United States Nuclear Regulatory Commission Official Hearing Exhibit
In the Matter of: Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3)
ASLBP #: 07-858-03-LR-BD01
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NYS00147B
Submitted: December 15, 2011

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A1 Reactor Vessel (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A1.RP-157	IV.A1-8(RP-25)	Reactor Vessel: flanges; nozzles; penetrations; safe ends; vessel shells, heads and welds	Steel (with stainless steel or nickel-alloy cladding); stainless steel; nickel alloy	Reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No
IV.A1.RP-50	IV.A1-11(R-59)	Top head enclosure (without cladding): top head; nozzles (vent, top head spray or RCIC, and spare)	Steel	Reactor coolant	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No
IV.A1.RP-51	IV.A1-9(R-60)	Top head enclosure: closure studs and nuts	High-strength, low-alloy steel	Air with reactor coolant leakage	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M3, "Reactor Head Closure Stud Bolting"	No
IV.A1.RP-201		Top head enclosure: closure studs and nuts	High-strength, low-alloy steel	Air with reactor coolant leakage	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A1 Reactor Vessel (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A1.RP-165		Top head enclosure: closure studs and nuts	High-strength, low-alloy steel	Air with reactor coolant leakage	Loss of material due to general, pitting, and crevice corrosion, or wear	Chapter XI.M3, “Reactor Head Closure Stud Bolting”	No
IV.A1.R-61	IV.A1-10(R-61)	Top head enclosure: vessel flange leak detection line	Stainless steel; nickel alloy	Air with reactor coolant leakage (Internal); or reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line	Yes, plant-specific
IV.A1.RP-227	IV.A1-14(R-63)	Vessel shell (including applicable beltline) components: shell; shell plates or forgings; shell welds; nozzle plates or forgings; nozzle welds	Steel (with or without cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	Yes, plant specific or integrated surveillance program
IV.A1.R-64	IV.A1-12(R-64)	Vessel shell: attachment welds	Stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M4, “BWR Vessel ID Attachment Welds,” and Chapter XI.M2, “Water Chemistry”	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A1	Reactor Vessel (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A1.R-62	IV.A1-13(R-62)	Vessel shell: intermediate beltline shell; beltline welds	Steel (with or without stainless steel cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Neutron irradiation embrittlement is a time-dependent aging mechanism evaluated for extended operation for all ferritic materials that have a neutron fluence >1E17 n/cm^2 (E >1 MeV) at the end of the period of extended operation. Aspects may involve a TLAA. In accordance with approved BWRVIP-74, the TLAA evaluates the impact of neutron embrittlement on: (a) adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, (b) need for inservice inspection of circumferential welds, and (c) Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. Additionally, the applicant is to monitor axial beltline weld embrittlement. One acceptable method is to determine that the mean RTNDT of the axial beltline welds at the end of the extended period of operation is less than the value specified by the staff in its March 7, 2000 letter (ADAMS ML031430372). See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA

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A2. REACTOR VESSEL (PRESSURIZED WATER REACTOR)

Systems, Structures, and Components

This section addresses the pressurized water reactor (PWR) vessel pressure boundary and consists of the vessel shell and flanges, the top closure head and bottom head, the control rod drive (CRD) mechanism housings, nozzles (including safe ends) for reactor coolant inlet and outlet lines and safety injection, and penetrations through either the closure head or bottom head domes for instrumentation and leakage monitoring tubes. Attachments to the vessel such as core support pads, as well as pressure vessel support and attachment welds, are also included in the table. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all systems, structures, and components that comprise the reactor coolant system are governed by Group A Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the PWR reactor vessel include the reactor vessel internals (IV.B2, IV.B3, and IV.B4, respectively, for Westinghouse, Combustion Engineering, and Babcock and Wilcox designs), the reactor coolant system and connected lines (IV.C2), and the emergency core cooling system (V.D1).

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A2 Reactor Vessel (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A2.RP-154	IV.A2-1(RP-13)	Bottom-mounted instrument guide tube (external to bottom head)	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	A plant-specific aging management program is to be evaluated	Yes, plant-specific
IV.A2.RP-52	IV.A2-2(R-71)	Closure head: stud assembly	High-strength, low-alloy steel	Air with reactor coolant leakage	Cracking due to stress corrosion cracking	Chapter XI.M3, “Reactor Head Closure Stud Bolting”	No
IV.A2.RP-54	IV.A2-4(R-73)	Closure head: stud assembly	High-strength, low-alloy steel	Air with reactor coolant leakage	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.A2.RP-53	IV.A2-3(R-72)	Closure head: stud assembly	High-strength, low-alloy steel	Air with reactor coolant leakage	Loss of material due to general, pitting, and crevice corrosion, or wear	Chapter XI.M3, “Reactor Head Closure Stud Bolting”	No
IV.A2.R-74	IV.A2-5(R-74)	Closure head: vessel flange leak detection line	Stainless steel	Air with reactor coolant leakage (Internal); or reactor coolant	Cracking due to stress corrosion cracking	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line	Yes, plant-specific
IV.A2.R-80	IV.A2-8(R-80)	Control rod drive head penetration: Flange bolting	Stainless steel	Air (with reactor coolant leakage)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A2	Reactor Vessel (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A2.R-78	IV.A2-6(R-78)	Control rod drive head penetration: flange bolting	Stainless steel	Air with reactor coolant leakage	Cracking due to stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No
IV.A2.R-79	IV.A2-7(R-79)	Control rod drive head penetration: flange bolting	Stainless steel	Air with reactor coolant leakage	Loss of material due to wear	Chapter XI.M18, "Bolting Integrity"	No
IV.A2.RP-186	IV.A2-9(R-75)	Control rod drive head penetration: nozzle welds	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.A2.R-77	IV.A2-10(R-77)	Control rod drive head penetration: pressure housing	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
IV.A2.RP-55	IV.A2-11(R-76)	Control rod drive head penetration: pressure housing	Stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No

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IV A2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Vessel (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.A2.RP-57	IV.A2-12(R-88)	Core support pads; core guide lugs	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.A2.R-17	IV.A2-13(R-17)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
IV.A2.RP-379	IV.A2-13(R-17)	External surfaces: reactor vessel top head and bottom head	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion," and Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.A2.RP-28	IV.A2-14(RP-28)	Flanges; nozzles; penetrations; pressure housings; safe ends; vessel shells, heads welds	Steel (with stainless steel or nickel-alloy cladding); stainless steel; nickel alloy	Reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A2 Reactor Vessel (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A2.RP-234	IV.A2-15(R-83)	Nozzle safe ends and welds: inlet; outlet; safety injection	Stainless steel; nickel alloy welds and/or buttering	Reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)" for nickel alloy components	No
IV.A2.RP-228	IV.A2-17(R-82)	Nozzles: inlet; outlet; safety injection	Steel (with or without cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	Yes, plant specific or integrated surveillance program

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A2 Reactor Vessel (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A2.R-81	IV.A2-16(R-81)	Nozzles: inlet; outlet; safety injection	Steel (with stainless steel or nickel-alloy cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Neutron irradiation embrittlement is a TLAA evaluated for extended operation for all ferritic materials with a neutron fluence greater than 1E17 n/cm^2 (E >1 MeV) at the end of the period of extended operation. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RTPTS value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. The applicant may choose to demonstrate that the materials in the inlet, outlet, and safety injection nozzles are not controlling for the TLAA evaluations.	Yes, TLAA
IV.A2.R-90	IV.A2-18(R-90)	Penetrations: head vent pipe (top head); instrument tubes (top head)	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," and Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No

IV A2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Vessel (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.A2.RP-59	IV.A2-19(R-89)	Penetrations: instrument tubes (bottom head)	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," and Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.A2.R-70	IV.A2-20(R-70)	Pressure vessel support skirt and attachment welds	Steel	Air – indoor, uncontrolled	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.A2.R-219	IV.A2-21(R-219)	Reactor vessel components: flanges; nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads and welds	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
A2 Reactor Vessel (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.A2.R-85	IV.A2-22(R-85)	Vessel shell: upper shell; intermediate shell; lower shell (including beltline welds)	SA508-Cl 2 forgings clad (with stainless steel) using a high-heat-input welding process	Reactor coolant	Crack growth due to cyclic loading	Growth of intergranular separations (underclad cracks) in low-alloy steel forging heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating an underclad flaw is in accordance with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. See the Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis,” for generic guidance for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
IV.A2.RP-229	IV.A2-24(R-86)	Vessel shell: upper shell; intermediate shell; lower shell (including beltline welds)	Steel (with or without cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	Yes, plant specific or integrated surveillance program

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IV A2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Vessel (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.A2.R-84	IV.A2-23(R-84)	Vessel shell: upper shell; intermediate shell; lower shell (including beltline welds)	Steel (with stainless steel or nickel-alloy cladding)	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Neutron irradiation embrittlement is a TLAA evaluated for extended operation for all ferritic materials with a neutron fluence greater than 1E17 n/cm^2 (E >1 MeV) at the end of the period of extended operation. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RTPTS value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
IV.A2.R-87	IV.A2-25(R-87)	Vessel shell: vessel flange	Steel	Reactor coolant	Loss of material due to wear	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components	No

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B1. REACTOR VESSEL INTERNALS (BOILING WATER REACTOR)

Systems, Structures, and Components

This section addresses the boiling water reactor (BWR) vessel internals and consists of the core shroud (including repairs) and core plate, the top guide, feedwater spargers, core spray lines and spargers, jet pump assemblies, fuel supports and control rod drive (CRD), and instrument housings, such as the intermediate range monitor (IRM) dry tubes, the low power range monitor (LPRM) dry tubes, and the source range monitor (SRM) dry tubes. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all structures and components that comprise the reactor vessel are governed by Group A or B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor vessel internals include the reactor pressure vessel (IV.A1) and the reactor coolant pressure boundary (IV.C1).

