacent safety-related SSCs, and that identified failures are evaluated and corrective actions are taken to preclude recurrence.

4. In April 2004 it was identified during system testing that a check valve in the High Pressure Coolant Injection system was leaking past the seat. The check valve was opened and the internals were found to contain rust. The accumulated rust prevented the check valve plug from moving freely. The valve internals were cleaned and significant loss of material degradation due to the rusting was not reported for the valve body or internals. A valve seat blue check was satisfactory and the valve was reassembled. The check valve was placed back in service and no other incidences of corrosion have occurred with this valve. A similar issue occurred on another check valve in the same line, and the valve was also returned to service after the internals were cleaned. This operating experience provides objective evidence that significant loss of material is not occurring inside carbon steel components in the HPCI system, and that existing maintenance activities provide opportunities for internal inspections that will identify loss of material of pressure boundary components prior to loss of 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 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 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

Flash point is measured for all new lubricating oil and for in-service Emergency Diesel Generator (EDG) lubricating oil. 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 March 2008, a lubricating oil sample was taken from the "D" Emergency Diesel engine crankcase in accordance with the Predictive Maintenance Program. The total base number (TBN) was in the Fault range for the type of oil. This was an unexpected step change from past experience. The condition was entered into the corrective action program. An additional sample was taken in April 2008 to monitor the condition of the lubricating oil and to ensure that the results of the March 2008 sample were accurate. Split samples were sent to two laboratories. Replacement of the lubricating oil was unnecessary because the TBN results from the two laboratories were consistent and within the normal range for the type of oil. Therefore, this example provides objective evidence that the Lubricating Oil Analysis aging management 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 to ensure that intended functions are maintained.

2. In July 2005, a lubricating oil sample was taken from the "B" Primary Condensate Pump motor upper bearing in accordance with the Predictive Maintenance Program. The total acid number (TAN) was just above the Alert limit. The viscosity value was normal. The condition was entered into the corrective action program. A recommendation was made to change the lubricating oil in the following refueling outage. The lubricating oil was changed and the subsequent TAN value returned to the normal range. 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.

3. In 2002, a lubricating oil sample was taken from the "C" Residual Heat Removal (RHR) pump motor upper bearing assembly in accordance with the Predictive Maintenance Program. The results indicated high moisture content. A confirmatory analysis was performed and the result was lower moisture content but one still above the limit. The condition was entered into the corrective action program. The extent of condition was limited to the "C" RHR pump motor. Hope Creek entered a Technical Specification Limited Condition Operation (LCO) 02-629 due to a degraded Emergency Core Cooling System (ECCS) pump. The cause of the elevated moisture content was determined to be a degraded lube oil cooler that allowed cooling water to contaminate the lubricating oil. The motor was removed, the lube oil cooler repaired, the bearing housings cleaned, and new lubricating oil added. The moisture content returned to the normal range. The RHR pump motor was restored and the LCO exited. 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.

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 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 ASME Section XI, Subsection IWE aging management program is an existing condition monitoring program that provides for inspection of primary containment components including steel containment shells and their integral attachments, containment hatches and airlocks, penetration sleeves, pressure retaining bolting, and other pressure retaining components for loss of material and fretting or lockup in an indoor air or treated water environment. The scope of the Hope Creek ASME Section XI, Subsection IWE aging management program is consistent with the scope identified in Subsection IWE-1000 and includes the Class MC pressure retaining components and their integral attachments including wetted surfaces of submerged areas of the pressure suppression chamber and vent system, containment pressure-retaining bolting, and metal containment surface areas, including welds and base metal. Containment seals and gaskets are not included in the scope of this program; instead they are in the scope of the 10 CFR Part 50 Appendix J aging management program. Hope Creek utilizes a steel containment; therefore there are no Class CC containment components or their integral attachments inspected in accordance with Subsection IWL.

The containment original design did not require an internal moisture barrier at the junction of the drywell concrete floor and the steel drywell shell. However, Hope Creek has elected to install a moisture barrier and will include its examination in the scope of the program in accordance with the IWE 2500 requirements. Installation of the moisture barrier is planned prior to the period of extended operation.

The program is implemented through procedures that implement ASME Section XI, Subsection IWE requirements for detecting loss of material, loss of preload and fretting or lockup. The primary containment environments addressed are: air-indoor and treated water.

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 visual examinations (General Visual and VT-3) and augmented inspections (VT-1) for evidence of aging effects that could affect structural integrity or leak tightness of the primary containment. Areas subject to augmented inspection are subject to visual inspection (VT-1) 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 and as approved per 10 CFR 50.55a. The ASME 2001 Code and 2003 Addenda 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 and loss of preload as addressed in 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 Hope Creek aging management program complies with Subsection IWE of ASME Section XI, 2001 Edition including 2003 Addenda, for steel containment (Class MC) pressure retaining components and their integral attachments, in accordance with the provisions of 10 CFR 50.55a. The requirements of IWE-2430 were removed from this Code year and are not applicable to Hope Creek. 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 Hope Creek ASME Section XI, Subsection IWE aging management 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 acceptance criteria for the ASME Section XI, Subsection IWE aging management program are in accordance with the requirements of the 2001 Edition with 2003 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 Hope Creek ASME Section XI, Subsection IWE aging management 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 program will be enhanced, as noted below, to provide reasonable assurance that the ASME Section XI, Subsection IWE program 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 in the following program elements:

1. Install an internal moisture barrier at the junction of the drywell concrete floor and the steel drywell shell prior to the period of extended operation. **Program Elements Affected: Scope of Program (Element 1)**

2. Revise the Hope Creek ASME Section XI, Subsection IWE implementing documents to require inspection of the moisture barrier for loss of sealing in accordance with IWE 2500 after it is installed. The original design for Hope Creek did not require an internal moisture barrier at the junction of the drywell concrete floor and steel drywell shell. **Program Elements Affected: Scope of Program (Element 1)**

3. Verify that the reactor cavity seal rupture drain lines are clear from blockage once prior to the period of extended operation, and one additional time during the first 10 years of the period of extended operation. **Program Elements Affected: Scope of Program (Element 1)**

4. Verify that drains at the bottom of the drywell air gap are clear from blockage once prior to the period of extended operation, and one additional time during the first 10 years of the period of extended operation. **Program Elements Affected: Scope of Program (Element 1)**

5. Investigate the source of any leakage detected by the reactor cavity seal rupture drain line instrumentation and assess its impact on the drywell shell. **Program Elements Affected: Scope of Program (Element 1)**

6. Monitor the drains at the bottom of the drywell air gap for leakage in the event leakage is detected by the reactor cavity seal rupture drain line instrumentation. **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 2004, the Torus shell and interior coatings were inspected by divers performing underwater IWE program inspections resulting in identification of coating deficiencies, with general corrosion and pitting. There were 16 areas with metal loss reported as ranging from 5 mils to 30 mils. The torus shell thickness in these areas is 1" thick minimum. Evaluation of the loss of material determined that the loss of material is acceptable since the reduction in torus shell thickness had not exceeded 10 percent of the nominal plate thickness and is also well under the 1/8 inch torus corrosion allowance included in the design of the torus shell. Based on this information, the areas described in the corrective action report were determined to be acceptable. However, cleaning and coating of the areas was recommended by engineering to prevent further degradation. The cleaning and underwater coating repair of the affected areas was completed during the subsequent outage. These areas will be re-inspected during future IWE underwater inspections. This example provides objective evidence that the ASME Section XI, Subsection IWE aging management program is capable of both monitoring and detection of the aging effects for coatings and the steel torus shell in submerged areas; and that appropriate corrective maintenance of protective coatings are performed when necessary.

2. In 2004, rust was identified on various components inside the torus shell during IWE program inspections, including a number of penetrations and downcomer supports. The condition of the base metal was acceptable; however, the inside of a number of the penetrations and 32 downcomers supports were recoated to prevent further degradation. This example provides objective evidence that the ASME Section XI, Subsection IWE aging management program is capable of both monitoring and detection of the aging effects associated with the steel containment and coatings, including the torus, and that appropriate corrective maintenance of protective coatings are performed when necessary.

3. In 2007 and 2009, UT examinations were performed to sample thickness of the Drywell shell at various locations, including near the interface of the concrete and drywell shell. The as found UT inspections were acceptable and were in excess of nominal thickness requirements. The original design of Hope Creek did not include a moisture barrier at the interior concrete floor to interior steel shell liner. Inspections of the shell immediately adjacent to the floor areas have found no signs of significant corrosion. This example provides objective evidence that the Hope Creek ASME Section XI, Subsection IWE aging management program is capable of both monitoring and detection of the aging effects associated with the steel containment; and that industry operating experience is used to identify degradation that has occurred at other plants.

The containment at Hope Creek has been found during inspections performed in accordance with ASME Section XI, Subsection IWE to be in acceptable condition. The drywell shell and torus are in good condition. Although minor corrosion has been found on the inside of the torus shell, it is not significant, and the aging management program will detect any future corrosion before the wall thickness is impacted. The drywell shell has shown no signs of significant corrosion, and the aging management program will provide reasonable assurance that significant degradation of the drywell shell 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 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 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, 3, and MC piping and component support members for loss of material, and loss of mechanical function in the following environments: air indoor, air outdoor and treated water. Bolting for supports is also included with these components and inspected for loss of material and for loss of preload by inspecting for missing, detached, or loosened bolts and nuts in the following environments: air indoor, air outdoor and treated water. 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 2001 Edition through the 2003 Addenda as approved in 10 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 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 2003, during the performance of ASME Section XI, Subsection IWE inspections, the inspectors identified light to heavy rust on nuts and washers for two bolts installed on a torus horizontal restraint (MC support). These bolts, nuts and washers are components of the torus horizontal restraint, which is managed by the ASME Section XI, Subsection IWF program. The inspection noted that there was no measurable loss of material. The condition was entered in the corrective action program for evaluation and performance of an extent of condition. As a result, the remaining torus lateral restraint bolts, nuts and washers were inspected during the next refueling outage (RF12). The inspectors noted light to heavy rust on additional washers and nuts. Corrective actions were initiated to remove the rust and re-inspect the washers and nuts. After the rust was removed, the supports were inspected, evaluated, and found acceptable for continued service without repair/replacement. This example demonstrates that examinations conducted in accordance with ASME Section XI, Subsection IWF identify aging effects that could impact the structural integrity of component supports. The example also illustrates that identified degradations are investigated for extent of condition and evaluated for continued service, or repair and replacement.

2. In 2004, failure of a nonsafety-related 8" diameter steam pipe caused loss of condenser vacuum and required operators to manually scram the plant. The direct cause of the event was fatigue due to vibration attributed to operating the system with a failed open air-operated valve (LV1039A) for twenty-five days. Event investigation determined that the failed open valve was caused by failure of the air supply line to the valve operator. The air supply line failure was apparently caused by fretting due to vibration of a loose rod hanger (H25), which rubbed against the air line. After the pipe rupture event, the upper rod of hanger H25 was found to be unscrewed from the eye nut. The jam nut at the eye nut and the upper rod was found to be fully unthreaded and easy to turn. This pipe hanger is nonsafety-related and is not in scope of ASME Section XI, Subsection IWF.

   As a result of the identified loose hanger, an extent of condition was performed to determine if the condition existed on other plant systems, and would include balance of plant (BOP) systems from the adjacent operating station, Salem Unit 1 and Unit 2. Field inspections were conducted on over 5000 BOP hangers. Two hundred six (206) hanger deficiencies were identified. In general, the deficiencies were in the following broad categories: rod or support is bent, rod or support is off vertical, spring can is

out of tolerance, support components are loose, and loose jam nuts. Evaluation of the deficiencies determined they have no immediate impact on structural integrity of piping or systems. The deficiencies were attributed to less than adequate installation of the hangers and lack of rigorous formal monitoring activities for nonsafety-related pipe supports. These supports are subject to system engineer walkdowns and are not included in the scope of ASME Section XI, Subsection IWF or other formal programs. The identified deficiencies were accepted by engineering evaluation or repaired in accordance with approved procedures.

In addition to the walkdowns, approximately 10,000 work order records were reviewed for eight Hope Creek balance of plant systems for the period of January 1987 to September 2004. The review identified approximately 50 hangers that had loose jam nuts and approximately 15 disconnected hangers. The loose jam nuts and disconnected hangers were repaired in accordance with Hope Creek procedures. While this operating experience example is not associated directly with the ASME Section XI, Subsection IWF program, it illustrates that the station's corrective action program is an effective program and demonstrates that conditions adverse to quality are thoroughly investigated to determine the extent and root cause, and evaluated for acceptance or repair and replacement and is effective in maintaining the design basis for non-ASME pipe supports.

3. In 2006, Hope Creek conducted visual examination (VT-3) of eight (8) ASME Class 1, 2, 3, and MC component supports in accordance with ASME Section XI, Subsection IWF. The supports consist of a sample of different support types (i.e., anchor, hanger, variable support, etc.) selected from Residual Heat Removal, Main Steam systems, and Metal Containment (MC). 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 Hope Creek ASME Class 1, 2, 3, and MC 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 2006, Hope Creek identified one (1) concrete anchor on the support for the 1" diameter service water pump lube water line and replaced the anchor in accordance with Hope Creek Repair, Replacement Program. The replaced anchor was found broken during a service water intake structure walkdown. Corrosion due to service water leakage or spray was suspected as the failure mechanism for the anchor. An Engineering Evaluation concluded that the support was capable of performing its intended function with consideration for the remaining concrete anchors, but recommended the repair to restore the support to its design configuration. As a part of the extent of condition determination, similar supports at the service water intake structure were inspected. The inspections identified no additional broken concrete anchors. This example demonstrates that identified degradations are investigated for extent of condition and evaluated for continued service, 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 loose fasteners, corrosion of fasteners, and broken concrete anchor, 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.2.1.30 10 CFR Part 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 due to aging effects such as loss of leakage tightness, loss of material, cracking, loss of sealing 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 Part 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 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 Integrated Leakage Rate Test measures overall containment leakage and the Local leakage rate tests 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 (LRT) demonstrate the leak-tightness of containment isolation barriers.

The LRT program documents and trends test results in accordance with the requirements and guidance provided in 10 CFR Part 50 Appendix J. The Leak Rate Test 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 Hope Creek in 2007 was approximately 30,700 standard cubic centimeters per minute (sccm), or 40%, of the total allowable technical specification limit of 76,795 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 the Primary Containment boundary.

2. A Focused Area Self-Assessment (FASA) conducted for the Hope Creek Appendix J Program was completed in July 2006. The purpose of the FASA is to evaluate the condition of and compliance with the regulatory requirements of Appendix J. The aspects of the program reviewed included program implementation organization, human performance/interface, program scope and continuous improvement. The overall rating for the Appendix J program was considered satisfactory. The assessment demonstrated that industry and plant operating experience are reviewed on a regular basis and that safety parameters are effectively monitored and trended by the program.

3. During the LLRT test in November 2004, system valves were found to have a measured leakage of 11,600 sccm, which exceeds the allowable limit of 5,400 sccm. The valves were declared inoperable and an investigation into the cause of the failures was initiated. The cause of the failure was due to damage to the valve seating area and repairs were made to resolve the degraded condition. This example demonstrates that corrective actions are implemented to repair a condition that causes excessive leakage and also demonstrates that follow-up leakage rate testing is performed to confirm that the deficiency has been corrected.

4. In April 2006, significant seat leakage on the auxiliary feedwater to main feedwater system check valve was discovered during the LLRT tests. The leakage was found to exceed its 5 gpm limit by 15 gpm. The valve was disassembled and inspected and the cause of the failure was due to manufacturing deficiencies on the valve poppet seat. This is a good example that shows degraded conditions are documented and corrective actions are implemented.

The data from the most recent running summary totals in 2007 show the total leakage has adequate margin at 40% of the allowable technical specification limit at Hope Creek. 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 impacting the primary containment boundary safety function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-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 program provides reasonable assurance that the 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 Masonry Wall Program

Program Description

The Masonry Wall Program is an existing program implemented as part of the Structures Monitoring Program. The Masonry Wall Program was developed to meet the regulatory requirements of 10 CFR 50.65, the Maintenance Rule; USNRC Regulatory Guide 1.160; and NUMARC 93-01, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants. Hope Creek has no safety-related masonry walls or masonry walls whose failure during a seismic event could adversely impact a safety-related function. As a result, NRC IE Bulletin 80-11, "Masonry Wall Design", does not apply.

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. Auxiliary Boiler Building
   b. Fire Water Pump House
   c. Masonry Wall Fire Barriers
   d. Switchyard
   e. 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 inspections show that detection of cracks, and other aging effects in masonry walls are being adequately managed. The inspection history revealed minor degradation of masonry block walls, but none that could impact their intended function. Deficiencies that have been identified have been evaluated and corrected, as appropriate. Concrete masonry walls are used only in non-Seismic Category I Structures. 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. In 2006, condition monitoring inspections were performed for Hope Creek masonry walls. The Masonry Wall Program is implemented by the Structures Monitoring Program. The checklist from the Structures Monitoring Program was used for the Main and Power Transformer masonry walls that perform a fire barrier intended function. Inspection results showed no significant degradation, such as efflorescence, spalling, or cracking.

2. In 2007, a corrective action report was issued to document, evaluate and repair cracks in a masonry wall near the turbine building that performed a fire barrier intended function. The cracks were evaluated by a qualified structural engineer. The structural engineer concluded that the cracks have no impact on the design basis of the masonry wall or the fire barrier intended function of the masonry wall. A work order was generated to seal the cracks. This example provides objective evidence that the station's corrective action program and Structures Monitoring Program are

documenting, evaluating, and correcting structural conditions adverse to quality.

3. In 2003, a corrective action report was issued to document and evaluate a fire barrier masonry wall that had a combustible material in the wall joints. The wall was located in the turbine building and the combustible material could affect its firewall rating. The combustible material was used to provide a designed control joint to prevent cracking in the wall. A design change was issued to cut back the joint material and the joints were sealed with an approved caulking. This is another example that the station's Corrective Action Program and Structures Monitoring Program are documenting, evaluating, and correcting structural conditions to maintain the masonry wall design basis.

The above examples provide objective evidence that the periodic structural inspections and corrective action reports 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 the identified aging effects 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, during the period of extended operation.

B.2.1.32 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 CFR 50.65 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 Regulatory Guide 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants." Hope Creek has no safety-related masonry walls or masonry walls whose failure during a seismic event could adversely impact a safety-related function. As a result, NRC IE Bulletin 80-11, "Masonry Wall Design", does not apply.

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". 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.

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 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 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. Auxiliary Boiler Building
   b. Fire Water Pump House
   c. Shoreline Protection Dike, and Sheet piles (Reg. Guide 1.127)
   d. Switchyard
   e. Turbine Building
   f. Transmission towers
   g. Yard Structures (Foundations for fire water tanks, manholes, Transformer foundations credited for SBO)
   h. Masonry walls, including fire barriers
   i. Building penetrations that perform flood barrier, pressure boundary, shelter and protection intended functions
   j. Miscellaneous steel (catwalks, vents, louvers, platforms, etc.)
   k. Pipe whip restraints, jet impingement and missile shields
   l. Ice barrier, trash rack (Reg. Guide 1.127)
   m. Panels, racks, cabinets, and other enclosures
   n. Metal-enclosed bus
   o. 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
   p. 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. Perform a one-time inspection of the external stainless steel surfaces of the expansion bellows at Condensate Storage Tank Dike for loss of material due to corrosion, within the ten-year period prior to the period of extended operation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

5. 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)**

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. **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 Hope Creek 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.

   Roofing Examination:

   In 2008, condition monitoring inspections were performed on various roofs in accordance with the Structures Monitoring Program. Roof inspections were performed for all the safety-related buildings for material condition of the roofing and drainage systems. The inspection results showed no significant findings, no ponding or spillover at drains and gutters. Also, there was no accumulation of debris at drains, scuppers or gutters, which would cause blockage. Corrective action reports were generated, resulting in the performance of minor housekeeping to correct as found conditions. These deficiencies were minor in nature and would not have affected the intended function of the roofing system.

   Reactor Building:

   In 2007, condition monitoring inspections of the Reactor Building including the Primary Containment and Torus were performed. The structural inspections results indicated that the areas were satisfactory. There was minor rust on the torus horizontal restraint end plates that connect to the wall. Additionally, there was some minor surface rusting of the Reactor Building floor framing steel. None of these conditions found warranted immediate repair.

   Service Water Intake Structure:

   In 2008, condition monitoring inspections were performed for the Hope Creek Service Water Intake Structure exterior concrete walls at the tidal zone. An interior inspection of the submerged walls for the 'D' train pump well was also performed. Since the traveling water screen preventive maintenance (PM) activity required the pump well to be dewatered, the inspection was able to included inaccessible areas of usually submerged walls. The submerged concrete walls for the 'D' train pump well and

exterior concrete walls for the entire Service Water Intake Structure, showed no evidence of degradation. There was some minor erosion from water flow at the wall corners that was noted as acceptable by the station structural engineer. Similar submerged wall inspections of the 'A', 'B' and 'C' train pump wells are planned to be performed when the respective pump wells are dewatered for the other traveling water screen PM activities.

Masonry Walls:

In 2006, condition monitoring inspections were performed for Hope Creek masonry walls. The checklist from the Structures Monitoring Program was used for the Main and Power Transformer fire barrier masonry walls. Inspection results showed no significant degradation, such as efflorescence, spalling, or cracking.

Shoreline Protection and Dike:

In 2008, condition monitoring inspections were performed for the Hope Creek Shoreline Protection and Dike structures. The inspection results showed the Shoreline Protection and Dike structures 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. In 2003, a corrective action report was issued to document, evaluate and repair degraded emergency diesel generator exhaust hoods. The exhaust hoods provide shelter and protection for the diesel exhaust stacks and are located on the roof of the Auxiliary Building. Material condition report identified overall corrosion of carbon steel components, cracked grout and corroded/displaced exhaust seal assembly. The condition was evaluated by a qualified structural engineer. The engineer concluded that the condition does not adversely impact the exhaust hood from performing its design function. A work order was generated to repair the grout and corroded elements, restoring them to its design condition. The work order report indicated the grout and the exhaust hood corroded components were repaired in accordance with station procedures. This example provides objective evidence that the station's corrective action program and Structures Monitoring Program are documenting, evaluating, and correcting structural conditions adverse to quality.

3. In 2006, a corrective action report was issued to document, evaluate and repair cracking of the Fire Water Storage Tanks' foundations. The noted condition was evaluated by a qualified structural engineer. The structural engineer concluded that the condition did not adversely impact the foundation's structural integrity and concluded the cause was due to shrinkage of concrete. A work order was generated to seal the cracks to

prevent water intrusion and freeze-thaw action. The work order report indicated the concrete cracks were sealed in accordance with station procedures. This is another example that provides objective evidence that the station's corrective action program and Structures Monitoring Program are documenting, evaluating, and correcting structural 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 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, during the period of extended operation.

B.2.1.33 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 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. 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 will be used to manage loss of material, cracking, and change in material properties for concrete components; loss of material and loss of preload for steel and metal components; and loss of material and loss of form for earthen water control structures in the following environments: air-indoor, air-outdoor, groundwater/soil 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 Part 50.65, Maintenance Rule. The program will be enhanced to include an inspection frequency of 5 years for structures/components submerged in water.

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 Hope Creek 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.

Hope Creek complies with RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants as applicable to the Service Water Intake Structure. Conformance to NRC's RG 1.127 was part of Hope Creek's original design basis. Elements of the program have been incorporated in the Structures Monitoring Program aging management program.

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. Shoreline Protection and Dike structures will be added to the program. **Program Element Affected: Scope of Program (Element 1)**

2. 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)**

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 Hope Creek. 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 Hope Creek service water intake structure can be exposed to a similar environment therefore there is a potential for this condition to occur. The disposition of this generic evaluation was that all site safety-related structures are subject to condition monitoring in accordance with the structures monitoring program. 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 2008, inspections were performed on submerged concrete walls and other structural components of the "D" Service Water Intake Structure pump bay to support the station equipment Preventative Maintenance (PM) requirements and for the condition monitoring of structures for Hope Creek. For the interior submerged concrete walls and the exterior submerged walls, there was no evidence of any deficiency or degradation. There was some minimal erosion at the wall corners that was noted as acceptable by the station structural engineer. There was corrosion noted on the support plates that provide the structural attachments for the submerged portion of the service water pump and screen to the structure. The upper support plates had significant corrosion that warranted an engineering evaluation of the condition. The evaluation noted that the design basis was maintained and adequate for all design basis events. The lower support plates were deemed acceptable since they exhibited less corrosion. Additionally, the ladder that goes down to the bay floor was noted as exhibiting signs of corrosion and degradation. One of the lateral support anchors was severely corroded around the nut of the anchor bolt. The corrosion of these components was a result of the submerged raw water environment that these components were subject to during plant operation. The engineering

evaluation judged the ladder to be acceptable and a notification was initiated to perform corrective maintenance on the ladder and anchorage during the next inspection period for this bay. As a result of the corrective action plan for the degradations noted from this inspection and to provide for a focused inspection of the normally submerged interior structural components of the service water pump bays, future inspections will be performed under a separate Preventative Maintenance (PM) condition monitoring inspection task to coincide with the traveling water screen/equipment station Preventative Maintenance task. This example provides objective evidence that this program will be capable of both monitoring and detecting aging affects associated with water control structures. In addition enhancement in the Preventative Maintenance Orders were coordinated such that structural inspections are preformed when equipment is removed and inaccessible areas are exposed.