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1 Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.R-92	IV.B1-1(R-92)	Core shroud (including repairs) and core plate: core shroud (upper, central, lower)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for core shroud, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.R-96	IV.B1-2(R-96)	Core shroud (including repairs) and core plate: shroud support structure (shroud support cylinder, shroud support plate, shroud support legs)	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for shroud support, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.R-95	IV.B1-4(R-95)	Core shroud and core plate: access hole cover (mechanical)	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1	Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.R-94	IV.B1-5(R-94)	Core shroud and core plate: access hole cover (welded)	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry" Because cracking initiated in crevice regions is not amenable to visual inspection, for BWRs with a crevice in the access hole covers, an augmented inspection is to include ultrasonic testing (UT) or other demonstrated acceptable inspection of cover welds.	No
IV.B1.R-93	IV.B1-6(R-93)	Core shroud and core plate: core plate and plate bolts (used in early BWRs)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, "BWR Vessel Internals" for core plate, and Chapter XI.M2, "Water Chemistry"	No
IV.B1.R-97	IV.B1-3(R-97)	Core shroud and core plate: LPCI coupling	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, "BWR Vessel Internals" for the LPCI coupling, and Chapter XI.M2, "Water Chemistry"	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1	Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.R-99	IV.B1-7(R-99)	Core spray lines and spargers: core spray lines (headers); spray rings; spray nozzles; thermal sleeves	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for core spray internals, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.R-104	IV.B1-8(R-104)	Fuel supports and control rod drive assemblies: control rod drive housing	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for lower plenum, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.RP-220	IV.B1-9(R-103)	Fuel supports and control rod drive assemblies: orificed fuel support	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F) and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	Chapter XI.M9, "BWR Vessel Internals"	No
IV.B1.R-105	IV.B1-10(R-105)	Instrumentation: Intermediate range monitor (IRM) dry tubes; source range monitor (SRM) dry tubes; incore neutron flux monitor guide tubes	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for lower plenum, and Chapter XI.M2, “Water Chemistry”	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1	Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.RP-219	IV.B1-11(R-101)	Jet pump assemblies: castings	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F) and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	Chapter XI.M9, "BWR Vessel Internals"	No
IV.B1.R-100	IV.B1-13(R-100)	Jet pump assemblies: thermal sleeve; inlet header; riser brace arm; holddown beams; inlet elbow; mixing assembly; diffuser castings	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for jet pump assembly, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.R-53	IV.B1-14(R-53)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1 Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.RP-182		Reactor vessel internals components	PH martensitic stainless steel (17-4PH and 15-5PH); martensitic stainless steel (SS 403, 410, 431, etc.)	Reactor coolant >250°C (>482°F) and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	Chapter XI.M9, "BWR Vessel Internals"	No
IV.B1.RP-26	IV.B1-15(RP-26)	Reactor vessel internals components	Stainless steel; nickel alloy	Reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.RP-381		Reactor vessel internals components	X-750 alloy	Reactor coolant and neutron flux	Cracking due to intergranular stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for core plate, and Chapter XI.M2, “Water Chemistry”	No
IV.B1.RP-200		Reactor vessel internals components	X-750 alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M9, "BWR Vessel Internals"	No
IV.B1.RP-377		Reactor vessel internals components: Jet pump wedge surface	Stainless steel	Reactor coolant	Loss of material due to wear	Chapter XI.M9, "BWR Vessel Internals"	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B1 Reactor Vessel Internals (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B1.RP-155	IV.B1-16(RP-18)	Steam dryers	Stainless steel	Reactor coolant	Cracking due to flow-induced vibration	Chapter XI.M9, "BWR Vessel Internals" for steam dryer	No
IV.B1.R-98	IV.B1-17(R-98)	Top guide	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals” for top guide, and Chapter XI.M2, “Water Chemistry”	No

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B2. REACTOR VESSEL INTERNALS (PWR) - WESTINGHOUSE

Systems, Structures, and Components

This section addresses the Westinghouse pressurized water reactor (PWR) vessel internals and consists of the upper internals assembly, the control rod guide tube assemblies, the core barrel, the baffle/former assembly, the lower internal assembly, and the instrumentation support structures. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all structures and components that comprise the reactor vessel are governed by Group A or B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor vessel internals include the reactor pressure vessel (IV.A2).

Inspection Plan

An applicant will submit an inspection plan for reactor internals to the NRC for review and approval with the application for license renewal in accordance with Chapter XI.M16A, "PWR Vessel Internals."

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-300	IV.B2-33(R-108)	Alignment and interfacing components: internals hold down spring	Stainless steel	Reactor coolant and neutron flux	Loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-301	IV.B2-40(R-112)	Alignment and interfacing components: upper core plate alignment pins	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-299	IV.B2-34(R-115)	Alignment and interfacing components: upper core plate alignment pins	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-271	IV.B2-10(R-125)	Baffle-to-former assembly: accessible baffle-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B2.RP-273 and IV.B2.RP-286)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-272	IV.B2-6(R-128)	Baffle-to-former assembly: accessible baffle-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B2.RP-274 and IV.B2.RP-287)	No
IV.B2.RP-270	IV.B2-1(R-124)	Baffle-to-former assembly: baffle and former plates	Stainless steel	Reactor coolant and neutron flux	Change in dimension due to void swelling	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-275	IV.B2-6(R-128)	Baffle-to-former assembly: baffle-edge bolts (all plants with baffle-edge bolts)	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-354		Baffle-to-former assembly: baffle-edge bolts (all plants with baffle-edge bolts)	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-273	IV.B2-10(R-125)	Baffle-to-former assembly: barrel-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-271)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-274	IV.B2-6(R-128)	Baffle-to-former assembly: barrel-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-272)	No
IV.B2.RP-284	IV.B2-12(R-143)	Bottom mounted instrument system: flux thimble tubes	Stainless steel (with or without chrome plating)	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) No expansion components; and Chapter XI.M37, "Flux Thimble Tube Inspection"	No
IV.B2.RP-293	IV.B2-24(R-138)	Bottom-mounted instrumentation system: bottom-mounted instrumentation (BMI) column bodies	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-298)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-292	IV.B2-21(R-140)	Bottom-mounted instrumentation system: bottom-mounted instrumentation (BMI) column bodies	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-297)	No
IV.B2.RP-296		Control rod guide tube (CRGT) assemblies: CRGT guide plates (cards)	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Primary Components (identified in the "Structure and Components" column) (for Expansion components see AMR Line Item IV.B2.RP-386)	No
IV.B2.RP-298	IV.B2-28(R-118)	Control rod guide tube (CRGT) assemblies: CRGT lower flange welds (accessible)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B2.RP-291 and IV.B2.RP-293)	No
IV.B2.RP-297		Control rod guide tube (CRGT) assemblies: CRGT lower flange welds (accessible)	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B2.RP-290 and IV.B2.RP-292)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-386		Control rod guide tube (CRGT) assemblies: C-tubes and sheaths	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) are only the components associated with a primary component that exceeded the acceptance limit. (for Primary components see AMR Item IV.B2.RP-296)	No
IV.B2.RP-355		Control rod guide tube assemblies: guide tube support pins	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	A plant-specific aging management program is to be evaluated	Yes, plant-specific
IV.B2.RP-356		Control rod guide tube assemblies: guide tube support pins	Nickel alloy	Reactor coolant and neutron flux	Loss of material due to wear	A plant-specific aging management program is to be evaluated	Yes, plant-specific
IV.B2.RP-387		Core barrel assembly: core barrel axial welds	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-388		Core barrel assembly: core barrel axial welds	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-282	IV.B2-8(R-120)	Core barrel assembly: core barrel flange	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-345		Core barrel assembly: core barrel flange	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-278	IV.B2-8(R-120)	Core barrel assembly: core barrel outlet nozzle welds	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion component (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-280	IV.B2-8(R-120)	Core barrel assembly: lower core barrel flange weld	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion component (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-281	IV.B2-9(R-122)	Core barrel assembly: lower core barrel flange weld	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion Components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-276	IV.B2-8(R-120)	Core barrel assembly: upper core barrel flange weld	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B2.RP-278, IV.B2.RP-280, IV.B2.RP-282, IV.B2.RP-294, IV.B2.RP-295,IV.B2.RP-281, IV.B2.RP-387, and IV.B2.RP-388)	No
IV.B2.RP-285	IV.B2-14(R-137)	Lower internals assembly: clevis insert bolts	Nickel alloy	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-289	IV.B2-20(R-130)	Lower internals assembly: lower core plate and extra-long (XL) lower core plate	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking, and fatigue	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-288	IV.B2-18(R-132)	Lower internals assembly: lower core plate and extra-long (XL) lower core plate	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B2.RP-291	IV.B2-24(R-138)	Lower support assembly: lower support column bodies (cast)	Cast austenitic stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-298)	No
IV.B2.RP-290	IV.B2-21(R-140)	Lower support assembly: lower support column bodies (cast)	Cast austenitic stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-297)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-294	IV.B2-24(R-138)	Lower support assembly: lower support column bodies (non-cast)	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-295	IV.B2-22(R-141)	Lower support assembly: lower support column bodies (non-cast)	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion Components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-276)	No
IV.B2.RP-286	IV.B2-16(R-133)	Lower support assembly: lower support column bolts	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-271)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-287	IV.B2-17(R-135)	Lower support assembly: lower support column bolts	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, “PWR Vessel Internals” Expansion component (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B2.RP-272)	No
IV.B2.RP-303	IV.B2-31(R-53)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B2.RP-24	IV.B2-32(RP-24)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
IV.B2.RP-268		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-269		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management
IV.B2.RP-265		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identified in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-267		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identified in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No
IV.B2.RP-382	IV.B2-26(R-142)	Reactor vessel internals: core support structure	Stainless steel; nickel alloy; cast austenitic stainless steel	Reactor coolant and neutron flux	Cracking, or Loss of material due to wear	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”	No
IV.B2.RP-302		Thermal shield assembly: thermal shield flexures	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B2 Reactor Vessel Internals (PWR) - Westinghouse

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B2.RP-346		Upper internals assembly: upper support ring or skirt	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No

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B3. REACTOR VESSEL INTERNALS (PWR) - COMBUSTION ENGINEERING

Systems, Structures, and Components

This section addresses the Combustion Engineering pressurized water reactor (PWR) vessel internals and consists of the upper internals assembly, the control element assembly (CEA) shrouds, the core support barrel, the core shroud assembly, and the lower internal assembly. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all structures and components that comprise the reactor vessel are governed by Group A or B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor vessel internals include the reactor pressure vessel (IV.A2).

Inspection Plan

An applicant will submit an inspection plan for reactor internals to the NRC for review and approval with the application for license renewal in accordance with Chapter XI.M16A, "PWR Vessel Internals."

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-312	IV.B3-2(R-149)	Control Element Assembly (CEA): shroud assemblies: instrument guide tubes in peripheral CEA assemblies	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B3.RP-313)	No
IV.B3.RP-313		Control Element Assembly (CEA): shroud assemblies: remaining instrument guide tubes in CEA assemblies	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, "Water Chemistry," and Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-312)	No
IV.B3.RP-320	IV.B3-9(R-162)	Core shroud assemblies (all plants): guide lugs and guide lug insert bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-319	IV.B3-9(R-162)	Core shroud assemblies (all plants): guide lugs and guide lug insert bolts	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear; Loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, "PWR Vessel Internals" Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-358		Core shroud assemblies (for bolted core shroud assemblies): (a) shroud plates and (b) former plates	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary component see AMR Item IV.B3.RP-314)	No
IV.B3.RP-318	IV.B3-8(R-163)	Core shroud assemblies (for bolted core shroud assemblies): (a) shroud plates and (b) former plates	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling	Chapter XI.M16A, "PWR Vessel Internals" Primary components (identified in the "Structure and Components" column) no Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-316	IV.B3-9(R-162)	Core shroud assemblies (for bolted core shroud assemblies): barrel-shroud bolts with neutron exposures greater than 3 dpa	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-314)	No
IV.B3.RP-317	IV.B3-7(R-165)	Core shroud assemblies (for bolted core shroud assemblies): barrel-shroud bolts with neutron exposures greater than 3 dpa	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of preload due to thermal and irradiation enhanced stress relaxation; loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-315)	No
IV.B3.RP-314	IV.B3-9(R-162)	Core shroud assemblies (for bolted core shroud assemblies): core shroud bolts (accessible)	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B3.RP-316, IV.B3.RP-330, and IV.B3.RP-358)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-315	IV.B3-7(R-165)	Core shroud assemblies (for bolted core shroud assemblies): core shroud bolts (accessible)	Stainless steel	Reactor coolant and neutron flux	Loss of preload due to thermal and irradiation enhanced stress relaxation; loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling	Chapter XI.M16A, “PWR Vessel Internals,” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B3.RP-317, and IV.B3.RP-331)	No
IV.B3.RP-359		Core shroud assemblies (welded): (shroud plates and (b) former plates	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling	Chapter XI.M16A, “PWR Vessel Internals,” Primary components (identified in the "Structure and Components" column) no Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-322		Core shroud assembly (for welded core shrouds in two vertical sections): Core shroud plate-former plate weld (a) The axial and horizontal weld seams at the core shroud re-entrant corners as visible from the core side of the shroud, within six inches of the central flange and horizontal stiffeners, and (b) the horizontal stiffeners in shroud plate-to-former plate weld	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B3.RP-323)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-326		Core shroud assembly (for welded core shrouds in two vertical sections): gap between the upper and lower plates	Stainless steel	Reactor coolant and neutron flux	Change in dimension due to void swelling	Chapter XI.M16A, "PWR Vessel Internals" Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-323		Core shroud assembly (for welded core shrouds in two vertical sections): remaining axial welds in shroud plate-to-former plate	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-322)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-324		Core shroud assembly (for welded core shrouds with full-height shroud plates): axial weld seams at the core shroud re-entrant corners, at the core mid-plane (+3 feet in height) as visible from the core side of the shroud	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B3.RP-325)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-360		Core shroud assembly (for welded core shrouds with full-height shroud plates): axial weld seams at the core shroud re-entrant corners, at the core mid-plane (+3 feet in height) as visible from the core side of the shroud	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B3.RP-361)	No
IV.B3.RP-325		Core shroud assembly (for welded core shrouds with full-height shroud plates): remaining axial welds, ribs, and rings	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-324)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-361		Core shroud assembly (for welded core shrouds with full-height shroud plates): remaining axial welds, ribs, and rings	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-360)	No
IV.B3.RP-362		Core support barrel assembly: lower cylinder welds	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-327)	No
IV.B3.RP-329	IV.B3-15(R-155)	Core support barrel assembly: lower cylinder welds and remaining core barrel assembly welds	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-327)	No
IV.B3.RP-333		Core support barrel assembly: lower flange weld, if fatigue life cannot be demonstrated by TLAA	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	Yes, evaluate to determine the potential locations and extent of fatigue cracking

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-389		Core support barrel assembly: lower flange weld (if fatigue analysis exists)	Stainless steel	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B3.RP-328	IV.B3-15(R-155)	Core support barrel assembly: surfaces of the lower core barrel flange weld (accessible surfaces)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-332	IV.B3-17(R-156)	Core support barrel assembly: upper core barrel flange	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-327	IV.B3-15(R-155)	Core support barrel assembly: upper core support barrel flange weld (accessible surfaces)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B3.RP-329, IV.B3.RP-335, IV.B3.RP-362, IV.B3.RP-363, IV.B3.RP-364)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-357		Incore instrumentation (ICI): ICI thimble tubes - lower	Zircaloy-4	Reactor coolant and neutron flux	Loss of material due to wear	A plant-specific aging management program is to be evaluated	Yes, plant-specific
IV.B3.RP-336	IV.B3-22(R-170)	Lower support structure: A286 fuel alignment pins (all plants with core shroud assembled in two vertical sections)	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear; loss of fracture toughness due to neutron irradiation embrittlement; loss of preload due to thermal and irradiation enhanced stress relaxation	Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-334	IV.B3-23(R-167)	Lower support structure: A286 fuel alignment pins (all plants with core shroud assembled with full-height shroud plates)	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Existing Program components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-364		Lower support structure: core support column	Cast austenitic stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation and thermal embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3RP-327)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-363		Lower support structure: core support column	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3RP-327)	No
IV.B3.RP-330	IV.B3-23(R-167)	Lower support structure: core support column bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item 'IV.B3.RP-314)	No
IV.B3.RP-331		Lower support structure: core support column bolts	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item 'IV.B3.RP-315)	No
IV.B3.RP-335	IV.B3-23(R-167)	Lower support structure: core support column welds, applicable to all plants except those assembled with full-height shroud plates	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B3.RP-327)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-365		Lower support structure: core support plate	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Primary component (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-343		Lower support structure: core support plate (applicable to plants with a core support plate), if fatigue life cannot be demonstrated by TLAA	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	Chapter XI.M2, “Water Chemistry”, and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	Yes, evaluate to determine the potential locations and extent of fatigue cracking
IV.B3.RP-390		Lower support structure: core support plate (applicable to plants with a core support plate), if fatigue analysis exists	Stainless steel	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B3.RP-342		Lower support structure: deep beams (applicable assemblies with full height shroud plates)	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, and fatigue	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-366		Lower support structure: deep beams (applicable assemblies with full height shroud plates)	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	No
IV.B3.RP-339	IV.B3-24(R-53)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B3.RP-24	IV.B3-25(RP-24)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
IV.B3.RP-309		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-311		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management
IV.B3.RP-306		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identified in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-307		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identified in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No
IV.B3.RP-382	IV.B3-22(R-170)	Reactor vessel internals: core support structure	Stainless steel; nickel alloy; cast austenitic stainless steel	Reactor coolant and neutron flux	Cracking, or Loss of material due to wear	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B3 Reactor Vessel Internals (PWR) - Combustion Engineering

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B3.RP-338		Upper internals assembly: fuel alignment plate (applicable to plants with core shrouds assembled with full height shroud plates), if fatigue life cannot be demonstrated by TLAA	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) no Expansion components	Yes, evaluate to determine the potential locations and extent of fatigue cracking
IV.B3.RP-391		Upper internals assembly: fuel alignment plate (applicable to plants with core shrouds assembled with full height shroud plates), if fatigue analysis exists	Stainless steel	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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B4. REACTOR VESSEL INTERNALS (PWR) - BABCOCK AND WILCOX

Systems, Structures, and Components

This section addresses the Babcock and Wilcox pressurized water reactor (PWR) vessel internals and consists of the plenum cover and plenum cylinder, the upper grid assembly, the control rod guide tube (CRGT) assembly, the core support shield assembly, the core barrel assembly, the lower grid assembly, and the flow distributor assembly. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all structures and components that comprise the reactor vessel are governed by Group A or B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor vessel internals include the reactor pressure vessel (IV.A2).

Inspection Plan

An applicant will submit an inspection plan for reactor internals to the NRC for review and approval with the application for license renewal in accordance with Chapter XI.M16A, "PWR Vessel Internals."

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4	Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-242	IV.B4-4(R-183)	Control rod guide tube (CRGT) assembly: accessible surfaces at four screw locations (every 90 degrees) for CRGT spacer castings	Cast austenitic stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Items IV.B4.RP-253 and IV.B4.RP-258)	No
IV.B4.RP-245	IV.B4-13(R-194)	Core barrel assembly: (a) upper thermal shield bolts; (b) surveillance specimen holder tube bolts (Davis-Besse, only); (c) surveillance specimen tube holder studs, and nuts (Crystal River Unit 3, only)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Items IV.B4.RP-247 and IV.B4.RP-248)	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4	Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-247	IV.B4-13(R-194)	Core barrel assembly: accessible lower core barrel (LCB) bolts and locking devices	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B4.RP-245, IV.B4.RP-246, IV.B4.RP-254, and IV.B4.RP-256)	No
IV.B4.RP-249	IV.B4-12(R-196)	Core barrel assembly: baffle plate accessible surfaces within one inch around each baffle plate flow and bolt hole	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B4.RP-250)	No
IV.B4.RP-241	IV.B4-7(R-125)	Core barrel assembly: baffle/former assembly: (a) accessible baffle-to-former bolts and screws; (b) accessible locking devices (including welds) of baffle-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary Components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B4.RP-244 and IV.B4.RP-375)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-240	IV.B4-1(R-128)	Core barrel assembly: baffle/former assembly: (a) accessible baffle-to-former bolts and screws; (b) accessible locking devices (including welds) of baffle-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, "PWR Vessel Internals." Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B4.RP-243.)	No
IV.B4.RP-250	IV.B4-12(R-196)	Core barrel assembly: core barrel cylinder (including vertical and circumferential seam welds); former plates	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-249)	No
IV.B4.RP-375		Core barrel assembly: internal baffle-to-baffle bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to fatigue	Chapter XI.M2, "Water Chemistry," and Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-241)	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-244	IV.B4-7(R-125)	Core barrel assembly; (a) external baffle-to-baffle bolts; (b) core barrel-to-former bolts; (c) locking devices (including welds) of external baffle-to-baffle bolts and core barrel-to-former bolts	Stainless steel	Reactor coolant and neutron flux	Cracking due to irradiation-assisted stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-241)	No
IV.B4.RP-243	IV.B4-1(R-128)	Core barrel assembly; (a) external baffle-to-baffle bolts; (b) core barrel-to-former bolts; (c) locking devices (including welds) of external baffle-to-baffle bolts and core barrel-to-former bolts; (d) internal baffle-to-baffle bolts	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, "PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-240)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-248	IV.B4-12(R-196)	Core support shield (CSS) assembly: accessible upper core barrel (UCB) bolts and locking devices	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B4.RP-245, IV.B4.RP-246, IV.B4.RP-254, IV.B4.RP-247, and IV.B4.RP-256)	No
IV.B4.RP-253	IV.B4-21(R-191)	Core support shield (CSS) assembly: (a) CSS cast outlet nozzles (Oconee Unit 3 and Davis-Besse, only); (b) CSS vent valve discs	Cast austenitic stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Item IV.B4.RP-242)	No
IV.B4.RP-252	IV.B4-16(R-188)	Core support shield (CSS) assembly: (a) CSS vent valve disc shaft or hinge pin (b) CSS vent valve top retaining ring (c) CSS vent valve bottom retaining ring	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) No Expansion components	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-251	IV.B4-15(R-190)	Core support shield (CSS) assembly: CSS top flange; plenum cover assembly: plenum cover weldment rib pads and plenum cover support flange	Stainless steel	Reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Primary component (identified in the "Structure and Components" column) No Expansion components	No
IV.B4.RP-256	IV.B4-25(R-210)	Flow distributor assembly: flow distributor bolts and locking devices	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals,” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Items IV.B4.RP-247 and IV.B4.RP-248)	No
IV.B4.RP-259	IV.B4-31(R-205)	Incore Monitoring Instrumentation (IMI) guide tube assembly: accessible top surfaces of IMI guide tube spider-to-lower grid rib sections welds	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see Item IV.B4.RP-260)	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4	Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-258	IV.B4-4(R-183)	Incore Monitoring Instrumentation (IMI) guide tube assembly: accessible top surfaces of IMI Incore guide tube spider castings	Cast austenitic stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see Item IV.B4.RP-242)	No
IV.B4.RP-254	IV.B4-25(R-210)	Lower grid assembly: alloy X-750 lower grid shock pad bolts and locking devices (TMI-1, only)	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals,” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Items IV.B4.RP-247 and IV.B4.RP-248)	No
IV.B4.RP-246	IV.B4-12(R-196)	Lower grid assembly: lower thermal shield (LTS) bolts	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	'Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Items IV.B4.RP-247 and IV.B4.RP-248)	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-260	IV.B4-31(R-205)	Lower grid assembly: (a) accessible pads; (b) accessible pad-to-rib section welds; (c) accessible alloy X-750 dowels, cap screws and locking devices	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M16A, “PWR Vessel Internals" Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-259)	No
IV.B4.RP-262	IV.B4-32(R-203)	Lower grid assembly: accessible alloy X-750 dowel-to-lower fuel assembly support pad welds	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-261)	No
IV.B4.RP-261	IV.B4-32(R-203)	Lower grid assembly: alloy X-750 dowel-to-guide block welds	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Primary components (identified in the "Structure and Components" column) (for Expansion components see AMR Items IV.B4.RP-262 and IV.B4.RP-352)	No

IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4	Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.R-53	IV.B4-37(R-53)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B4.RP-24	IV.B4-38(RP-24)	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
IV.B4.RP-376		Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Reduction in ductility and fracture toughness due to neutron irradiation	Ductility - Reduction in Fracture Toughness is a TLAA (BAW-2248A) to be evaluated for the period of extended operation. See the SRP, Section 4.7, "Other Plant-Specific TLAAs," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.B4.RP-238		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-239		Reactor vessel internal components (inaccessible locations)	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management
IV.B4.RP-236		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M2, “Water Chemistry” and Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identifies in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No

IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
B4 Reactor Vessel Internals (PWR) – Babcock & Wilcox

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.B4.RP-237		Reactor vessel internal components with no additional measures	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; change in dimension due to void swelling; loss of preload due to thermal and irradiation enhanced stress relaxation; loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals” Note: Components with no additional measures are not uniquely identified in GALL tables - Components with no additional measures are defined in Section 3.3.1 of MRP-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines"	No
IV.B4.RP-382	IV.B4-42(R-179)	Reactor vessel internals: core support structure	Stainless steel; nickel alloy; cast austenitic stainless steel	Reactor coolant and neutron flux	Cracking, or Loss of material due to wear	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”	No
IV.B4.RP-352		Upper grid assembly: alloy X-750 dowel-to-upper fuel assembly support pad welds (all plants except Davis-Besse)	Nickel alloy	Reactor coolant and neutron flux	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M16A, “PWR Vessel Internals” Expansion components (identified in the "Structure and Components" column) (for Primary components see AMR Item IV.B4.RP-261)	No

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C1. REACTOR COOLANT PRESSURE BOUNDARY (BOILING WATER REACTOR)

Systems, Structures, and Components

This section addresses the boiling water reactor (BWR) primary coolant pressure boundary and consists of the reactor coolant recirculation system and portions of other systems connected to the pressure vessel extending to the second containment isolation valve or to the first anchor point outside containment. The connected systems include the residual heat removal (RHR), low–pressure core spray (LPCS), high–pressure core spray (HPCS), low–pressure coolant injection (LPCI), high–pressure coolant injection (HPCI), reactor core isolation cooling (RCIC), isolation condenser (IC), reactor water cleanup (RWC), standby liquid control (SLC), feedwater (FW), and main steam (MS) systems; and the steam line to the HPCI and RCIC pump turbines. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all systems, structures, and components that comprise the reactor coolant pressure boundary are governed by Group A Quality Standards.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration, or are subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor coolant pressure boundary include the reactor pressure vessel (IV.A1), the emergency core cooling system (V.D2), the standby liquid control system (VII.E2), the reactor water cleanup system (VII.E3), the shutdown cooling system (older plants) (VII.E4), the main steam system (VIII.B2), and the feedwater system (VIII.D2).

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C1 Reactor Coolant Pressure Boundary (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C1.RP-230	IV.C1-1(R-03)	Class 1 piping, fittings and branch connections < NPS 4	Steel; stainless steel	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal, mechanical, and vibratory loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, Chapter XI.M2, “Water Chemistry,” and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	No
IV.C1.R-52	IV.C1-2(R-52)	Class 1 piping, piping components, and piping elements	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
IV.C1.R-08	IV.C1-3(R-08)	Class 1 pump casings; valve bodies and bonnets	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies.	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C1 Reactor Coolant Pressure Boundary (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C1.RP-43	IV.C1-10(R-27)	Closure bolting	Steel; stainless steel	Air	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
IV.C1.RP-42	IV.C1-12(R-26)	Closure bolting	Steel; stainless steel	Air with reactor coolant leakage	Loss of material due to general (steel only), pitting, and crevice corrosion or wear	Chapter XI.M18, "Bolting Integrity"	No
IV.C1.R-15	IV.C1-4(R-15)	Isolation condenser components	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry” The AMP in Chapter XI.M1 is to be augmented to detect cracking due to stress corrosion cracking and verification of the program's effectiveness is necessary to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. An acceptable verification program includes temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes, detection of aging effects is to be evaluated

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C1	Reactor Coolant Pressure Boundary (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C1.R-225	IV.C1-5(R-225)	Isolation condenser components	Steel; stainless steel	Reactor coolant	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components The AMP in Chapter XI.M1 is to be augmented to detect cracking due to cyclic loading and verification of the program's effectiveness is necessary to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. An acceptable verification program includes temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes, detection of aging effects is to be evaluated
IV.C1.RP-39	IV.C1-6(R-16)	Isolation condenser components	Steel; stainless steel	Reactor coolant	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and Chapter XI.M2, "Water Chemistry"	No
IV.C1.R-23	IV.C1-7(R-23)	Piping, piping components, and piping elements	Steel	Reactor coolant	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No
IV.C1.R-21	IV.C1-8(R-21)	Piping, piping components, and piping elements greater than or equal to 4 NPS	Nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry"	No

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IV C1	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant Pressure Boundary (BWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C1.R-20	IV.C1-9(R-20)	Piping, piping components, and piping elements greater than or equal to 4 NPS	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry”	No
IV.C1.RP-44	IV.C1-11(R-28)	Pump and valve closure bolting	Steel; stainless steel	System temperature up to 288°C (550°F)	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation; check ASME Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. (SRP Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA
IV.C1.RP-158	IV.C1-14(RP-27)	Reactor coolant pressure boundary components	Steel (with stainless steel or nickel-alloy cladding); stainless steel; nickel alloy	Reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
IV.C1.R-220	IV.C1-15(R-220)	Reactor coolant pressure boundary components: piping, piping components, and piping elements	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA

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C2. REACTOR COOLANT SYSTEM AND CONNECTED LINES (PRESSURIZED WATER REACTOR)

Systems, Structures, and Components

This section addresses the pressurized water reactor (PWR) primary coolant pressure boundary and consists of the reactor coolant system and portions of other connected systems generally extending up to and including the second containment isolation valve or to the first anchor point and including the containment isolation valves, the reactor coolant pump, valves, pressurizer, and the pressurizer relief tank. The connected systems include the residual heat removal (RHR) or low pressure injection system, high pressure injection system, sampling system, and the small-bore piping. With respect to other systems such as the core flood system (CFS) or the safety injection tank (SIT) and the chemical and volume control system (CVCS), the isolation valves associated with the boundary between ASME Code class 1 and 2 are located inside the containment. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and with the exception of the pressurizer relief tank, which is governed by Group B Quality Standards, all systems, structures, and components that comprise the reactor coolant system are governed by Group A Quality Standards. The recirculating pump seal water heat exchanger is discussed in V.D1.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration, or are subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the reactor coolant pressure boundary include the reactor pressure vessel (IV.A2), the steam generators (IV.D1 and IV.D2), the emergency core cooling system (V.D1), and the chemical and volume control system (VII.E1).

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IV C2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant System and Connected Lines (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C2.RP-235	IV.C2-1(R-02)	Class 1 piping, fittings and branch connections < NPS 4	Stainless steel; steel with stainless steel cladding	Reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal, mechanical, and vibratory loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, Chapter XI.M2, “Water Chemistry,” and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	No
IV.C2.R-05	IV.C2-3(R-05)	Class 1 piping, piping components, and piping elements	Cast austenitic stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Monitoring and control of primary water chemistry in accordance with EPRI 1014986 minimize the potential for SCC. Material selection according to NUREG-0313, Rev. 2, guidelines of ≤0.035% C and ≥7.5% ferrite reduces susceptibility to SCC. For CASS components that do not meet either one of the above, a plant-specific aging management program is evaluated The program is to include (a) adequate inspection methods to ensure detection of cracks, and (b) flaw evaluation methodology for CASS components that are susceptible to thermal aging embrittlement.	Yes, plant-specific

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IV C2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant System and Connected Lines (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C2.R-52	IV.C2-4(R-52)	Class 1 piping, piping components, and piping elements	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
IV.C2.RP-344	IV.C2-2(R-07)	Class 1 piping, piping components, and piping elements	Stainless steel; steel with stainless steel cladding	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.C2.R-09	IV.C2-5(R-09)	Class 1 pump casings; valve bodies	Steel (with stainless steel cladding); stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.C2.R-08	IV.C2-6(R-08)	Class 1 pump casings; valve bodies and bonnets	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies.	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C2	Reactor Coolant System and Connected Lines (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C2.R-11	IV.C2-7(R-11)	Closure bolting	High-strength, low-alloy steel; stainless steel	Air with reactor coolant leakage	Cracking due to stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No
IV.C2.R-12	IV.C2-8(R-12)	Closure bolting	Low-alloy steel, stainless steel	Air (with reactor coolant leakage)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
IV.C2.RP-166		Closure bolting	Steel	Air – indoor, uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No
IV.C2.RP-167		Closure bolting	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
IV.C2.R-17	IV.C2-9(R-17)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
IV.C2.RP-380	IV.C2-9(R-17)	External surfaces: reactor coolant pressure boundary piping or components adjacent to dissimilar metal (Alloy 82/182) welds	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion," and Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C2 Reactor Coolant System and Connected Lines (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C2.R-18	IV.C2-10(R-18)	Piping and components (External surfaces); bolting	Steel; stainless steel	System temperature up to 340°C (644°F)	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.C2.RP-222	IV.C2-11(RP-11)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
IV.C2.RP-12	IV.C2-12(RP-12)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
IV.C2.RP-159	IV.C2-13(RP-31)	Piping, piping components, and piping elements	Nickel alloy	Reactor coolant or steam	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.C2.RP-221	IV.C2-14(RP-10)	Piping, piping components, and piping elements	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

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IV C2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant System and Connected Lines (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C2.RP-23	IV.C2-15(RP-23)	Piping, piping components, and piping elements; flanges; heater sheaths and sleeves; penetrations; thermal sleeves; vessel shell heads and welds	Steel (with stainless steel or nickel-alloy cladding); stainless steel; nickel alloy	Reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
IV.C2.R-58	IV.C2-18(R-58)	Pressurizer components	Steel (with stainless steel or nickel-alloy cladding); stainless steel	Reactor coolant	Cracking due to cyclic loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry” Cracks in the pressurizer cladding could propagate from cyclic loading into the ferrite base metal and weld metal. However, because the weld metal between the surge nozzle and the vessel lower head is subjected to the maximum stress cycles and the area is periodically inspected as part of the ISI program, the existing AMP is adequate for managing the effect of pressurizer clad cracking.	No

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IV C2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant System and Connected Lines (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C2.R-25	IV.C2-19(R-25)	Pressurizer components	Steel (with stainless steel or nickel-alloy cladding); stainless steel	Reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.C2.R-217	IV.C2-20(R-217)	Pressurizer heater sheaths and sleeves; heater bundle diaphragm plate	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.C2.RP-37	IV.C2-21(R-06)	Pressurizer instrumentation penetrations; heater sheaths and sleeves; heater bundle diaphragm plate; manways and flanges	Nickel alloy; nickel-alloy cladding	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.C2.RP-231	IV.C2-22(R-14)	Pressurizer relief tank: tank shell and heads; flanges; nozzles	Stainless steel; steel with stainless steel cladding	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for ASME Code components, and Chapter XI.M2, “Water Chemistry”	No