3. In 2003 it was observed that there were cracks and spalling of the concrete of the strainer room roof curb in the northeast corner of the service water intake structure roof at elevation 135'. Upon further investigation by site engineering, additional cracking was noted in the concrete roof slab, concrete curbs and concrete hatch plugs on the various roof elevations. The condition of the roof's structural design basis was evaluated by site engineering. The cracks in the curb and slab are minor and not significant from an aspect of structural integrity of the building. The cracks in the northeast and southwest corners of the roof are also considered minor and did not pose any structural concerns. In addition there is reinforcing steel at the corners that prevents the cracked sections from falling. The spalling and cracks on the hatch plug corners do not impair the structural integrity on the components. The likely cause of the cracks in the slab is a result of expansion and contraction, due to changes in temperature, followed by the effects of freeze-thaw in winter. The crack in the curbs are most likely due to the shear effects experienced from the slab expansions, followed by the effects of weather. Cracks and spalls at the hatch plug corners are due to impacts during hatch plug lifts. The degraded conditions were repaired in accordance with engineering guidance and concrete repair specifications. This example provides objective evidence that the station's corrective action program is documenting, evaluating, and correcting structural conditions adverse to quality.

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 example 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.2.1.34 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 Hope Creek 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 1 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 Hope Creek Protective Coating Monitoring and Maintenance Program is consistent with the guidance in ASTM D 5163-05(a) in that the program 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 includes monitoring and trending activities, which is an expansion beyond the program described in the Hope Creek response to GL 98-04, which is based on Regulatory Guide 1.54, Rev. 0 and its referenced ANSI standards (since withdrawn).

The Protective Coating Monitoring and Maintenance Program requires individuals responsible for inspecting, coordinating, and evaluating the conditions of the coatings to have 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 all accessible areas of containment are included in the inspection plan. 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 areas noted during the initial walk-through 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. In accordance with the program, the coatings evaluator dispositions all coating deficiencies in the written inspection report, describing 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. 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

Hope Creek responded to GL 98-04 providing information on their protective coatings program, and an assessment of their emergency core cooling systems (ECCS) operations. Hope Creek implemented 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 performs a preventive means to mitigate 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. 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 2001, an inspection of the Hope Creek service level I coatings was performed during the refueling outage. The inspection methodology was based on the guidelines of ASTM D 5163. The inspections covered five areas: (1) primary containment outside of the torus, (2) drywell at elevations 100-ft and 109 through 127-ft, (3) drywell head and flange, (4) interior of the torus, and (5) drywell at elevation 87-ft. The inspection consisted of visual examinations, including references to industry pictorial standards, on the various metal and concrete surfaces in the selected areas. The summary of inspections in the coatings report indicated that the coatings applied to metal and concrete surfaces were in good condition. Recommendations were made for future maintenance work in the drywell and torus and documented in the Hope Creek corrective action program. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in monitoring, trending, and assessing the condition of the service level I coatings and documenting coating conditions.

2. In 2004, a diver inspection was performed in the torus during the refueling outage. The purpose of the inspection was to assess the conditions of the underwater torus coatings and underlying metallic surfaces of the torus. The inspectors found thirty-nine (39) areas with coating deficiencies, all of which were due to mechanical damage as opposed to other forms of disbondment such as cracking, peeling, and delamination. The loss of material due to corrosion of the underlying steel (maximum loss was measured at 28 mils) at the areas of the 39 identified coating deficiencies was within the acceptance criteria of 94 mils. Although the mechanism of the coating deficiencies were not related to the coatings' ability to adhere to the substrate and that the observed loss of material on the torus metal surfaces were within the acceptance criteria, coating repairs were performed during the 2004 outage. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in assessing and correcting the conditions of the service level I coatings underwater in the torus.

3. During the 2009 refueling outage, the Hope Creek service level I coatings in the drywell were inspected following the guidelines of ASTM D 5163. Due to limited access, the coatings assessment was limited to coatings applied to steel and concrete surfaces at Elevations 102-ft and 87-ft. The first area assessed was the concrete floor to drywell shell interface at Elevation 87-ft to determine the condition of the coatings. The coatings did not exhibit any signs of peeling or delamination. There was no visible corrosion on the drywell shell. The remaining coating inspections consisted of visual examinations on the various metal and concrete coated surfaces. The summary of inspections in the coatings report indicated that the coatings applied to metal and concrete surfaces were in good condition. There were many instances of small areas of mechanically-damaged coatings bounded by sound coatings. These conditions were documented in the corrective action program and were satisfactorily addressed in the 2009 outage. This example provides objective evidence that the Protective Coating Monitoring and Maintenance Program is effective in assessing and correcting the conditions of the service level I coatings.

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.2.1.35 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 neutron monitoring 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 Hope Creek 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 and distributed from the Farley Nuclear Plant. An evaluation and assessment of the Hope Creek 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 Hope Creek. The field inspections validated that similar adverse condition did not exist at Hope Creek as described in the Farley Nuclear Plant OE report. This example illustrates that the Hope Creek 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. On April 17, 2006, a motor lead damaged by heat exposure was visually discovered at Hope Creek. An engineering evaluation of the cable condition was performed. The damaged portion of the cable was removed and new cable was spliced into place to eliminate the heat-damaged cable completely. This example illustrates that the 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 March 2, 2004 a power cord in the Radiation Monitoring System was visually discovered to have degraded outer insulation (jacket) by an engineer during a periodic system walkdown. No other cable degradation was observed in the system. The system was evaluated to be operable. The power cable was replaced prior to any loss of function in accordance with the corrective action program. This example illustrates that the Hope Creek

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 Hope Creek 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 Hope Creek 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

This 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.2.1.36 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 Leak Detection and Radiation Monitoring System, and the Neutron Monitoring System not included in the Hope Creek 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 Leak Detection and Radiation Monitoring System, Neutron Monitoring System and other Hope Creek 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 Hope Creek EQ program, or are not subject to adverse localized environments.

Calibration results and findings of surveillance programs will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards for the in-scope portions of the Leak Detection and Radiation Monitoring System. Cable testing results will be assessed for cable aging degradation prior to the period of extended operation and at least once every 10 years afterwards for the in-scope portions of the Neutron Monitoring System.

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-109619.

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 neutron monitoring 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 CR 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. General Electric Service Information Letter (GE SIL) 564 Rev 1, Verification of SRM, IRM and LPRM Detector Response, was issued December 2003. The SIL provides a methodology for verifying that SRM, IRM and LPRM detectors and signal path cabling are operating properly prior to reactor startup. It recommended that BWR owners perform the tests presented in the SIL before startup from any outage wherein under-vessel work activities could affect nuclear instrumentation detector or signal path integrity. The impact of this information on the equipment at Hope Creek was assessed. An engineering evaluation identified changes to the maintenance procedures and maintenance items that further improved the long-term performance of the Neutron Monitoring System. This example provide objective evidence that this program will use industry operating experience to make improvements in monitoring and detecting cable and connector problems in instrumentation circuits.
2. In November 2004, a common cause analysis was initiated in response to an adverse trend with problems with instrumentation cables located under the reactor vessel. A cross discipline team was formed to investigate the failures to identify the causes of the problems with instrumentation located under the reactor vessel. For example, the SRM and IRM J-Loop cable were found to be failing at a higher rate than prior experience. It was found that the J-loop connectors under vessel each had insulating sleeves installed over the connector for electrical insulation. Water (from refueling maintenance activities) tended to collect in the top of the sleeve promoting the formation of a puddle and eventual leaching of water into the connector.

It was determined that the best solution is to remove the sleeves to improve the cable water resistance. The problem with water collecting at the SRM and IRM J-Loop cable connector was resolved. This example provides objective evidence that the program will detect problems with instrumentation cable and connections and take corrective actions prior to the loss of intended function because this program will review calibration and test data for adverse trends that could indicate possible insulation degradation. This example also demonstrates the corrective action process is effective in evaluating and resolving problems with instrumentation cable and connections.

3. In April 2002, a degraded sensor cable was discovered on the Turbine Building Circulating Water Sump Radiation Monitor. The degraded cable was discovered during a system restoration after installing an unrelated design change. Specifically, about 30 seconds after the Turbine Building Circulating Water Sump Radiation Monitor was placed into service, the radiation monitor spiked, tripping the Turbine Building Circulating Water Sump off per design. Subsequent troubleshooting revealed that the sensor connector cable had degraded and the connector was loose from repeated cleaning and handling. The radiation monitor spiking was due to vibration-induced noise caused by water flowing through the system piping. The cable was replaced and detector checked. This example provides objective evidence that the program will detect problems with instrumentation cable and connections prior to the loss of intended function. This example also demonstrates the corrective action process is effective in evaluating and resolving problems with instrumentation cable and connections.

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 are 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.2.1.37 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 exposure 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 Hope Creek 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 Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients, Hope Creek 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. In August 2007 the cable vaults for class 1E motor feeds and controls for service water were observed to be potentially flooded in the vicinity of the Manhole 102 yard area. The vaults were observed at the time to be under standing water from recent heavy rain. Each vault contains four power cables, one medium voltage 5 kV cable (Okonite with EPR insulation and Hypalon jacket) and three other 480-volt cables. The power cable in question is designed for direct burial. A corrective action process notification was initiated to address the impact on the cable vaults. The Hope Creek yard area in the vicinity of the cable vaults was re-graded to minimize rainwater (and brackish service water yard dumps) from pooling on top of the vaults, creating a swale from the vault area to the storm drain south of the vault. Corrective actions included a technical evaluation. Two cable vaults have been inspected. The cables were found submerged in water. The water was pumped out of the cable vault. The cable vault structure was found to be in good material condition. The remaining cable vaults are scheduled for inspection. This example provides objective evidence that corrective actions are taken to in response to industry operating experience and to minimize the water intrusion into the cable vaults.

3. A self-assessment was conducted in February 2008 evaluating critical medium voltage underground cable in response to industry generic operating experience. The assessment addressed testing practices, spare cable contingencies and potential vulnerabilities. The report concluded that existing underground medium voltage cable insulation (EPR) is considered to be the best material for this application. Best industry practices were evaluated for cable monitoring and testing, and follow-up actions were created to develop the test program and institute preventive maintenance activities for this shielded cable. This example provides objective evidence that industry operating experience will be used to improve the program such that if any aging effects of interest do occur, they would be detected 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 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.2.1.38 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 Hope Creek.

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 aging management 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 busses 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. An electrical transient occurred in the Hope Creek switchyard in January 2006 in an outdoor section of non-segregated metal enclosed bus (MEB) associated with the 13.8 kV Island Substation, which is not in scope for license renewal. The electrical fault was caused by a breakdown of insulation properties between bus bars caused by tracking across a dislodged insulating boot (over an interconnecting joint). The cause of the dislodged insulating boot was improper installation of the bus bar protective boots. The last corrective maintenance action was worked ten years earlier. A lack of effective preventive maintenance (PM) also contributed to this electrical transient. This particular MEB section had no routine preventive maintenance tasks scheduled to periodically inspect this MEB section. Corrective actions included installing new boots with an approved design, established appropriate PM tasks for this MEB section, and completed extent of condition inspections of adjoining transformers MEB sections for similar conditions (which were found to be satisfactory). The affected MEB sections were cleaned, the transformers were tested satisfactorily, and the MEB section was return to service. This example provides objective evidence that corrective actions are taken for conditions adverse to quality, and that the new Metal Enclosed Bus program will be capable of both monitoring and detecting the aging effects associated with MEB insulation.

2. Visual inspections were performed in March 2005 of 4kV outdoor metal bus and connections to the Station Service Transformers. The inspections found deterioration of an alignment cover (flexible boot) on the outdoor portions of metal enclosed bus, with layers peeling off of the boot from the inside. The observed condition was that the boot "is starting to deteriorate" and was therefore recommended for replacement at the next opportunity. This boot is located at the transition from hard metal bus duct to the Station Power Transformers. The 'boot' is a protective covering over the links, comprised of a neoprene rubber material (exposed to sunlight) called an Alignment Joint Assembly. It also functions to accommodate thermal expansion and vibration. The preventive maintenance activity checks the flexible rubber joint for rips or holes, and is performed on a 3-year frequency in parallel with transformer maintenance. There are 8 total Alignment Joint Assemblies (two of which are in scope for license renewal) and all were subsequently replaced or repaired, with no plant impact or operational problems experienced. These Alignment Joint Assemblies were original plant equipment, and

had been in service for over 20 years at the time of their replacement. A recurring task PM activity exists to systematically replace the exterior (outdoor) Alignment Joint Assemblies in scope for license renewal on the 1AX501 and 1BX501 transformers. No significant age-related degradation was detected during these metal bus inspections. The bus enclosures were found to be clean, with no evidence of overheating of bus connections. These activities demonstrate that the bus is generally accessible for visual inspection and in good condition, 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 corrective actions are taken prior to loss of intended function, and that the new Metal Enclosed Bus program will be capable of both monitoring and detection of the aging effects associated with bus insulation.

3. A 3-year preventive maintenance (PM) activity was performed in November 2004 to inspect/clean 4.16 kV non-segregated bus 10A109 near the 1BX501 Station Service Transformer located outdoor. Bus bar tape and Raychem coverings were found to be deteriorated, specifically sunken in towards the bus bar with some bubbling observed. The fill putty and insulation tape were removed and repaired. No insulator cracks or loose bolts were identified. The work scope included removal of access covers and inspection for the accumulation of dust and debris, moisture and corrosion, as well as confirmatory megger testing. The PM activity demonstrated that the bus is accessible for visual inspection, 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 corrective actions are taken prior to loss of intended function, and 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 in scope for license renewal at Hope Creek is located outdoors, the corresponding operating experience has been good, 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.2.1.39 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

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 Hope Creek has successfully identified loose connections through the effective use of thermography. Hope Creek experience is in alignment with the industry in that electrical connections have not experienced a high degree of failures and that existing Hope Creek 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 June 2007 a routine thermography survey found a hot connection during an eight-hour service test on battery charger 1D-D-413. Specifically, the DC positive output lug connection was found to be 62 degrees F hotter than its associated DC negative output lug connection. A temperature difference of 135 degrees F or more requires immediate action. Normally, both lug connections should be about the same temperature. The charger was operating at 200A for a routine surveillance test. No other abnormal temperatures were reported. Previous routine thermography of this connection during normal operating conditions indicated no elevated temperatures. The connection was repaired and retested 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 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 January 2007 a routine thermography survey found elevated temperatures on a fuse block associated with a switchgear cubicle space heater circuit. Some electrical connections temperatures were found to be 16 to 50 degrees F higher than ambient. A temperature difference of 135 degrees F or more requires immediate action. Normally, all of the connections should be about the same temperature. The fuse holder and its electrical connections were repaired and retested satisfactorily prior to the loss of function. This example provides objective evidence that thermography will detect loose electrical connections prior to a loss of function. This also 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.

3. In March 2006, a routine thermography survey discovered a hot spot on a terminal strip connector in a breaker cubicle. The connection was found to be 31 degrees F higher than the other associated terminal strip connections. A temperature difference of 135 degrees F or more requires immediate action. Normally, all of the associated terminal strip connections should be about the same temperature. This condition required the connections to be monitored more frequently until the breaker cubicle could be de-energized for repairs. The terminal strip connections were repaired and tested satisfactorily. This example provides objective evidence that 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. 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.

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 Hope Creek due to the presence of salt deposits or surface contamination.

The scope of the program includes high voltage insulators in the 500 kV switchyard, portions of the 13.8 kV buses, and the 500 kV Salem-Hope Creek crosstie. 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 new 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, portions of the 13.8 kV buses, and the 500 kV Salem-Hope Creek crosstie conductors. 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 Hope Creek. 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. Hope Creek 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.

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 Part 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 Part 50, Appendix B.

The High Voltage Insulators program consists of administratively controlled procedures, which are implemented in accordance with the requirements of 10 CFR Part 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. Industry operating experience shows the potential for loss of offsite power due to salt deposits on switchyard insulators. 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 Hope Creek 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 Hope Creek 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. Hope Creek operated throughout the storm. The combination of salt on the insulator surface and atmospheric moisture caused a flashover. Circuit breakers opened to isolate the fault on the Salem end of the line, without a significant effect on Salem plant equipment. Circuit breakers also opened to isolate the fault from Hope Creek and (by design) resulted in loss of the 1AX501 bus and loading of emergency diesel generators. Due to other malfunctions, an automatic reactor scram was initiated. The high voltage insulators were subsequently cleaned/washed prior to returning the unit 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 Hope Creek is considered rare.

3. Visual inspection of Hope Creek switchyard high voltage insulators is performed 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 & 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 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 or 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 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 standby diesel generator exhaust expansion joints. 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.

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 includes 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 will also detect cracking of standby diesel exhaust expansion joints prior to loss of intended function. The program includes visual inspections of heat transfer surfaces 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 standby diesel 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, and stainless steel components subject to diesel exhaust. For stainless steel and copper alloy components in this program and subject to these environments, 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 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. The program also includes visual inspections of the standby diesel 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

The Periodic Inspection 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 standby diesel 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 Part 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 Part 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 Part 50, Appendix B. This aging management program is included in the Hope Creek 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 Hope Creek 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 were performed on outdoor stainless steel piping, to confirm that potential external salt contamination from the Delaware River has not resulted in degradation of the piping. Inspections were performed in January 2005 and September 2007. All of the inspection results have been satisfactory, with no indication of age related degradation. 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 Hope Creek are not experiencing loss of material.

3. On March 26, 2003 a small tear was discovered on the Hope Creek Technical Support Center Ventilation Fan discharge flexible connection while performing a preventive maintenance task. The corrective action process was initiated. Further evaluation found that the tear was on the outer shell of the flexible connection and did not affect the ventilation system function. The tear was repaired. This 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 during unrelated work activities, 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, cracking, reduction of heat transfer, 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 in the scope of license renewal. The tank within the scope of this program is the stainless steel Condensate Storage Tank. The condensate storage tank is supported on a concrete foundation.

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 tank, 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 installed at the interface edge between the tank bottom and the concrete foundation for signs of degradation. The tank vent 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 tank within the scope of this program is the stainless steel Condensate Storage Tank. 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 installed at the interface edge between the tank bottom and the concrete foundation for signs of degradation. The tank vent 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 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. The tank vent 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. Grout installed at the interface edge between the tank bottom and the concrete foundation will be periodically inspected for degradation. The tank vent 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 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 at the interface edge between the tank bottom and the concrete foundation minimizes water and moisture intrusion at the interface. Therefore, grout installed at this interface will be periodically inspected for degradation that could allow water to get under the tank bottom. The tank vent bird screen will be visually inspected for loss of material. The five year visual inspection frequency 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 since the condensate storage tank is the only tank in 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. The tank within the scope of this program is the stainless steel Condensate Storage Tank. 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 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 are qualitative in assessing the extent of degraded or missing grout. 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 Part 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, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 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 Part 50, Appendix B. This aging management program is included in the Hope Creek license renewal UFSAR supplement.

Operating Experience – Element 10

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 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 stainless steel piping attached to the Condensate Storage Tank, to confirm that potential external salt contamination from the Delaware River has not resulted in degradation of the piping. Inspections have been performed in January 2005 and September 2007. All of the inspection results have been satisfactory, with no indication of age related degradation. This operating experience provides objective evidence that stainless steel components subject to the outdoor air environment at Hope Creek, and located in proximity to the stainless steel Condensate Storage Tank in the scope of this aging management program, are not experiencing loss of material.

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 for the stainless steel Condensate Storage Tank in the scope of this program. This tank is not coated. No age related degradation issues were identified associated with the external surfaces of this tank.

During over 20 years of operation, there has been no degradation of the tank external surfaces exposed to the outdoor air environment. The good physical condition of the Condensate Storage Tank 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 Buried Non-Steel Piping Inspection aging management program is an existing condition monitoring program that manages the buried reinforced concrete piping and components in the 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 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.

The Buried Non-Steel Piping Inspection aging management program also manages the aging effects on buried stainless steel piping and components in the Condensate Storage and Transfer System and the Fire Protection System that are exposed to an external soil environment. The program relies on visual inspections of the external surfaces of the piping and components to identify loss of material. Inspection of buried components identifies coating degradation, if coated, or base metal corrosion, if uncoated.

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.

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. 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 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 and 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 Buried Non-Steel Piping Inspection aging management program consists of system components within the scope of license renewal that are buried and included in the Service Water System, the Condensate Storage and Transfer System and the Fire Protection System. This includes the buried reinforced concrete piping in the Service Water System that extends from the carbon steel spool piece at the Service Water Intake Structure to the interface of the Reactor Building and the buried stainless steel piping in the Fire Protection System that extends from the Reactor Building into the ground in several locations. Additionally, the Buried Non-Steel Piping Inspection aging management program consists of buried stainless steel piping in the Condensate Storage and Transfer System that extends from the Condensate Storage Tank piping to a buried seismic anchor block credited for structural support. Opportunistic and focused inspections are performed when the piping and components are excavated for maintenance or for any other reason.

The Buried Non-Steel Piping Inspection aging management program will be enhanced to include at least one opportunistic or focused excavation and inspection of buried reinforced concrete piping and components and at least one opportunistic or focused excavation and inspection of stainless steel buried 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 of buried reinforced concrete piping and components and at least one opportunistic or focused excavation and inspection of stainless steel buried piping and components 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. 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 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 Service Water System and the buried stainless steel

piping and components in the Condensate Storage and Transfer System and the Fire Protection System that is exposed to an external soil or groundwater environment. The buried reinforced concrete piping and components are inspected for cracking, loss of bond, increase in porosity and permeability, and loss of material. The buried stainless steel piping and components are inspected for loss of material.

Parameters Monitored/Inspected – Element 3

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 Service Water System that are exposed to an external soil or groundwater environment to inspect for cracking, loss of bond, increase in porosity and permeability, and loss of material. The Buried Non-Steel Piping Inspection aging management program also relies on opportunistic or focused inspections of the buried stainless steel piping and components in the Condensate Storage and Transfer System and the Fire Protection System that are exposed to an external soil environment to inspect for loss of material.

These aging effects will be identified through visual inspections of the external surfaces of the piping and components. Opportunistic or 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 piping and components are uncovered during 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.

The 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 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 the buried reinforced concrete piping and components in the 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 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. Examination methods include visual inspections of the external surface of buried piping and components. The methods used to inspect for degradation are implemented in accordance with accepted industry

standards.

The Buried Non-Steel Piping Inspection aging management program will inspect the buried stainless steel piping and components in the Condensate Storage and Transfer System and the Fire Protection System that are exposed to an external soil environment for loss of material and will detect degradation of the component prior to loss of its intended function. Examination methods include visual inspections of the external surface of buried piping and components. The methods used to inspect for degradation are implemented 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 Hope Creek shows that there have been no underground leaks that developed as a result of failure of the external surface of buried stainless steel or 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. In 2004, it was determined that the service water loop underground headers joint epoxy coating was blistering internally. The cause of this blistering was due to exposure of the bell and spigot joints and other piping joints to river water on the internal surface of the pipe and not due to external age related degradation. There have been no inspections of buried stainless steel piping at Hope Creek to date. Additionally there have been no failures of buried stainless steel piping at Hope Creek to date.

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 commodities 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 and 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 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 Part 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 Part 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 Part 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 Hope Creek 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 Hope Creek shows that there have been no underground leaks that developed as a result of failure of the external surface of buried stainless steel or 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 2004, it was determined that the service water loop underground headers joint epoxy coating was blistering internally. The cause of this blistering was due to exposure of the bell and spigot joints and other piping joints to river water on the internal surface of the pipe and not due to external age related degradation. This blistering was grit blasted, cleaned, NDE examined, prepared and recoated using new coating ENECON coating. All joints were rescanned and were found to have adequate metal thickness. No immediate need for installation of WEKO seals was warranted. The exterior surface of the buried reinforced concrete piping of the Service Water system has a tar and fiber material, which protects the joints from outside, and no problems have been identified or suspected with the coating. The service water headers joints are inspected once every three years internally, one loop every 18 months. This provides objective evidence that susceptible buried piping is internally inspected on a routine basis, and any indication of degradation would be evaluated. Additionally, this operating example provides objective evidence that excavation and inspection of piping and components have been occurring opportunistically when underground pipe is exposed for other maintenance.

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

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 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 stainless steel 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)**

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 consistent with the current licensing basis during the period

of extended operation.

B.2.2.5 Boral Monitoring Program

Program Description

The Boral Monitoring Program is an existing program that monitors the Boral test coupon inspection and/or testing results at other Boiling Water Reactor (BWR) sites. If these results indicate a problem with the Boral neutron absorbing material potentially affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons in the Hope Creek spent fuel pool (SFP).