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C2	Reactor Coolant System and Connected Lines (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C2.R-13	IV.C2-23(R-13)	Pressurizer relief tank: tank shell and heads; flanges; nozzles	Steel (with stainless steel or nickel-alloy cladding)	Treated borated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.C2.RP-383		Pressurizer relief tank: tank shell and heads; flanges; nozzles (non-ASME Section XI components)	Stainless steel; steel with stainless steel cladding	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
IV.C2.RP-156	IV.C2-24(RP-22)	Pressurizer surge and steam space nozzles; welds	Nickel alloy	Reactor coolant or steam	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.C2.R-19	IV.C2-16(R-19)	Pressurizer: integral support	Steel; stainless steel	Air with metal temperature up to 288°C (550°F)	Cracking due to cyclic loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components	No

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IV C2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Reactor Coolant System and Connected Lines (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.C2.RP-40	IV.C2-17(R-24)	Pressurizer: spray head	Nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No
IV.C2.RP-41	IV.C2-17(R-24)	Pressurizer: spray head	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No
IV.C2.R-223	IV.C2-25(R-223)	Reactor coolant pressure boundary components: piping, piping components, and piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; thermal sleeves	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
C2 Reactor Coolant System and Connected Lines (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.C2.R-56	IV.C2-26(R-56)	Reactor coolant system piping and fittings: cold leg; hot leg; surge line; spray line	Steel (with stainless steel cladding); stainless steel	Reactor coolant	Cracking due to cyclic loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components	No
IV.C2.R-30	IV.C2-27(R-30)	Reactor coolant system piping and fittings: cold leg; hot leg; surge line; spray line	Steel (with stainless steel cladding); stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No

D1. STEAM GENERATOR (RECIRCULATING)

Systems, Structures, and Components

This section addresses the recirculating-type steam generators, as found in Westinghouse and Combustion Engineering pressurized water reactors (PWRs), including all internal components and water/steam nozzles and safe ends. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the primary water side (tube side) of the steam generator is governed by Group A Quality Standards, and the secondary water side is governed by Group B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the steam generators include the reactor coolant system and connected lines (IV.C2), the containment isolation components (V.C), the main steam system (VIII.B1), the feedwater system (VIII.D1), the steam generator blowdown system (VIII.F), and the auxiliary feedwater system (VIII.G).

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IV D1	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Recirculating)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D1.R-10	IV.D1-2(R-10)	Closure bolting	Steel	Air with reactor coolant leakage	Cracking due to stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No
IV.D1.RP-46	IV.D1-10(R-32)	Closure bolting	Steel; stainless steel	Air – indoor, uncontrolled (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
IV.D1.R-17	IV.D1-3(R-17)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
IV.D1.RP-36	IV.D1-4(R-01)	Instrument penetrations and primary side nozzles; safe ends; welds	Steel (with nickel-alloy cladding); nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.D1.R-37	IV.D1-5(R-37)	Pressure boundary and structural: steam nozzle and safe end; feedwater nozzle and safe end	Steel	Secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
D1 Steam Generator (Recirculating)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.D1.RP-17	IV.D1-7(RP-17)	Primary side components: divider plate	Stainless steel	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-367	IV.D1-6(RP-21)	Primary side components: divider plate	Steel (with nickel-alloy cladding); nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry” For nickel alloy divider plate assemblies and associated welds made of Alloy 600, effectiveness of the chemistry control program should be verified to ensure that cracking due to PWSCC is not occurring.	Yes, detection of aging effects is to be evaluated
IV.D1.R-221	IV.D1-8(R-221)	Recirculating steam generator components: flanges; penetrations; nozzles; safe ends; lower heads and welds	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA
IV.D1.RP-372		Steam generator components: shell assembly	Steel	Secondary feedwater or steam	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry” and Chapter XI.M32, “One-Time Inspection”	No

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IV D1	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Recirculating)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D1.R-33	IV.D1-11(R-33)	Steam generator components: top head; steam nozzle and safe end; upper and lower shell; feedwater (FW) and auxiliary FW nozzle and safe end; FW impingement plate and support	Steel	Secondary feedwater or steam	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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IV	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
D1	Steam Generator (Recirculating)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.D1.RP-368	IV.D1-12(R-34)	Steam generator components: upper and lower shell; transition cone; new transition cone closure weld	Steel	Secondary feedwater or steam	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 2 components, and Chapter XI.M2, "Water Chemistry" As noted in NRC IN 90-04, if general and pitting corrosion of the shell exists, Chapter XI.M1 methods may not be sufficient to detect general and pitting corrosion (and the resulting corrosion-fatigue cracking), and additional inspection procedures are to be developed. This issue is limited to Westinghouse Model 44 and 51 Steam Generators where a high stress region exists at the shell to transition cone weld. The new transition is only applicable to replacement recirculating steam generators.	Yes, detection of aging effects is to be evaluated
IV.D1.R-39	IV.D1-13(R-39)	Steam generator feedwater impingement plate and support	Steel	Secondary feedwater	Loss of material due to erosion	A plant-specific aging management program is to be evaluated	Yes, plant-specific
IV.D1.RP-48	IV.D1-16(R-41)	Steam generator structural: tube support lattice bars	Steel	Secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion and general corrosion	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
D1 Steam Generator (Recirculating)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.D1.R-42	IV.D1-17(R-42)	Steam generator structural: tube support plates	Steel	Secondary feedwater or steam	Ligament cracking due to corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-384	IV.D1-14(RP-14)	Steam generator structural: U-bend supports including anti-vibration bars	Steel; chrome plated steel; stainless steel; nickel alloy	Secondary feedwater or steam	Cracking due to stress corrosion cracking or other mechanism(s)	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-225	IV.D1-15(RP-15)	Steam generator structural: U-bend supports including anti-vibration bars	Steel; chrome plated steel; stainless steel; nickel alloy	Secondary feedwater or steam	Loss of material due to fretting	Chapter XI.M19, “Steam Generators”	No
IV.D1.RP-226	IV.D1-15(RP-15)	Steam generator structural: U-bend supports including anti-vibration bars	Steel; chrome plated steel; stainless steel; nickel alloy	Secondary feedwater or steam	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-232	IV.D1-1(R-07)	Steam generator: primary nozzles; nozzle to safe end welds; manways; flanges	Stainless steel; steel with stainless steel cladding	Reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No

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IV D1	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Recirculating)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D1.RP-161	IV.D1-9(RP-16)	Steam generator: Tube bundle wrapper and associated supports and mounting hardware	Steel	Secondary feedwater or steam	Loss of material due to erosion, general, pitting, and crevice corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.R-40	IV.D1-18(R-40)	Tube plugs	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.R-43	IV.D1-19(R-43)	Tubes	Nickel alloy	Secondary feedwater or steam	Changes in dimension ("denting") due to corrosion of carbon steel tube support plate	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.R-44	IV.D1-20(R-44)	Tubes and sleeves	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.R-46	IV.D1-21(R-46)	Tubes and sleeves	Nickel alloy	Reactor coolant and secondary feedwater/steam	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
D1 Steam Generator (Recirculating)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.D1.R-48	IV.D1-22(R-48)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Cracking due to intergranular attack	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.R-47	IV.D1-23(R-47)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Cracking due to outer diameter stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-233	IV.D1-24(R-49)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Loss of material due to fretting and wear	Chapter XI.M19, “Steam Generators”	No
IV.D1.R-50	IV.D1-25(R-50)	Tubes and sleeves (exposed to phosphate chemistry)	Nickel alloy	Secondary feedwater or steam	Loss of material due to wastage and pitting corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D1.RP-385		Tube-to-tube sheet welds	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry” A plant-specific program is to be evaluated; the effectiveness of the water chemistry program should be verified to ensure cracking is not occurring.	Yes, plant-specific.
IV.D1.RP-49	IV.D1-26(R-51)	Upper assembly and separators including: feedwater inlet ring and support	Steel	Secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No

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D2. STEAM GENERATOR (ONCE-THROUGH)

Systems, Structures, and Components

This section addresses the once-through type steam generators, as found in Babcock & Wilcox pressurized water reactors (PWRs), including all internal components and water/steam nozzles and safe ends. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the primary water side (tube side) of the steam generator is governed by Group A Quality Standards, and the secondary water side is governed by Group B Quality Standards.

Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in IV.E.

System Interfaces

The systems that interface with the steam generators include the reactor coolant system and connected lines (IV.C2), the main steam system (VIII.B1), the feedwater system (VIII.D1), the steam generator blowdown system (VIII.F), and the auxiliary feedwater system (VIII.G).

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IV D2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Once-Through)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D2.RP-46	IV.D2-6(R-32)	Closure bolting	Steel; stainless steel	Air – indoor, uncontrolled (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
IV.D2.R-17	IV.D2-1(R-17)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
IV.D2.RP-36	IV.D2-2(R-01)	Instrument penetrations and primary side nozzles; safe ends; welds	Steel (with nickel-alloy cladding); nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” and Chapter XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No
IV.D2.R-222	IV.D2-3(R-222)	Once-through steam generator components: primary side nozzles, safe ends, and welds	Steel (with or without nickel-alloy or stainless steel cladding); stainless steel; nickel alloy	Reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA

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IV REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM
D2 Steam Generator (Once-Through)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
IV.D2.RP-47	IV.D2-4(R-35)	Primary side components: upper and lower heads, and tube sheet welds exposed to reactor coolant	Steel (with stainless steel or nickel-alloy cladding)	Reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry”	No
IV.D2.R-31	IV.D2-5(R-31)	Secondary manway covers; handhole covers	Steel	Air with leaking secondary-side water and/or steam	Loss of material due to erosion	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 2 components	No
IV.D2.R-36	IV.D2-9(R-36)	Steam generator components: secondary side nozzles (vent, drain, and instrumentation)	Nickel alloy	Secondary feedwater or steam	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection," or Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD.”	No
IV.D2.R-38	IV.D2-7(R-38)	Steam generator components: feedwater (FW) and auxiliary FW nozzles and safe ends; steam nozzles and safe ends	Steel	Secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No
IV.D2.RP-153	IV.D2-8(R-224)	Steam generator components: shell assembly	Steel	Secondary feedwater or steam	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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IV D2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Once-Through)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D2.R-33	IV.D2-10(R-33)	Steam generator components: top head; steam nozzle and safe end; upper and lower shell; feedwater (FW) and auxiliary FW nozzle and safe end; FW impingement plate and support	Steel	Secondary feedwater or steam	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.D2.R-42	IV.D2-11(R-42)	Steam generator structural: tube support plates	Steel	Secondary feedwater or steam	Ligament cracking due to corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.RP-162		Steam generator: tube bundle wrapper and associated supports and mounting hardware	Steel	Secondary feedwater or steam	Loss of material due to erosion, general, pitting, and crevice corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.R-40	IV.D2-12(R-40)	Tube plugs	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No

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IV D2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Once-Through)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D2.R-226	IV.D2-13(R-226)	Tubes	Nickel alloy	Secondary feedwater or steam	Changes in dimension ("denting") due to corrosion of carbon steel tube support plate	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.R-44	IV.D2-14(R-44)	Tubes and sleeves	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.R-46	IV.D2-15(R-46)	Tubes and sleeves	Nickel alloy	Reactor coolant and secondary feedwater/steam	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
IV.D2.R-48	IV.D2-16(R-48)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Cracking due to intergranular attack	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.R-47	IV.D2-17(R-47)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Cracking due to outer diameter stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No
IV.D2.RP-233	IV.D2-18(R-49)	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Loss of material due to fretting and wear	Chapter XI.M19, “Steam Generators”	No

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IV D2	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Steam Generator (Once-Through)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.D2.RP-185	IV.D2-4(R-35)	Tube-to-tube sheet welds	Nickel alloy	Reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry” A plant-specific program is to be evaluated; the effectiveness of the water chemistry program should be verified to ensure cracking is not occurring	Yes, plant-specific

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E. COMMON MISCELLANEOUS MATERIAL/ENVIRONMENT COMBINATIONS

Systems, Structures, and Components

This section addresses the aging management programs for miscellaneous material/environment combinations which may be found throughout the reactor vessel, internals and reactor coolant system's structures and components. For the material/environment combinations in this part, aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation, therefore, no resulting aging management programs for these structures and components are required.

System Interfaces

The structures and components covered in this section belong to the engineered safety features in PWRs and BWRs. (For example, see System Interfaces in V.A to V.D2 for details.)

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IV E	REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM Common Miscellaneous Material Environment Combinations						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
IV.E.RP-03	IV.E-1(RP-03)	Piping, piping components, and piping elements	Nickel alloy	Air – indoor, uncontrolled (External)	None	None	No
IV.E.RP-378		Piping, piping components, and piping elements	Nickel alloy	Air with borated water leakage	None	None	No
IV.E.RP-04	IV.E-2(RP-04)	Piping, piping components, and piping elements	Stainless steel	Air – indoor, uncontrolled (External)	None	None	No
IV.E.RP-05	IV.E-3(RP-05)	Piping, piping components, and piping elements	Stainless steel	Air with borated water leakage	None	None	No
IV.E.RP-06	IV.E-4(RP-06)	Piping, piping components, and piping elements	Stainless steel	Concrete	None	None	No
IV.E.RP-07	IV.E-5(RP-07)	Piping, piping components, and piping elements	Stainless steel	Gas	None	None	No
IV.E.RP-353	IV.E-6(RP-01)	Piping, piping components, and piping elements	Steel	Concrete	None	None, provided: 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.

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CHAPTER V

ENGINEERED SAFETY FEATURES

OAGI0001390_00285

MAJOR PLANT SECTIONS

A. Containment Spray System (Pressurized Water Reactors)

B. Standby Gas Treatment System (Boiling Water Reactors)

C. Containment Isolation Components

D1. Emergency Core Cooling System (Pressurized Water Reactors)

D2. Emergency Core Cooling System (Boiling Water Reactors)

E. External Surfaces of Components and Miscellaneous Bolting

F. Common Miscellaneous Material/Environment Combinations

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A. CONTAINMENT SPRAY SYSTEM (PRESSURIZED WATER REACTORS)

Systems, Structures, and Components

This section addresses the containment spray system for pressurized water reactors (PWRs) designed to lower the pressure, temperature, and gaseous radioactivity (iodine) content of the containment atmosphere following a design basis event. Spray systems using chemically treated borated water are reviewed. The system consists of piping and valves, including containment isolation valves, flow elements, orifices, pumps, spray nozzles, eductors, and the containment spray system heat exchanger (for some plants).

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the containment spray system outside or inside the containment are governed by Group B Quality Standards.

Pumps and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in V.E. Common miscellaneous material/environment combinations, where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation, are included in V.F.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the containment spray system are the PWR emergency core cooling (V.D1), and open- or closed-cycle cooling water systems (VII.C1 or VII.C2).

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V ENGINEERED SAFETY FEATURES
A Containment Spray System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.A.E-26	V.A-1(E-26)	Ducting, piping, and components (External surfaces)	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.A.EP-42	V.A-2(EP-42)	Encapsulation components	Steel	Air – indoor, uncontrolled (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.A.EP-43	V.A-3(EP-43)	Encapsulation components	Steel	Air with borated water leakage (Internal)	Loss of material due to general, pitting, crevice, and boric acid corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.A.E-28	V.A-4(E-28)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.A.EP-94	V.A-5(EP-13)	Heat exchanger components	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-37	V.A-6(EP-37)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.A.EP-93	V.A-7(E-19)	Heat exchanger components	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-91	V.A-8(E-20)	Heat exchanger components	Stainless steel	Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V ENGINEERED SAFETY FEATURES
A Containment Spray System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.A.EP-92	V.A-9(E-17)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-90	V.A-10(E-18)	Heat exchanger components	Steel	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.A.EP-100	V.A-11(EP-39)	Heat exchanger tubes	Copper alloy	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-78	V.A-12(EP-47)	Heat exchanger tubes	Copper alloy	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.A.EP-96	V.A-13(EP-35)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-79	V.A-14(EP-50)	Heat exchanger tubes	Stainless steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.A.E-21	V.A-15(E-21)	Heat exchanger tubes	Stainless steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V ENGINEERED SAFETY FEATURES
A Containment Spray System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.A.EP-74	V.A-16(EP-34)	Heat exchanger tubes	Stainless steel	Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.A.EP-75	V.A-17(EP-40)	Heat exchanger tubes	Steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.A.E-43	V.A-18(E-43)	Motor cooler	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.A.E-29	V.A-19(E-29)	Piping and components (Internal surfaces)	Steel	Air – indoor, uncontrolled (Internal)	Loss of material due to general corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.A.EP-97	V.A-20(EP-36)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-76	V.A-21(EP-45)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.A.EP-27	V.A-22(EP-27)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.A.EP-95	V.A-23(EP-33)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

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V ENGINEERED SAFETY FEATURES
A Containment Spray System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.A.EP-98	V.A-24(EP-44)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.A.EP-77	V.A-25(EP-46)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.A.EP-81	V.A-26(EP-53)	Piping, piping components, and piping elements (Internal surfaces); tanks	Stainless steel	Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.A.EP-41	V.A-27(EP-41)	Piping, piping components, and piping elements; tanks	Stainless steel	Treated water (borated)	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
V.A.E-12	V.A-28(E-12)	Piping, piping components, and piping elements; tanks	Stainless steel	Treated water (borated) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No

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B. STANDBY GAS TREATMENT SYSTEM (BOILING WATER REACTORS)

Systems, Structures, and Components

This section addresses the standby gas treatment system found in boiling water reactors (BWRs) and consists of ductwork, filters, and fans. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the standby gas treatment system are governed by Group B Quality Standards.

Specifically, charcoal absorber filters are to be addressed consistent with the NRC position on consumables, provided in the NRC letter from Christopher I. Grimes to Douglas J. Walters of NEI, dated March 10, 2000. Components that function as system filters are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, from an aging management review (on a plant-specific basis), under 10 CFR 54.21(a)(1)(ii). As part of the methodology description, the application should identify the standards that are relied on for replacement, for example, National Fire Protection Association (NFPA) standards for fire protection equipment.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in V.E. Common miscellaneous material/environment combinations, where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation, are included in V.F.

System Interfaces

There are no system interfaces with the standby gas treatment system addressed in this section.

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V ENGINEERED SAFETY FEATURES
B Standby Gas Treatment System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.B.E-25	V.B-1(E-25)	Ducting and components (Internal surfaces)	Steel	Air – indoor, uncontrolled (Internal)	Loss of material due to general corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.B.E-40	V.B-2(E-40)	Ducting, closure bolting	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.B.E-26	V.B-3(E-26)	Ducting, piping, and components (External surfaces)	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.B.EP-59	V.B-4(E-06)	Elastomer seals and components	Elastomers	Air – indoor, uncontrolled (External)	Hardening and loss of strength due to elastomer degradation	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.B.EP-58	V.B-4(E-06)	Elastomer seals and components	Elastomers	Air – indoor, uncontrolled (Internal)	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.B.EP-37	V.B-5(EP-37)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.B.EP-97	V.B-6(EP-36)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.B.EP-27	V.B-7(EP-27)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No

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V ENGINEERED SAFETY FEATURES
B Standby Gas Treatment System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.B.EP-54	V.B-8(EP-54)	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.B.EP-111	V.B-9(E-42)	Piping, piping components, and piping elements	Steel (with coating or wrapping)	Soil or concrete	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
V.B.EP-103		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
V.B.EP-107		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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C. CONTAINMENT ISOLATION COMPONENTS

Systems, Structures, and Components

This section addresses the containment isolation components found in all designs of boiling water reactors (BWR) and pressurized water reactors (PWR) in the United States. The system consists of isolation barriers in lines for BWR and PWR nonsafety systems, such as the plant heating, waste gas, plant drain, liquid waste, and cooling water systems. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the containment isolation components are governed by Group A or B Quality Standards.

The aging management programs for hatchways, hatch doors, penetration sleeves, penetration bellows, seals, gaskets, and anchors are addressed in II.A and II.B. The containment isolation valves for in-scope systems are addressed in the appropriate sections in IV, VII, and VIII.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in V.E. Common miscellaneous material/environment combinations, where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation, are included in V.F.

System Interfaces

There are no system interfaces with the containment isolation components addressed in this section.

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V ENGINEERED SAFETY FEATURES
C Containment Isolation Components

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.C.E-35	V.C-1(E-35)	Containment isolation piping and components (External surfaces)	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.C.E-30	V.C-2(E-30)	Containment isolation piping and components (External surfaces)	Steel	Condensation (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.C.E-34	V.C-3(E-34)	Containment isolation piping and components (Internal surfaces)	Stainless steel	Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.C.EP-63	V.C-4(E-33)	Containment isolation piping and components (Internal surfaces)	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.C.E-22	V.C-5(E-22)	Containment isolation piping and components (Internal surfaces)	Steel	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V ENGINEERED SAFETY FEATURES
C Containment Isolation Components

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.C.EP-62	V.C-6(E-31)	Containment isolation piping and components (Internal surfaces)	Steel	Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.C.EP-95	V.C-7(EP-33)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.C.EP-98	V.C-8(EP-44)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.C.EP-99	V.C-9(EP-48)	Piping, piping components, and piping elements	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.C.EP-103		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
V.C.EP-107		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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D1. EMERGENCY CORE COOLING SYSTEM (PRESSURIZED WATER REACTORS)

Systems, Structures, and Components

This section addresses the emergency core cooling systems for pressurized water reactors (PWRs) designed to cool the reactor core and provide safe shutdown following a design basis accident. The core cooling systems consist of the core flood system (CFS), residual heat removal (RHR) (or shutdown cooling (SDC)), high-pressure safety injection (HPSI), low-pressure safety injection (LPSI), and spent fuel pool (SFP) cooling systems, the lines to the chemical and volume control system (CVCS), the emergency sump, the HPSI and LPSI pumps, the pump seal coolers, the RHR heat exchanger, and the refueling water tank (RWT).