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 program that monitors the Boral test coupon inspection and/or testing results at other Boiling Water Reactor (BWR) sites. If these results indicate a problem with the Boral neutron absorbing material potentially affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons in the Hope Creek spent fuel pool (SFP). This practice is consistent with the Hope Creek UFSAR and previous NRC information.

Preventive Actions – Element 2

The Boral Monitoring Program is an existing program that monitors the Boral test coupon inspection and/or testing results at other Boiling Water Reactor (BWR) sites. If these results indicate a problem with the Boral neutron absorbing material potentially affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons in the Hope Creek spent fuel pool (SFP). The assumption is that the spent fuel pool environments, including the pool's water chemistry and radiation field, and the Boral material characteristics are consistent enough so that the results at other BWR sites are representative of the results if the Hope Creek Boral test coupons were inspected and/or tested. The Boral Monitoring Program aging management programs used at these other BWR sites is a condition monitoring program and does not include activities for prevention or mitigation of aging effects.

The Boral Monitoring Program aging management program used at these other BWR sites is a condition monitoring program and does not rely on preventive actions.

Parameters Monitored/Inspected – Element 3

The Boral surveillance performed by other Boiling Water Reactor (BWR) sites include visual inspections and/or testing of their Boral test specimens or coupons to monitor changes in physical properties of the Boral in the spent fuel pool. Examination of the Boral test coupon include visual examination and photography, and may include dimensional measurements, weight and density/specific gravity measurement, and neutron attenuation measurement. The Boral test coupon is visually examined to detect aging affects such as corrosion, pitting, swelling, or other degradation. The Boral test coupon may be photographed if, in the judgment of the technician, there is any information of significance that should be photographically documented. Dimensional measurements such as length, width and thickness are taken to document if physical changes are occurring in the Boral test coupon. The Boral test coupon is weighed and in some instances, the density/specific gravity is calculated to determine if there any changes in the physical properties. A measurement by neutron attenuation is performed to determine if there has been any change in the Boron-10 content.

These inspections and/or testing are performed by a qualified contractor or measurement laboratory and will ensure against unexpected degradation of the Boral neutron-absorbing material.

Detection of Aging Effects – Element 4

The Boral surveillance performed by other Boiling Water Reactor (BWR) sites include visual inspections and/or testing of the Boral test specimens or coupons to monitor changes in physical properties of Boral. These Boral test coupons are in the spent fuel pool and subject to irradiated fuel assemblies to ensure that the Boral test coupons of the BWR sites are representative of their Boral in their spent fuel pool storage racks. Also, the assumption is that the spent fuel pool environments and the Boral neutron absorbing material characteristics are consistent enough for the other BWR sites so that the inspection and/or testing results from other sites are representative of the results if the Hope Creek Boral test coupons were examined. Examination of the Boral test coupon include visual examination and photography, and may include dimensional measurements, weight and density/specific gravity measurement, and neutron attenuation measurement. The Boral test coupon is visually examined to detect aging affects such as corrosion, pitting, swelling, or other degradation. The test coupon may be photographed if, in the judgment of the technician, there is any information of significance that should be photographically documented. Dimensional measurements such as length, width and thickness may be taken to document if physical changes are occurring in the test coupon, which could indicate a change in the Boral material affecting its intended function. The Boral test coupon is weighed and in some instances, the density/specific gravity is calculated to determine if there any changes in the physical properties. A measurement by neutron attenuation is performed to determine if there has been any change in the Boron-10 content. The Boral test coupons for these other BWR sites are removed in accordance with a prescribed schedule that is site specific. Hope

Creek will request test reports from the Boral surveillance program of these other BWR sites every two years for evaluation and trending.

The use of operating experience from these other BWR sites should result in more industry operating experience data or test reports than would be obtained with a Hope Creek Boral coupon testing surveillance program. Generally these BWR sites' surveillance programs would retrieve a coupon or coupons for examination every refueling cycle for about the first five refueling cycles after initiating their surveillance program. Then their surveillance program would continue with a frequency of approximately once every five refueling cycles to perform examinations on their Boral test coupons going forth. Other BWR sites' surveillance programs utilize an inspection frequency that may be based on a multi-year surveillance (i.e., every two years), therefore different from what was previously described. Using multiple BWR sites for obtaining Boral coupon test results will ensure that a sufficient number of test reports are available for evaluation and trending to provide reasonable assurance that the Hope Creek Boral Monitoring Program will maintain the intended function of the Boral neutron absorbing material during the period of extended operation.

Monitoring and Trending – Element 5

The Boral Monitoring Program monitors the Boral test coupon inspection or testing results at other Boiling Water Reactor (BWR) sites. If these results indicate a problem with the Boral neutron absorbing material potentially affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons in the Hope Creek spent fuel pool (SFP). The assumption is that the spent fuel pool environments and the Boral neutron absorbing material characteristics are consistent enough for the other BWR sites so that the inspection and/or testing results from other sites are representative of the results if the Hope Creek Boral test coupons were inspected and/or tested. This assumption is justified since the industry testing results do not show significant variation from BWR site to BWR site. Hope Creek will request test reports from the Boral surveillance program of these other BWR sites every two years for evaluation and trending. The test results will be used to assess the condition of the Boral neutron absorbing material used in the Hope Creek spent fuel pool storage racks. The test results will provide the information and data needed to perform trending for indication of a potential degradation that may impact the performance of the Boral neutron absorbing material. A summary of test results received from other BWR Boral surveillance will be entered into the plant document retrieval system. If these results indicate a problem with the Boral neutron absorbing material affecting its intended function (i.e., absorb neutrons), Hope Creek will initiate inspection and/or testing of its Boral test coupons. Test results obtained from seven BWR sites for the period of 2004 through 2007, have provided evidence that supports the use of the existing Boral Monitoring Program for detecting and managing the aging affects of Boral. The test results from these seven BWR sites can be summarized as follows: examinations of the coupons involved visual observations, dimensional measurements (length, width and thickness), weight and density determinations and neutron attenuation measurements and the examination results were that material performance was satisfactory. Additionally, there were some minor issues noted (e. g., clad pitting, clad

blistering, and light oxide film of the clad) but there has been no impact on the Boral neutron absorbing material affecting its intended function. Using the test results from these seven BWR sites provides supporting data and documentation that supports the conclusion that using operational experience provides reasonable assurance that the detecting and managing of aging affects from other BWR sites can be used to predict the potential aging affects of the Boral material used in the Hope Creek spent fuel pool storage racks. Hope Creek intends to continue the current Hope Creek Boral Monitoring Program practice into the period of extended operation.

Acceptance Criteria – Element 6

The Boral Monitoring Program monitors the Boral test coupon inspection and/or testing results at other Boiling Water Reactor (BWR) sites. Hope Creek will request test reports from the Boral surveillance programs of these other BWR sites every two years for evaluation and trending. These BWR sites' Boral surveillance programs have acceptance criteria that are focused on the type of inspection and/or testing that are performed within their surveillance program. The Boral surveillance performed by other BWR sites may include visual inspections and/or testing of the Boral test specimens or coupons. The Boral surveillance program performed by other BWR sites vary from a qualitative type program such that visual inspections only are performed to a quantitative type program such that in addition to visual inspections, dimensional measurements are performed along with testing of the Boron-10 content. These programs monitor changes in physical properties of the Boral by performing visual examinations and/or test measurements on representative Boral test coupons so that the intended function "absorb neutrons" will be maintained during the period of extended operation.

The acceptance criteria utilized for the Boral neutron absorbing material will be based on the type of test results that are obtained from the other BWR site's test report. For those BWR sites that perform only a qualitative visual examination to assess the condition of their Boral neutron absorbing material, the Hope Creek qualitative acceptance criteria will be based on those results. If the conclusion from the BWR site's test report indicates satisfactory results, no addition action is required but to document the receipt of that test report for trending in the accordance with the Hope Creek Boral Monitoring Program. If the test report conclusion indicates performance less than satisfactory, the test report information will be entered into the Hope Creek corrective action program for further evaluation. The corrective action process will perform an evaluation to determine if the test results are acceptable or if further action is required, such as requesting additional previous or historical test results from the same BWR site that can be used for correlating trends of the Boral neutron absorbing material performance. Additionally, if as a result of historical trending of these test results shows that an divergence or inconsistency in the test report results indicates potential degradation of the Boral neutron absorbing material performance corrective actions will be initiated. This could trigger the requirement to retrieve one Boral test coupon from the Hope Creek spent fuel pool and initiate inspection and/or testing and evaluation in accordance with the Boral Monitoring Program. For those BWR sites that perform quantitative examinations of their coupons that include visual

observations, dimensional measurements (length, width and thickness), weight and density determinations and neutron attenuation measurements, the quantitative acceptance criteria is 1) the increase in thickness at any point should not exceed 10% of the initial thickness at that point and 2) a decrease of no more than 5% in Boron-10 content, as determined by neutron attenuation, is acceptable. If the conclusion from the BWR site's test report indicates satisfactory results, no addition action is required but to document the receipt of that test report for trending in the accordance with the Hope Creek Boral Monitoring Program. If the test report conclusion indicates at least one of the two acceptance criteria is unsatisfactory, the test report information will be entered into the Hope Creek corrective action program for further evaluation. Additionally, this could trigger the requirement to retrieve one Boral test coupon from the Hope Creek spent fuel pool and initiate inspection, testing and evaluation in accordance with the Boral Monitoring Program. Utilizing the Hope Creek Boral Monitoring Program and the Corrective Action Program in performing evaluations and trending of test results provide reasonable assurance that the Hope Creek Boral Monitoring Program will maintain the intended function of the Hope Creek Boral neutron absorbing material during the period of extended operation.

Corrective Actions – Element 7

See response to Element 6 above. 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 Part 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.

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 Boral Monitoring Program aging management program used at these other BWR sites is a condition monitoring program and does not rely on preventative or mitigative actions.

Degraded conditions are documented in accordance with the 10 CFR Part 50, Appendix B corrective action program. This program ensures that conditions adverse to quality are promptly corrected, with follow-up activities as required to confirm that the corrective actions were completed. If the condition is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to prevent recurrence. In addition, the components in the scope of this program are periodically monitored. Continued periodic inspections will confirm the effectiveness of prior corrective actions taken.

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 Part 50, Appendix B. This aging management program is included in the Hope Creek 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 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. Trending recent test results from other BWR sites for the past five years demonstrates that the Boral neutron absorbing material is performing satisfactorily and no significant degradations have been have been observed or documented. Industry operating experience was obtained from seven Boiling Water Reactor (BWR) sites for Boral test coupons. These seven test reports show no aging effect significantly impacting the intended function. Utilizing the operating experience from existing Boral surveillance programs at these other BWR sites provides a technical basis to demonstrate that Hope Creek does not need to implement an inspection and/or testing surveillance program of their Boral test coupons. Below is summary of the industry operating experience for these seven BWR sites:

   These BWR plants submit their Boral test coupon(s) to a qualified vendor for inspection and testing in accordance with the vendor's Boral surveillance program. The inspection and testing of these test coupon(s) generally involves visual observations and photography, dimensional measurements (length, width and thickness), weight and density determinations, and neutron attenuation measurements. Additionally, most of the BWR plants included B-10 areal density measurements with the surveillance program. The vendor prepares a report documenting the inspection and testing results and submits the report to the BWR plant. The following summarizes the inspection and testing results from the various BWR plants:

   The visual inspections of the coupon showed that with the exception of some localized pitting and some blistering of the aluminum skin of the coupons exposed to the spent fuel pool water, the condition of the coupons were as expected. It was noted that both the pitting and blistering were conditions of appearance and did not affect the function of the material. Within the accuracy of the measurements for the length, width, and thickness measurements, there were no significant changes from the initial pre-irradiated benchmarked measurements. The coupon showed a slight increase in weight and density that were within the

expected accuracy of the measurements. 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 was that the Boral neutron absorbing material in the spent fuel storage racks have retained their dimensional and neutron-absorption properties and capable of continuing to perform their intended function to absorb neutrons.

The summary of the inspection and testing results for the seven BWR plants discussed above provides objective evidence that the use and trending of industry operating experience demonstrates that the Boral neutron absorbing material will be capable of continuing to perform its intended function absorb neutrons.

2. Hope Creek has had no fuel assembly or blade guide movement impacted by Boral deformation (e.g., swelling, blistering). Almost every cell of the spent fuel pool racks have been accessed except for those cells listed as "DO NOT USE". Station procedure "Supplemental Hope Creek Special Nuclear Material and Core Component Storage Information," describes the Spent Fuel Pool cells that are considered as "DO NOT USE" cells. Older fuel assemblies (i.e., early plant discharges) have been moved to support Dry Cask Storage campaigns and Thermal Management requirements. There have been no problems experienced either removing fuel assemblies from these cells or inserting other fuel assemblies into these cells. There are 15 cells on the "DO NOT USE" list due to high cell friction. These cells failed drag tests in 1989 (1 cell) and 1992 (14 cells) soon after installation of the spent fuel pool racks and are thus not attributable to Boral deformation. The spent fuel pool racks were installed in multiple phases at Hope Creek. The other cells on this "DO NOT USE" list have interference problems (i.e., with hangers, equipment stored in the spent fuel pool, identification strips, the refueling bridge), have damage at the top of the cells, contain failed fuel assemblies, or contain other equipment (i.e., dummy bundle). There is one cell where the fuel assembly sits high in the cell but this behavior has not been attributed to Boral deformation. Camera inspection did not show Boral swelling or blistering. Therefore, based on the actual usage of the spent fuel pool racks, Hope Creek has no problems with the Boral performance and there is reasonable assurance that the Hope Creek Boral performance is no different from the industry Boral performance. It is acceptable to continue to monitor industry Boral performance rather than perform inspections and /or testing of the Hope Creek Boral test coupons.

As discussed in the examples above, the 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

None.

Conclusion

The existing Boral Monitoring Program aging management program provides reasonable assurance that reduction of neutron-absorbing capacity and loss of material/general corrosion 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.2.2.6 Small-Bore Class 1 Piping Inspection

Program Description

The Small-Bore Class 1 Piping Inspection program is a new program that will manage the aging effect of cracking in small-bore (greater than or equal to NPS 1 and less than NPS 4) Class 1 piping through the use of a combination of volumetric examinations and visual inspections. This new program is comprised of the existing ASME Section XI ISI (Risk Informed Inservice Inspection, RI-ISI) program that performs volumetric and visual examinations for selected Class 1 small-bore butt welds and other selected small-bore socket welds, and a 100% inspection of all accessible Class 1 socket welds in the recirculation system using volumetric or other industry approved techniques. The RI-ISI program provides a robust inspection selection process and is based upon the susceptibility to degradation and the consequences of a piping failure, which is founded on actual service experience with nuclear plant piping failure data. The RI-ISI program requires volumetric and VT-2 examinations on a frequency and number determined by ASME Code Case N-578-1 and the Hope Creek ISI Program Plan. These ongoing inspections combined with a 100% inspection of all accessible Class 1 socket welds in the recirculation system using volumetric or other industry approved techniques will be effective in identifying any age related or underlying deficiencies. Any deficiencies identified are evaluated under the corrective action program.

The Small-Bore Class 1 Piping Inspection program will effectively manage the aging effect of cracking in small-bore (greater than or equal to NPS 1 and less than NPS 4) Class 1 piping by identifying and evaluating cracking prior to loss of intended function.

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 Small-Bore Class 1 Piping Inspection aging management program will include a 100% inspection of the accessible Class 1 socket welds in the recirculation system, as well as ongoing ASME Section XI ISI (Risk Informed Inservice Inspection, RI-ISI) volumetric and visual examinations for selected Class 1 small-bore butt welds and other selected small-bore socket welds. The selected inspections include locations that are susceptible to cracking. The program will include measures to verify that unacceptable cracking indications are not occurring in Class 1 small-bore piping.

The Small-Bore Class 1 Piping Inspection aging management program manages the aging effects for the applicable systems, components, and environments.

Preventive Actions – Element 2

The Hope Creek Small-Bore Class 1 Piping Inspection aging management program is a condition monitoring program and does not include activities for preventing or mitigating aging degradation. The Hope Creek ASME Section XI ISI (Risk Informed Inservice Inspection, RI-ISI) program also does not prevent degradation due to aging effects but provides measures for monitoring to detect weld degradation after its occurrence but prior to loss of intended function. Therefore, no guidance is provided on preventive or mitigating activities.

Parameters Monitored/Inspected – Element 3

Volumetric examinations, or other approved inspection techniques will inspect 100% of all the accessible Class 1 socket welds of the recirculation system to identify degrading welds. Other selected accessible socket welds and small-bore butt welds are inspected to detect cracking caused by stress corrosion cracking, and thermal and mechanical loading. The aspects of program inspection techniques included in the Risk Informed Inservice Inspection (RI-ISI) program are based on the EPRI RI-ISI Topical Report, EPRI TR-112657, and ASME Code Case N-578-1. The elements of the RI-ISI program include the identification of risk important piping segments, the selection of the elements that are to be inspected within the risk important piping, and the identification of the appropriate inspection methods. The Hope Creek RI-ISI program requires examination of selected "high" risk and "medium" risk weld locations to detect cracking in small-bore Class 1 piping.

The inspections include locations that are susceptible to cracking. The program will include measures to verify that unacceptable cracking indications are not occurring in small-bore Class 1 piping. The program inspections detect degradation of components before loss of their intended function. This program is independent of methods to mitigate or prevent degradation.

Detection of Aging Effects – Element 4

The Hope Creek Small-Bore Class 1 Piping Inspection aging management program detects aging effects before there is a loss of the structure and component intended functions. The parameters monitored and inspected ensure the structure and component intended functions will be adequately maintained for license renewal under all CLB design conditions. The aspects of program inspection techniques are appropriate for detecting degrading welds caused by cracking due to stress corrosion, and thermal and mechanical loading. All accessible Class 1 recirculation system small-bore socket welds are inspected for degraded conditions as well as other selected small-bore socket and butt welds, as directed by the RI-ISI program requirements. The program inspection techniques are included in the RI-ISI program and are based on the EPRI RI-ISI Topical Report, EPRI TR-112657, and ASME Code Case N-578-1. For small-bore Class 1 piping, the RI-ISI program requires examination of selected "high" risk and "medium" risk weld locations to detect cracking. Volumetric examinations, or other approved inspection techniques will inspect 100% of all the accessible Class 1 socket welds of the recirculation system to identify degrading welds. Other selected accessible socket welds

and small-bore butt welds are inspected to detect cracking caused by stress corrosion cracking, and thermal and mechanical loading.

Historical small-bore piping weld failures on the reactor recirculation system provide the basis for conservatively inspecting all accessible small-bore socket welds in the recirculation system using industry standard inspection techniques.

Monitoring and Trending – Element 5

The intent of the Small-Bore Class 1 Piping Inspection aging management program is to identify conditions such as flaws or other indications that may be precursors to leaks or ruptures in a system's pressure boundary. The process for selecting inspection locations is based upon risk significant components and structures. EPRI TR-112657 and Code Case N-578-1 provide a robust selection process and inspection schedule and is founded on actual service experience with nuclear plant piping failure data. This new program will detect cracking in small-bore Class 1 piping before there is a loss of the intended function for the inspected piping.

All inspections are based on susceptibility, accessibility, dose considerations, operating experience, and limiting locations of the total population of small-bore Class 1 piping locations. The frequency of the inspections will detect cracking and age related degradation prior to loss of intended function, based on industry and plant-specific operating experience. A risk informed inspection schedule directs appropriate inspections to be performed on a timely basis and results of the inspections are evaluated in accordance with station corrective action procedures, which direct additional inspections as required. This demonstrates the program is not based solely on detecting aging degradation but evaluates corrective action items that prevent a loss of intended functions.

Acceptance Criteria – Element 6

Examinations that reveal flaws or relevant indications exceeding acceptance criteria may be acceptable by supplemental examinations, corrective measures, repair/replacement activities, or analytical evaluations in accordance with ASME Code Case N-578-1. The alternative criteria for additional examinations contained in Code Case N-578-1 provide more guidance for examination method and categorization for parts to be examined. The supplemental inspections performed on accessible recirculation system piping will be evaluated, reviewed, and dispositioned consistent with ASME Section XI code requirements.

Acceptance criteria for the inspections in this program are based on inspection criteria specified in the RI-ISI program implementation procedures. The conditional acceptance criteria ensure that the structure and component intended function are maintained under all CLB design conditions. The acceptance criteria include, but are not limited to evaluations from thickness profiles, excess surface signals, tip signal plots, to name a few. Focused transducers may be used for flaw sizing and characteristics.

Acceptance criteria for the inspections in this program are based on results meeting ASME Code Case N-578-1, Subarticle-2430 criteria. The alternative criteria for additional examinations contained in Code Case N-578-1 provide more guidance for acceptance criteria. 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 to verify the ability to perform its intended function under applicable design basis conditions, and to determine if corrective actions are required. The ability of pressure retaining component requirements and structural requirements under applicable design basis operating and environmental conditions are evaluated.

Acceptance criteria for the volumetric inspections in this program are quantitative, in that the requirement is to maintain the CLB design conditions. Visual inspections are qualitative in that they are relied upon to determine if any cracking is occurring based on the visually observable surface conditions. Indications of significant cracking or other significant degradation will require additional evaluation to quantify the material and compare it to the applicable design requirements. Visual and volumetric inspections are performed by qualified personnel in accordance with approved station procedures meeting all applicable ASME code requirements.

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 Part 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 weld degradation will be evaluated for the structure and components ability to perform its intended function under applicable design basis conditions, and to determine if corrective actions are required. The degradation is evaluated based on pressure retaining and structural requirements under applicable design basis operating and environmental conditions.

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 Small-Bore Class 1 Piping Inspection aging management program is a condition monitoring program.

The site corrective action program, quality assurance (QA) procedures, site review and approval process, and administrative controls are implemented in

accordance with the requirements of 10 CFR Part 50, Appendix B. Evaluations will be performed for inspection results that do not satisfy established criteria and a notification report will be initiated to document the concern in accordance with the 10 CFR Part 50, Appendix B corrective action program. The 10 CFR Part 50, Appendix B corrective action program address the corrective actions, confirmation process, and administrative controls and 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 preclude recurrence and review extent of condition. Continued periodic inspections will confirm the effectiveness of prior corrective actions taken.

Administrative Controls – Element 9

Administrative controls for this program are in accordance with station procedures, and include a formal review and approval process.

Administrative controls for this program are in accordance with regulatory and station procedures. The RI-ISI program requirements are maintained and controlled by the RI-ISI Program Implementation Procedure. Administrative controls for the implementation of the new supplemental inspection program have been established and will be maintained in accordance with the Hope Creek station procedure review and approval process.

Operating Experience- Element 10

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 inspection technique for small-bore Class 1 piping is appropriate 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 Small-Bore Class 1 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. Small-bore pipe cracking in the reactor recirculation loop was first observed in February 1987 on the Loop "A" discharge valve seat drain. After the condition was discovered, an investigation into the cause of the crack was performed as was an industry review to determine corrective action required to prevent a recurrence of the event. The analysis found the cause of the cracking was initiated by an original root weld imperfection which was then propagated by the recirculation pump speed induced piping vibrations. The section of the failed pipe weld was removed and replaced with a shorter piece to raise the natural resonant frequency of the piece and the issue was believed to be solved.

   Later in that year during a mid-cycle outage, cracks were observed at the flow transmitter instrument line on the outer radius of the "B" suction loop elbows. In addition, more failures were observed at the "A" loop discharge

valve bonnet and packing gland vents. The damaged vent connections were found to be caused by vibration fatigue and the corrective actions were to cut and cap the drain lines.

Following similar failures of recirculation system isolation valve seat drain assemblies and instrumentation piping in 1988, 2001, and 2005, engineering evaluations recommended the recirculation pump speeds are limited to reduce small-bore piping vibration. Additional corrective actions included detailed fatigue analyses, weld repairs, piping replacements, and the implementation of a non-destructive examination program. Together these corrective action items have prevented additional failures from occurring on the recirculation piping system since 2005.

This OE show that adverse conditions are identified and the corrective action items implemented are effective in preventing adverse conditions from occurring in the recirculation piping system.

2. In October 2001, while performing a primary containment walkdown at the beginning of the 10th refueling outage, plant personnel observed a leak on the 'A' Reactor Recirculation Pump suction pipe elbow taps. The observed leak was producing a 3-4' spray with the reactor vessel pressure at approximately 300-400 psig.

   The condition was entered into the corrective action program and a root cause evaluation was performed. The leak was located where a 1" pipe is welded to the 28" suction line of the "A" recirculation pump. After the pipe insulation was removed at the failure location, it was determined that the failure occurred at a socket weld fitting. The visible through wall crack extended for approximately 180 degrees about the circumference. The visual examination did not show any evidence of external corrosion degradation such as pitting on the base metal or weld and determined that a single circumferential through wall crack was confined to the weld. Radiographic examination indicated that there was a gap at the bottom of the socket weld fitting, as expected, in addition to showing the single through wall crack. No other significant indications were noted in the failed fillet weld.