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the emergency core cooling system are governed by Group B Quality Standards. Portions of the RHR, HPSI, and LPSI systems and the CVCS extending from the reactor coolant system up to and including the second containment isolation valve are governed by Group A Quality Standards and covered in IV.C2.

Pumps and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in V.E. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VI.F.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the emergency core cooling system include the reactor coolant system and connected lines (IV.C2), the containment spray system (V.A), the spent fuel pool cooling and cleanup system (VII.A3), the closed-cycle cooling water system (VII.C2), the ultimate heat sink (VII.C3), the chemical and volume control system (VII.E1), and the open-cycle cooling water system (service water system) (VII.C1).

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V	ENGINEERED SAFETY FEATURES
D1	Emergency Core Cooling System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D1.E-28	V.D1-1(E-28)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.D1.EP-94	V.D1-2(EP-13)	Heat exchanger components	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-37	V.D1-3(EP-37)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D1.EP-93	V.D1-4(E-19)	Heat exchanger components	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-91	V.D1-5(E-20)	Heat exchanger components	Stainless steel	Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.D1.EP-92	V.D1-6(E-17)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-90	V.D1-7(E-18)	Heat exchanger components	Steel	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V ENGINEERED SAFETY FEATURES
D1 Emergency Core Cooling System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D1.EP-78	V.D1-8(EP-47)	Heat exchanger tubes	Copper alloy	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.EP-96	V.D1-19(EP-35)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-79	V.D1-10(EP-50)	Heat exchanger tubes	Stainless steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.E-21	V.D1-11(E-21)	Heat exchanger tubes	Stainless steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.D1.EP-75	V.D1-12(EP-40)	Heat exchanger tubes	Steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.E-43	V.D1-13(E-43)	Motor cooler	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No

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V ENGINEERED SAFETY FEATURES
D1 Emergency Core Cooling System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D1.E-24	V.D1-14(E-24)	Orifice (miniflow recirculation)	Stainless steel	Treated water (borated)	Loss of material due to erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant-specific
V.D1.E-01	V.D1-15(E-01)	Partially-encased tanks with breached moisture barrier	Stainless steel	Raw water	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant-specific
V.D1.EP-101	V.D2-18(EP-2)	Piping, piping components, and piping elements	Aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.D1.E-47	V.D1-16(E-47)	Piping, piping components, and piping elements	Cast austenitic stainless steel	Treated water (borated) >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
V.D1.EP-97	V.D1-17(EP-36)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

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V ENGINEERED SAFETY FEATURES
D1 Emergency Core Cooling System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D1.EP-76	V.D1-19(EP-45)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.EP-27	V.D1-19(EP-27)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D1.EP-52	V.D1-20(EP-52)	Piping, piping components, and piping elements	Gray cast iron	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D1.EP-54	V.D1-21(EP-54)	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D1.EP-95	V.D1-22(EP-33)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-98	V.D1-23(EP-44)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D1.EP-80	V.D1-24(EP-51)	Piping, piping components, and piping elements	Stainless steel	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.EP-55	V.D1-25(EP-55)	Piping, piping components, and piping elements	Stainless steel	Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V D1	ENGINEERED SAFETY FEATURES Emergency Core Cooling System (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
V.D1.EP-72	V.D1-26(EP-31)	Piping, piping components, and piping elements	Stainless steel	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
V.D1.E-13	V.D1-27(E-13)	Piping, piping components, and piping elements	Stainless steel	Treated water (borated)	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
V.D1.EP-77	V.D1-28(EP-46)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D1.EP-81	V.D1-29(EP-53)	Piping, piping components, and piping elements (Internal surfaces); tanks	Stainless steel	Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.D1.EP-103		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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V ENGINEERED SAFETY FEATURES
D1 Emergency Core Cooling System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D1.EP-107		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
V.D1.EP-41	V.D1-30(EP-41)	Piping, piping components, and piping elements; tanks	Stainless steel	Treated water (borated)	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
V.D1.E-12	V.D1-31(E-12)	Piping, piping components, and piping elements; tanks	Stainless steel	Treated water (borated) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No
V.D1.EP-49	V.D1-32(EP-49)	Pump casings	Steel (with stainless steel cladding)	Treated water (borated)	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes, verify that plant-specific program addresses clad breach
V.D1.E-38	V.D1-33(E-38)	Safety injection tank (accumulator)	Steel (with stainless steel or nickel-alloy cladding)	Treated water (borated) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No

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D2. EMERGENCY CORE COOLING SYSTEM (BOILING WATER REACTORS)

Systems, Structures, and Components

This section addresses the emergency core cooling systems for boiling water reactors (BWRs) designed to cool the reactor core and provide safe shutdown following a design basis accident. The cooling systems consist of the high-pressure coolant injection (HPCI), reactor core isolation cooling (RCIC), high-pressure core spray (HPCS), automatic depressurization (ADS), low-pressure core spray (LPCS), low-pressure coolant injection (LPCI), and residual heat removal (RHR) systems, including various pumps and valves, the RHR heat exchangers, and the drywell and suppression chamber spray system (DSCSS). The auxiliary area ventilation system includes RCIC, HPCI, RHR, and core spray pump room cooling.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the emergency core cooling system outside the containment are governed by Group B Quality Standards and the portion of the DSCSS inside the containment up to the isolation valve is governed by Group A Quality Standards. Portions of the HPCI, RCIC, HPCS, LPCS, and LPCI (or RHR) systems extending from the reactor vessel up to and including the second containment isolation valve are governed by Group A Quality Standards and covered in IV.C1.

Pumps and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

The system piping includes all pipe sizes, including instrument piping.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in V.E. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VI.F.

System Interfaces

The systems that interface with the emergency core cooling system include the reactor vessel (IV.A1), the reactor coolant pressure boundary (IV.C1), the feedwater system (VIII.D2), the condensate system (VIII.E), the closed-cycle cooling water system (VII.C2), the open-cycle cooling water system (VII.C1), and the ultimate heat sink (VII.C3).

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V ENGINEERED SAFETY FEATURES
D2 Emergency Core Cooling System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D2.EP-113	V.D2-1(E-04)	Drywell and suppression chamber spray system (internal surfaces): flow orifice; spray nozzles	Steel	Air – indoor, uncontrolled (Internal)	Loss of material due to general corrosion; fouling that leads to corrosion	A plant-specific aging management program is to be evaluated	Yes, plant-specific
V.D2.E-26	V.D2-2(E-26)	Ducting, piping, and components (External surfaces)	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.D2.EP-94	V.D2-3(EP-13)	Heat exchanger components	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-37	V.D2-4(EP-37)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D2.EP-93	V.D2-5(E-19)	Heat exchanger components	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-91	V.D2-6(E-20)	Heat exchanger components	Stainless steel	Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.D2.EP-92	V.D2-7(E-17)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

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V ENGINEERED SAFETY FEATURES
D2 Emergency Core Cooling System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D2.EP-90	V.D2-8(E-18)	Heat exchanger components	Steel	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.D2.EP-78	V.D2-9(EP-47)	Heat exchanger tubes	Copper alloy	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D2.EP-96	V.D2-10(EP-35)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-79	V.D2-11(EP-50)	Heat exchanger tubes	Stainless steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-21	V.D2-12(E-21)	Heat exchanger tubes	Stainless steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
V.D2.EP-74	V.D2-13(EP-34)	Heat exchanger tubes	Stainless steel	Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.D2.EP-75	V.D2-14(EP-40)	Heat exchanger tubes	Steel	Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-23	V.D2-15(E-23)	Heat exchanger tubes	Steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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V ENGINEERED SAFETY FEATURES
D2 Emergency Core Cooling System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D2.E-29	V.D2-16(E-29)	Piping and components (Internal surfaces)	Steel	Air – indoor, uncontrolled (Internal)	Loss of material due to general corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.D2.E-27	V.D2-17(E-27)	Piping and components (Internal surfaces)	Steel	Condensation (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.D2.EP-71	V.D2-19(EP-26)	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-11	V.D2-20(E-11)	Piping, piping components, and piping elements	Cast austenitic stainless steel	Treated water >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
V.D2.EP-97	V.D2-21(EP-36)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-76	V.D2-22(EP-45)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D2.EP-27	V.D2-23(EP-27)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
V.D2.EP-54	V.D2-24(EP-54)	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No

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V ENGINEERED SAFETY FEATURES
D2 Emergency Core Cooling System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D2.EP-95	V.D2-25(EP-33)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-98	V.D2-26(EP-44)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
V.D2.EP-72	V.D2-27(EP-31)	Piping, piping components, and piping elements	Stainless steel	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
V.D2.EP-73	V.D2-28(EP-32)	Piping, piping components, and piping elements	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-37	V.D2-29(E-37)	Piping, piping components, and piping elements	Stainless steel	Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry”	No
V.D2.EP-77	V.D2-30(EP-46)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-07	V.D2-31(E-07)	Piping, piping components, and piping elements	Steel	Steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No

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V ENGINEERED SAFETY FEATURES
D2 Emergency Core Cooling System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.D2.E-10	V.D2-32(E-10)	Piping, piping components, and piping elements	Steel	Treated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
V.D2.EP-60	V.D2-33(E-08)	Piping, piping components, and piping elements	Steel	Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
V.D2.E-09	V.D2-34(E-09)	Piping, piping components, and piping elements	Steel	Treated water	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No
V.D2.EP-61	V.D2-35(E-14)	Piping, piping components, and piping elements (Internal surfaces)	Stainless steel	Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
V.D2.EP-103		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
V.D2.EP-107		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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E. EXTERNAL SURFACES OF COMPONENTS AND MISCELLANEOUS BOLTING

Systems, Structures, and Components

This section addresses the aging management programs for the degradation of external surfaces of all steel structures and components, including closure boltings in the engineered safety features in pressurized water reactors (PWRs) and boiling water reactors (BWRs). For the steel components in PWRs, this section addresses only boric acid corrosion of external surfaces as a result of dripping borated water leaking from an adjacent PWR component. Boric acid corrosion can also occur for steel components containing borated water due to leakage, such components and the related aging management program are covered in the appropriate major plant sections in V.

System Interfaces

The structures and components covered in this section belong to the engineered safety features in PWRs and BWRs. (For example, see System Interfaces in V.A to V.D2 for details.)