   The Root Cause investigation found that the crack was attributed to a fatigue failure at the toe of the socket weld. The weld crack was at a location typical to promote fatigue failure in a highly susceptible system. The crack was most likely caused by the second natural frequency of the piping combined with the additional accelerometer weight, being resonant with the five-vane passing, running frequency of the "A" Recirc pump. Corrective action consisted of repair of the cracked weld using a 2 X 1 weld profile and the removal of the accelerometers on both the "A" and "B" recirculation lines. In addition, an extent of condition evaluation was performed that resulted in a walk down of all recirculation sample lines for similar conditions as well as the performance of dye-penetrant examination of all other susceptible welds.

   The effectiveness of the corrective actions was confirmed by inspections on other lines (lines originating at the outside radius of the elbow, used for flow

indication) to confirm no further cracking was occurring. Volumetric examinations were performed during refueling outages R11 and R12 with no flaws detected. A penetrant exam was performed during the R13 refueling outage, with no flaws detected. The inspection frequency has now been increased to 72 months.

This OE provides objective evidence that the walkdown and inspection programs are effective in detecting incipient cracks in the small-bore piping. It also demonstrates the effectiveness of the corrective action process in determining the cause and the development and implementation of effective corrective actions to prevent recurrence of an adverse condition.

3. Hope Creek was taken off line the weekend of March 26, 2005, to investigate the source of unidentified drywell leakage, which had been increasing over the prior few weeks. The source of the leak was determined to be a crack in a weld on a 4 inch NPS portion of the B Reactor Recirculation system decontamination assembly.

   The condition was entered into the plant corrective action program and a root cause investigation was performed. The cause of the crack was determined to be a direct result of fatigue initiation and propagation due to the configuration of the 4 inch NPS portion of the B Reactor Recirculation system decontamination connection assembly.

   Corrective action consisted of removing the cracked weld and replacing the weld. This action was completed prior to restart from the outage. Corrective action to prevent future fatigue cracking of the decontamination connections was to shorten the length of the 4 inch decontamination connection pipe to increase its natural frequency to be non-coincident with the normal recirculation pump vane passing frequencies. This was performed on both the A and B Loop decontamination connections. This action was also completed prior to restart from the outage. The extent of condition (EOC) evaluation resulted in inspections on similar piping connections in the reactor recirculation system but did not identify any additional cracking. These inspections included penetrant testing (PT), ultrasonic testing (UT), and radiographic testing (RT) exams. In addition, EOC analyses and calculation reviews did not identify other similar design vulnerabilities.

   The effectiveness of the corrective actions was confirmed through follow-up visual surface and UT inspections of the Recirc system decontamination assemblies during the following outage.

   This OE provides objective evidence that the walkdown and inspection programs are effective in detecting incipient cracks in the small-bore piping. This OE also demonstrates the effectiveness of the corrective action process in determining the cause and developing and implementing effective corrective actions to prevent recurrence of an adverse condition.

4. In May 2003 during the RF11 outage, a VT-2 inservice leak test was performed on Class 1 systems. During the inspections the following discrepancies were noted and entered into the corrective action process for

appropriate corrective action. Numerous valve packing leaks were discovered, a small through seat leak was noted on a solenoid valve, and seven leaks were identified ranging from 5 to 50 drops per minute from control rod drive flange joints. All of the above identified leaks were repaired or dispositioned appropriately utilizing the corrective action process.

Although none of the issues identified above constituted a loss or degradation of the Class 1 pressure boundary, the inspection techniques and sensitivity to reporting these types of leaks demonstrates a high level of assurance that the program provides appropriate guidance for inspections and evaluations, deficiencies are entered into the corrective action process, and appropriate action is taken as necessary to ensure effective condition monitoring of piping and components within the scope of license renewal.

The above examples provide objective evidence that existing Class 1 ISI inspections supplemented with the new Small-Bore Class 1 Piping Inspection aging management program are capable of both monitoring and detecting the aging effects of cracking.

The operating experience related to the Small-Bore Class 1 Piping Inspection 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 as required per applicable investigations. There is sufficient confidence that the implementation of the Small-Bore Class 1 Piping Inspection program will effectively identify degradation prior to failure or loss of intended function. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Small-Bore Class 1 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

None.

Conclusion

The new Small-Bore Class 1 Piping Inspection aging management program will provide reasonable assurance that the aging effects of cracking 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 NUREG-1801 Chapter X Aging Management Programs

This section provides summaries of the NUREG-1801 Chapter X programs credited for managing the effects of aging.

B.3.1.1 Metal Fatigue of Reactor Coolant Pressure Boundary

Program Description

The Metal Fatigue of Reactor Coolant Pressure Boundary Program is an existing program that manages cumulative fatigue damage in the selected reactor coolant components subject to the reactor coolant and treated water environments.

The Metal Fatigue of Reactor Coolant 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 pressure boundary 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, FatiguePro, 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.

The continued implementation of the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program provides reasonable assurance that fatigue of reactor coolant pressure boundary components will be managed so that the intended functions of the components within the scope of License Renewal will be maintained during the period of extended operation.

The preventive activities employed by the program are effective in preventing cumulative fatigue damage and are adequate to prevent significant degradation.

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: Parameters Monitored or Inspected (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: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Monitoring and Trending (Element 5) and Acceptance Criteria (Element 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: Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Monitoring and Trending (Element 5) and Acceptance Criteria (Element 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: Corrective Actions (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) would be maintained consistent with the CLB for the period of extended operation:

1. Hope Creek experienced an Emergency Core Cooling System (ECCS) actuation on May 29, 2007. As a result, there was a High Pressure Coolant Injection (HPCI) injection through the Core Spray nozzle. The corrective action program was invoked to update the fatigue usage analysis for the Core Spray nozzle. The analysis consisted of the latest information from the Metal Fatigue of Reactor Coolant Pressure Boundary program, and confirmed that the cumulative usage factor was still less than 1.00 for the Core Spray nozzle. Therefore, this example provides objective evidence that the program's confirmation process was successfully used and that the program engineer was able to verify that the design basis was maintained for a reactor pressure boundary component.

2. In October 2004, Hope Creek experienced a High Pressure Coolant Injection (HPCI) event. As a result, the actual cumulative injection cycles exceeded the number of events that was assumed in the Core Spray (CS) nozzle fatigue analysis. The HPCI event is considered an Emergency Core Cooling System (ECCS) injection event, which was not previously monitored in the program. The corrective action program was used to evaluate the condition, resulting in an analysis indicating that the cumulative usage factor was 0.815, which is less than the design limit of 1.0. Another corrective action was implemented to update the cycle counting procedure to specifically include ECCS injections to ensure future ECCS injections are counted. The extent of condition indicated that this condition was an isolated case. Therefore, this example provides objective evidence that the existing Metal Fatigue of Reactor Coolant Pressure Boundary program is capable of evaluating conditions that have exceeded original design limits to ensure that the design basis of the reactor coolant boundary is maintained, and to take corrective action to prevent a recurrence of the condition.

3. The Metal Fatigue of Reactor Coolant Pressure Boundary program tracks component cycles and transients. The program has a corrective action process where if the Ratio of Lifetime Cycles (RLC40) exceeds 1.0 for any cycle limit, a SAP Notification is generated to evaluate the condition for future actions. The 2006 annual review of plant transients indicated that the Heatup and Cooldown transients will exceed the 40-year lifetime ratio if the current trend of transients continues. The evaluation of this condition indicated that there were a large number of heatups and cooldowns early in plant life. From 1986 through 1995 there were 5 transients per year. From 1996 through 2002 the trend was down to 1.6 per year. The current trend (2003 through 2006) is 3.5 transients per year. The 40-year life limit for both categories (heatups and cooldowns) is 120 cycles, or equivalent to an average of 3 transients of each category per year. As of 12/31/2007, the cycle count for these categories is 79, thus there is adequate margin to prevent cracking due to fatigue. The corrective action for this condition is to continue to trend the transients in accordance with the program.

4. To support the TLAAs associated with metal fatigue of the reactor coolant system pressure boundary components, Hope Creek analyzed the projected cumulative usage factor, incorporating the environmental fatigue effects for the six (6) NUREG/CR-6260 locations; Reactor Vessel (CRD

penetrations), Reactor Recirculation Piping (recirculation inlet and outlet nozzles), Reactor Vessel Feedwater Nozzle (nozzle safe end and corner), Core Spray Line Reactor Vessel Nozzle and associated Class 1 Piping (nozzle safe end and corner), Feedwater Line Class 1 Piping (tee), and the RHR Class 1 Piping (RHR supply and return piping). The detailed analyses found the cumulative usage factors, with the environmental factor added, had met the acceptance criteria of < 1.0 for all locations except for the reactor pressure vessel feedwater nozzle safe end. Hope Creek will implement a computer-based program, which will continually monitor plant data and provide current stress-based and cycle-based fatigue calculations for the six NUREG/CR-6260 locations to ensure that the RCS pressure boundary design basis is maintained. Corrective action will be taken prior to exceeding the environmental assisted fatigue CUF value of 1.0. Therefore, this example provides objective evidence that the Metal Fatigue of Reactor Coolant Pressure Boundary program completed the 60-year environmental fatigue assessments required for license renewal, a computer-based program will continue to monitor the fatigue usage at the select locations and that corrective actions will be taken prior to the environmental assisted fatigue cumulative usage factors exceeding the acceptance criteria of 1.0.

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 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. 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 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.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 September 2001, the Hope Creek collected actual temperature data in the High Pressure Coolant Injection (HPCI) Room 4111 due to active steam leaks. The temperature information was provided to the EQ engineer to evaluate the impact on EQ for the HPCI pump motor. The EQ engineer concluded that the pump motor had a qualified life of 7.75 years and required a replacement on 12/24/01. The motor was replaced during the 2001 outage. This example provides objective evidence that the existing Environmental Qualification (EQ) of Electric Components program is capable of addressing changing plant conditions and re-evaluating the technical basis for EQ life, making recommendations, and including recommendations implementation.

2. As part of implementing corrective action from a Level 1 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. Hope Creek initiated an effort to re-evaluate all EQ maintenance frequencies while converting the EQ binders into an electronic format in 2007. The re-evaluation updated all of the EQ calculations, and resulted in extending the EQ maintenance of several component types, providing a significant cost savings to the company. This example provides objective evidence that the Environmental Qualification (EQ) of Electric Components program allows for improvements such as re-evaluations of components for EQ maintenance frequencies with technical justification.

There is sufficient confidence that the implementation of the Environmental Qualification (EQ) of Electric 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 Environmental Qualification (EQ) of Electrical Components 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.

APPENDIX C

RESPONSE TO BWRVIP APPLICANT ACTION ITEMS

Of the BWRVIP reports credited for Hope Creek license renewal, the following NRC safety evaluation reports (SERs) for license renewal have licensee action items:

- BWRVIP-18-A BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines
- BWRVIP-25 BWR Core Plate Inspection and Flaw Evaluation Guidelines
- BWRVIP-26-A BWR Top Guide Inspection and Flaw Evaluation Guidelines
- BWRVIP-38 BWR Shroud Support Inspection and Flaw Evaluation Guidelines
- BWRVIP-41 BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines (Revision 1)
- BWRVIP-42-A BWR LPCI Coupling Inspection and Flaw Evaluation Guidelines
- BWRVIP-47-A BWR Lower Plenum Inspection and Flaw Evaluation Guidelines
- BWRVIP-48-A BWR Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines
- BWRVIP-49-A BWR Instrument Penetration Inspection and Flaw Evaluation Guidelines
- BWRVIP-74-A BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines

License renewal applicant action items (AAIs) identified in the corresponding SERs for each of the above BWRVIP reports are addressed in the following tables. BWRVIP-76 is not included because the SER has not yet been issued. BWRVIP-27-A is not included because the Hope Creek Standby Liquid Control system does not inject through the Core DP penetration. BWRVIP reports without SERs for license renewal have no AAIs and are therefore not included in the tables.

It is recognized that the first three AAIs from each of the license renewal SERs applicable to the above BWRVIP reports are fundamentally identical. For that reason they are combined in the table and addressed together.

Action Item Description	HCGS Response
Common Action Items from BWRVIP-18-A, -25, -26-A, -38, -41, 42-A, -47A, -48-A, -49-A, -74-A	
BWRVIP-All (1) The license renewal applicant is to verify that its plant is bounded by the report. Further, the renewal applicant is to commit to programs described as necessary in the BWRVIP reports to manage the effects of aging during the period of extended operation. Applicants for license renewal will be responsible for describing any such commitments and identifying how such commitments will be controlled. Any deviations from the aging management programs within these BWRVIP reports described as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the components or other information presented in the report, such as materials of construction, will have to be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1).	The BWRVIP reports applicable to Hope Creek have been reviewed and verified that Hope Creek is bounded by the reports. Additionally, Hope Creek commits to programs described as necessary in the BWRVIP reports to manage the effects of aging during the period of extended operations. If, upon review of a BWRVIP approved guideline, it is determined that known exceptions to full compliance are warranted, the NRC will be notified of the exception within 45 days of the receipt of NRC final approval of the guideline. Commitments are administratively controlled in accordance with the requirements of 10 CFR 50, Appendix B
BWRVIP-All (2) 10 CFR 54.21(d) requires that an FSAR supplement for the facility contains 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 applicable BWRVIP report shall ensure that the programs and activities specified as necessary in the applicable BWRVIP reports are summarily described in the FSAR supplement.	The FSAR supplements for Hope Creek are included as Appendix A of the LRA and include a summary of the programs and activities specified as necessary for the BWRVIP program.

Action Item Description	HCGS Response
BWRVIP-All (3) 10 CFR 54.22 requires that each application for license renewal include any technical specification changes (and the justification for the changes) or additions necessary to manage the effects of aging during the period of extended operation as part of the renewal application. The applicable BWRVIP reports may state that there are no generic changes or additions to technical specifications associated with the report as a result of its aging management review and that the applicant will provide the justification for plant-specific changes or additions. Those applicants for license renewal referencing the applicable BWRVIP report shall ensure that the inspection strategy described in the reports does not conflict with or result in any changes to their technical specifications. If technical specification changes or additions do result, then the applicant must ensure that those changes are included in its application for license renewal.	There are no technical specification changes identified for Hope Creek based upon the BWRVIP reports.
Additional Action Items	
BWRVIP-18-A Core Spray Internals Inspection and Flaw Evaluation Guidelines	
BWRVIP-18 (4) Applicants referencing the BWRVIP-18 report for license renewal should identify and evaluate any potential TLAA issues which may impact the structural integrity of the subject RPV internal components.	There were no TLAA issues identified for the Hope Creek internal core spray components.

BWRVIP-25 Core Plate Inspection and Flaw Evaluation Guidelines	
BWRVIP-25 (4) Due to susceptibility of the rim hold-down bolts to stress relaxation, applicants referencing the BWRVIP-25 report for license renewal should identify and evaluate the projected stress relaxation as a potential TLAA issue.	Preload of the rim hold-down bolts is required to prevent lateral motion of the core plate for those plants that do not have core plate wedges installed. While a generic study reported in Appendix B of BWRVIP-25 states that the Hope Creek core plate rim hold down bolts will retain at least 81% of their preload, a plant specific analysis is required to determine the amount of preload necessary to prevent core plate motion throughout the period of extended operation. To address this issue, a plant-specific fluence analysis was performed to determine fluence values at the core plate rim hold down bolt locations at various EFPY values up to 56 EFPY. A plant-specific structural analysis was then performed using the new fluence values and it determined that the pre-load of the rim hold down bolts would be sufficient to prevent lateral motion of the core plate until the plant reaches 43.9 EFPY, which will occur after entry into the period of extended operation. Since this analysis will not bound 56 EFPY (60 years), additional actions are required. Prior to the period of extended operation, the plant will install core plate wedges or perform an analysis to demonstrate the component function is maintained.
BWRVIP-25 (5) Until such time as an expanded technical basis for not inspecting the rim hold-down bolts is approved by the staff, applicants referencing the BWRVIP-25 report for license renewal should continue to perform inspections of the rim hold-down bolts.	Hope Creek inspection operating experience associated with the core plate rim hold-down bolts is described in Section B.2.1.9 of the application. Until such time as an expanded technical basis for not inspecting the rim hold-down bolts is approved by the NRC, Hope Creek will continue to perform inspections of the rim hold-down bolts, unless core plate wedges are installed.

BWRVIP-26-A Top Guide Inspection and Flaw Evaluation Guidelines	
BWRVIP-26 (4) Due to IASCC susceptibility of the subject safety-related components, applicants referencing the BWRVIP-26 report for license renewal should identify and evaluate the projected accumulated neutron fluence as a potential TLAA issue.	Hope Creek has determined that the neutron fluence threshold for IASCC susceptibility has been exceeded. No TLAA has been identified. During the period of extended operation, the aging of the top guide will be managed by inspections conducted as part of the Hope Creek BWR Vessel Internals program. The Hope Creek BWR Vessel Internals program now requires that at least 10% of the grid beam cells containing control rod drives/blades will be inspected every twelve years with at least one-half of the inspections being performed within the first six years of each twelve-year interval. The top guide locations to be inspected are those subject to neutron fluence levels that exceed the IASCC threshold of 5.0E+20 n/cm2. The inspections are performed using the enhanced visual inspection technique, EVT-1. Hope Creek will continue to perform inspections on at least 10% of the top guide locations every twelve years during the period of extended operation.
BWRVIP-42-A BWR LPCI Coupling Inspection and Flaw Evaluation Guidelines.	
BWRVIP-42 (4) Applicants referencing the BWRVIP-42 report for license renewal should identify and valuate any potential TLAA issues which may impact the structural integrity of the subject RPV internal components	There is no TLAA identified for the LPCI coupling.
BWRVIP-42 (5) The BWRVIP committed to address development of the technology to inspect inaccessible welds and to have the individual LR applicant notify the NRC of actions planned. Applicants referencing BWRVIP-42 report for license renewal should identify the action as open and to be addressed once the BWRVIP's response to this issue has been reviewed and accepted by the staff.	Hope Creek inspects the LPCI coupling in accordance with guidelines described in BWRVIP-42-A, except for one inaccessible location. HCGS recognizes the inspection of inaccessible welds is a generic open action. HCGS will address this issue once the BWRVIP's response to this issue has been reviewed and accepted by the NRC.
BWRVIP-47-A, BWR Lower Plenum Inspection and Flaw Evaluation Guidelines	
BWRVIP-47 (4) Due to fatigue of the subject safety-related components, applicants referencing the BWRVIP-47 report for LR should identify and evaluate the projected CUF as a potential TLAA issue.	Fatigue usage is considered a TLAA for lower plenum components. This is addressed in Section 4.3.1 of the LRA.

BWRVIP-74-A , BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines	
BWRVIP-74-A (4) The staff is concerned that leakage around the reactor vessel seal rings could accumulate in the VFLD lines, cause an increase in the concentration of contaminants and cause cracking in the VFLD line. The BWRVIP-74 report does not identify this component as within the scope of the report. However, since the VFLD line is attached to the RPV and provides a pressure boundary function, LR applicants should identify an AMP for the VFLD line.	The Hope Creek vessel flange leak detection line (VFLD) is included in the scope of scope of license renewal. Aging of the vessel flange leak detection line is managed by the Water Chemistry and One-Time Inspection programs.
BWRVIP-74-A (5) LR applicants shall describe how each plant-specific aging management program addresses the following elements: (1) scope of program, (2) preventative actions, (3) parameters monitored and inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, (7) corrective actions, (8) confirmation process, (9) administrative controls, and (10) operating experience.	There is no plant-specific aging management program credited for managing aging of the Hope Creek reactor vessel. Descriptions of the Hope Creek aging management programs credited for managing the reactor pressure vessel are described in Appendix B. These descriptions include any program element that deviates from the NUREG-1801 program element.
BWRVIP-74-A (6) The staff believes inspection by itself is not sufficient to manage cracking. Cracking can be managed by a program that includes inspection and water chemistry. BWRVIP-29 describes a water chemistry program that contains monitoring and control guidelines for BWR water that is acceptable to the staff. BWRVIP-29 is not discussed in the BWRVIP-74 report. Therefore, in addition to the previously discussed BWRVIP reports, LR applicants shall contain water chemistry programs based on monitoring and control guidelines for reactor water chemistry that are contained in BWRVIP-29.	As discussed in Appendix B, the Hope Creek Water Chemistry Control program meets the requirements of the latest BWRVIP Water Chemistry guidelines (BWRVIP-130) to help ensure the long-term integrity of the reactor vessel and internals. As described in the Water Chemistry program, BWRVIP-130 replaced BWRVIP-29 as the BWR water chemistry standard. Revisions later than BWRVIP-29 are permitted by Chapter XI.M2 of NUREG-1801. Several aging management programs credit the Water Chemistry program to mitigate cracking of reactor vessel components, including the BWR Stress Corrosion Cracking Program and the BWR Internals program.
BWRVIP-74-A (7) LR applicants shall identify their vessel surveillance program, which is either an ISP or plant-specific-in-vessel surveillance program, applicable to the LR term.	As described in Appendix B, the Reactor Vessel Surveillance program for Hope Creek is an Integrated Surveillance Program (ISP) for the license renewal term.

BWRVIP-74-A (8) LR applicants should verify that the number of cycles assumed in the original fatigue design is conservative to assure that the estimated fatigue usage for 60 years of plant operation is not underestimated. The use of alternative actions for cases where the estimated fatigue usage is projected to exceed 1.0 will require case-by-case staff review and approval. Further, a LR applicant must address environmental fatigue for the components listed in the BWRVIP-74 report for the LR period.	Metal fatigue (including discussions of cycles, projected cumulative usage factors, environmental factors, etc.) is evaluated as a TLAA in Chapter 4.3 of the LRA. Environmental fatigue for those components described in NUREG/CR-6260 is addressed in Section 4.3 of the LRA.
BWRVIP-74-A (9) Appendix A to the BWRVIP-74 report indicates that a set of P-T curves should be developed for the heat-up and cool-down operating conditions in the plant at a given EFPY in the LR period.	The development of P-T limit curves for Hope Creek for the period of extended period of operation is described as a TLAA in Section 4.2 of the LRA.
BWRVIP-74-A (10) To demonstrate that the beltline materials meet the Charpy USE criteria specified in Appendix B of the report, the applicant shall demonstrate that the percent reduction in Charpy USE for their beltline materials are less than those specified for the limiting BWR/3-6 plates and the non-Linde 80 submerged arc welds and that the percent reduction in Charpy USE for their surveillance weld and plate are less than or equal to the values projected using the methodology in RG 1.99, Revision 2.	The discussion of Charpy upper shelf energy (USE) evaluation for Hope Creek for the LR period is described as a TLAA in Section 4.2 of the LRA.
BWRVIP-74-A (11) To obtain relief from the in-service inspection of the circumferential welds during the LR period, the BWRVIP report indicates each licensee will have to demonstrate that (1) at the end of the renewal period, the circumferential welds will satisfy the limiting conditional failure frequency for circumferential welds in the Appendix E for the staff's July 28, 1998, SER, and (2) that they have implemented operator training and established procedures that limit the frequency of cold overpressure events to the amount specified in the staff's FSER.	The discussion of the relief from the in-service inspection of the circumferential welds for Hope Creek for the LR period is described in Section 4.2 of the LRA.
BWRVIP-74-A (12) As indicated in the staff's March 7, 2000, letter to Carl Terry, a LR applicant shall monitor axial beltline weld embrittlement. One acceptable method is to determine that the mean RT_{NDT} of the limiting axial beltline weld at the end of the period of extended operation is less than the values specified in Table 1 of this FSER.	The unit-specific axial weld probability of failure calculated for Hope Creek is less than the failure probabilities calculated by the NRC staff. Refer to the discussion of the Reactor Pressure Vessel Axial Weld Failure Probability TLAA in Section 4.2 of the LRA.

BWRVIP-74-A (13) The Charpy USE, P-T limit, circumferential weld and axial weld RPV integrity evaluations are all dependent upon the neutron fluence. The applicant may perform neutron fluence calculations using staff approved methodology or may submit the methodology for staff review. If the applicant performs the neutron fluence calculation using a methodology previously approved by the staff, the applicant should identify the NRC letter that approved the methodology.	Hope Creek used an NRC approved methodology to determine fluence for the period of extended operation, as discussed in Section 4.2 of the LRA.
BWRVIP-74-A (14) Components that have indications that have been previously analytically evaluated in accordance with sub-section IWB-3600 of Section XI to the ASME Code until the end of the 40-year service period shall be re-evaluated for the 60-year service period corresponding to the LR term.	Hope Creek has not performed flaw evaluations for found indications in accordance with subsection IWB-3600 of ASME Section XI for the 40-year life of the plant. Therefore there are no indications that require re-evaluation for the period of extended operation.

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APPENDIX D Technical Specification Changes

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