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V ENGINEERED SAFETY FEATURES
E External Surfaces of Components and Miscellaneous Bolting

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.E.EP-116		Bolting	Copper alloy	Any environment	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-117		Bolting	Nickel alloy	Any environment	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-120		Bolting	Stainless steel	Treated borated water	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.E-41	V.E-2(E-41)	Bolting	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.E.EP-64	V.E-1(EP-1)	Bolting	Steel; stainless steel	Air – outdoor (External)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-118		Bolting	Steel; stainless steel	Air – outdoor (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No

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V ENGINEERED SAFETY FEATURES
E External Surfaces of Components and Miscellaneous Bolting

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.E.EP-121		Bolting	Steel; stainless steel	Fuel oil	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-119		Bolting	Steel; stainless steel	Raw water	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-122		Bolting	Steel; stainless steel	Treated water	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.E-02	V.E-6(E-02)	Closure bolting	Steel	Air with steam or water leakage	Loss of material due to general corrosion	Chapter XI.M18, "Bolting Integrity"	No
V.E.E-03	V.E-3(E-03)	Closure bolting	Steel, high-strength	Air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No
V.E.EP-70	V.E-4(EP-25)	Closure bolting	Steel; stainless steel	Air – indoor, uncontrolled (External)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No

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V ENGINEERED SAFETY FEATURES
E External Surfaces of Components and Miscellaneous Bolting

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.E.EP-69	V.E-5(EP-24)	Closure bolting	Steel; stainless steel	Air – indoor, uncontrolled (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No
V.E.E-44	V.E-7(E-44)	External surfaces	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.E.E-45	V.E-8(E-45)	External surfaces	Steel	Air – outdoor (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.E.E-28	V.E-9(E-28)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.E.E-46	V.E-10(E-46)	External surfaces	Steel	Condensation (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.E.EP-114		Piping, piping components, and piping elements	Aluminum	Air - outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
V.E.EP-38	V.E-11(EP-38)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
V.E.EP-123		Underground piping, piping components, and piping elements	Steel; stainless steel	Air-indoor, uncontrolled (External) or condensation (External)	Loss of material due to general (steel only), pitting and crevice corrosion	Chapter XI.M41, “Buried and Underground Piping and Tanks”	No

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F. COMMON MISCELLANEOUS MATERIAL/ENVIRONMENT COMBINATIONS

Systems, Structures, and Components

This section addresses the aging management programs for miscellaneous material/environment combinations which may be found throughout the emergency safety feature system's structures and components. For the material/environment combinations in this part, aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation and, therefore, no resulting aging management programs for these structures and components are required.

System Interfaces

The structures and components covered in this section belong to the engineered safety features in pressurized water reactors (PWRs) and boiling water reactors (BWRs). (For example, see System Interfaces in V.A to V.D2 for details.)

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V ENGINEERED SAFETY FEATURES
F Common Miscellaneous Material/Environment Combinations

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.F.EP-14	V.F-1(EP-14)	Ducting, piping, and components	Galvanized steel	Air – indoor, controlled (External)	None	None	No
V.F.EP-15	V.F-6(EP-15)	Piping elements	Glass	Air – indoor, uncontrolled (External)	None	None	No
V.F.EP-87		Piping elements	Glass	Air – outdoor	None	None	No
V.F.EP-65		Piping elements	Glass	Air with borated water leakage	None	None	No
V.F.EP-68		Piping elements	Glass	Closed-cycle cooling water	None	None	No
V.F.EP-66		Piping elements	Glass	Condensation (Internal/External)	None	None	No
V.F.EP-67		Piping elements	Glass	Gas	None	None	No
V.F.EP-16	V.F-7(EP-16)	Piping elements	Glass	Lubricating oil	None	None	No
V.F.EP-28	V.F-8(EP-28)	Piping elements	Glass	Raw water	None	None	No

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V ENGINEERED SAFETY FEATURES
F Common Miscellaneous Material/Environment Combinations

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.F.EP-29	V.F-10(EP-29)	Piping elements	Glass	Treated water	None	None	No
V.F.EP-30	V.F-9(EP-30)	Piping elements	Glass	Treated water (borated)	None	None	No
V.F.EP-3	V.F-2(EP-3)	Piping, piping components, and piping elements	Aluminum	Air – indoor, uncontrolled (Internal/External)	None	None	No
V.F.EP-10	V.F-3(EP-10)	Piping, piping components, and piping elements	Copper alloy	Air – indoor, uncontrolled (External)	None	None	No
V.F.EP-9	V.F-4(EP-9)	Piping, piping components, and piping elements	Copper alloy	Gas	None	None	No
V.F.EP-12	V.F-5(EP-12)	Piping, piping components, and piping elements	Copper alloy (≤15% Zn and ≤8% Al)	Air with borated water leakage	None	None	No
V.F.EP-17	V.F-11(EP-17)	Piping, piping components, and piping elements	Nickel alloy	Air – indoor, uncontrolled (External)	None	None	No
V.F.EP-115		Piping, piping components, and piping elements	Nickel alloy	Air with borated water leakage	None	None	No

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V ENGINEERED SAFETY FEATURES
F Common Miscellaneous Material/Environment Combinations

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
V.F.EP-18	V.F-12(EP-18)	Piping, piping components, and piping elements	Stainless steel	Air – indoor, uncontrolled (External)	None	None	No
V.F.EP-82		Piping, piping components, and piping elements	Stainless steel	Air – indoor, uncontrolled (Internal)	None	None	No
V.F.EP-19	V.F-13(EP-19)	Piping, piping components, and piping elements	Stainless steel	Air with borated water leakage	None	None	No
V.F.EP-20	V.F-14(EP-20)	Piping, piping components, and piping elements	Stainless steel	Concrete	None	None	No
V.F.EP-22	V.F-15(EP-22)	Piping, piping components, and piping elements	Stainless steel	Gas	None	None	No
V.F.EP-4	V.F-16(EP-4)	Piping, piping components, and piping elements	Steel	Air – indoor, controlled (External)	None	None	No
V.F.EP-112	V.F-17(EP-5)	Piping, piping components, and piping elements	Steel	Concrete	None	None, provided 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.

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V F	ENGINEERED SAFETY FEATURES Common Miscellaneous Material/Environment Combinations						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
V.F.EP-7	V.F-18(EP-7)	Piping, piping components, and piping elements	Steel	Gas	None	None	No

CHAPTER VI

ELECTRICAL COMPONENTS

OAGI0001390_00320

ELECTRICAL COMPONENTS

A. Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

B. Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

OAGI0001390_00321

A. EQUIPMENT NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Systems, Structures, and Components

This section addresses electrical cables and connections that are not subject to the environmental qualification requirements of 10 CFR 50.49 and that are installed in power and instrumentation and control (I&C) applications. The power cables and connections addressed are low-voltage (<1000 volts) and medium-voltage (2 kilovolts [kV] to 35 kV). High voltage (> 35 kV) power cables and connections have unique, specialized constructions and must be evaluated on a plant-specific basis.

This section also addresses components that are relied upon to meet the station blackout (SBO) requirements for restoration of offsite power. The offsite power system relied upon in the plant-specific current licensing basis for compliance with 10 CFR 50.63, that is used to connect the plant to the offsite power source, is included in the SBO restoration equipment scope. The electrical distribution equipment out to the first circuit breaker with the offsite distribution system (i.e., equipment in the switchyard) should be included within the SBO restoration equipment scope. This path typically includes the circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system, and associated control circuits and structures. However, the staff's review is based on the plant-specific current licensing basis, regulatory requirements, and offsite power design configurations.

Electrical cables and their required terminations (i.e., connections) are typically reviewed as a single commodity. The types of connections included in this review are splices, mechanical connectors, fuse holders, and terminal blocks. This common review is translated into program actions, which treat cables and connections in the same manner.

Electrical cables and connections that are in the plant's environmental qualification (EQ) program are addressed in VI.B.

System Interfaces

Electrical cables and connections functionally interface with all plant systems that rely on electric power or instrumentation and control. Electrical cables and connections also interface with and are supported by structural commodities (e.g., cable trays, conduit, cable trenches, cable troughs, duct banks, cable vaults, and manholes) that are reviewed, as appropriate, in the Systems, Structures, and Components section.

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VI A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.A.LP-30	VI.A-1(LP-12)	Cable connections (metallic parts)	Various metals used for electrical contacts	Air – indoor, controlled or uncontrolled or Air – outdoor	Increased resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No
VI.A.LP-35	VI.A-4(L-03)	Conductor insulation for inaccessible power cables greater than or equal to 400 volts (e.g., installed in conduit or direct buried)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by significant moisture	Reduced insulation resistance due to moisture	Chapter XI.E3, "Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No
VI.A.LP-36	VI.A-5(L-04)	Connector contacts for electrical connectors exposed to borated water leakage	Various metals used for electrical contacts	Air with borated water leakage	Increased resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	Chapter XI.M10, “Boric Acid Corrosion”	No
VI.A.LP-24	VI.A-7(LP-02)	Fuse holders (not part of active equipment): insulation material	Insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate; other	Air – indoor, controlled or uncontrolled	None	None	No

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VI A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.A.LP-31	VI.A-8(LP-01)	Fuse holders (not part of active equipment): metallic clamps	Various metals used for electrical connections	Air – indoor, controlled or uncontrolled	Increased resistance of connection due to fatigue caused by frequent manipulation or vibration	Chapter XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms or fatigue caused by frequent manipulation or vibration	No
VI.A.LP-23	VI.A-8(LP-01)	Fuse holders (not part of active equipment): metallic clamps	Various metals used for electrical connections	Air – indoor, uncontrolled	Increased resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply); fatigue due to ohmic heating, thermal cycling, electrical transients	Chapter XI.E5, "Fuse Holders"	No
VI.A.LP-32	VI.A-10(LP-11)	High-voltage insulators	Porcelain; malleable iron; aluminum; galvanized steel; cement	Air – outdoor	Loss of material due to mechanical wear caused by wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated	Yes, plant-specific

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VI A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.A.LP-28	VI.A-9(LP-07)	High-voltage insulators	Porcelain; malleable iron; aluminum; galvanized steel; cement	Air – outdoor	Reduced insulation resistance due to presence of salt deposits or surface contamination	A plant-specific aging management program is to be evaluated 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)	Yes, plant-specific
VI.A.LP-33	VI.A-2(L-01)	Insulation material for electrical cables and connections (including terminal blocks, fuse holders, etc.)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture	Reduced insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Chapter XI.E1, "Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No
VI.A.LP-34	VI.A-3(L-02)	Insulation material for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture	Reduced insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Chapter XI.E2, "Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No

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VI A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.A.LP-25	VI.A-11(LP-04)	Metal enclosed bus: bus/connections	Various metals used for electrical bus and connections	Air – indoor, controlled or uncontrolled or Air – outdoor	Increased resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	No
VI.A.LP-29	VI.A-12(LP-10)	Metal enclosed bus: enclosure assemblies	Elastomers	Air – indoor, controlled or uncontrolled or Air – outdoor	Surface cracking, crazing, scuffing, dimensional change (e.g. “ballooning” and “necking”), shrinkage, discoloration, hardening and loss of strength due to elastomer degradation	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
VI.A.LP-41	VI.A-13(LP-06)	Metal enclosed bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – indoor, controlled or uncontrolled	None	None	No
VI.A.LP-42	VI.A-13(LP-06)	Metal enclosed bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.S6, "Structures Monitoring"	No
VI.A.LP-44	VI.A-13(LP-06)	Metal enclosed bus: external surface of enclosure assemblies	Steel	Air – indoor, controlled	None	None	No
VI.A.LP-43	VI.A-13(LP-06)	Metal enclosed bus: external surface of enclosure assemblies	Steel	Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.S6, "Structures Monitoring"	No

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VI A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.A.LP-26	VI.A-14(LP-05)	Metal enclosed bus: insulation; insulators	Porcelain; xenoy; thermo-plastic organic polymers	Air – indoor, controlled or uncontrolled or Air – outdoor	Reduced insulation resistance due to thermal/ thermoxidative degradation of organics/ thermoplastics, radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	No
VI.A.LP-39	VI.A-15(LP-09)	Switchyard bus and connections	Aluminum; copper; bronze; stainless steel; galvanized steel	Air – outdoor	Loss of material due to wind-induced abrasion; Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific
VI.A.LP-46	VI.A-16(LP-08)	Transmission conductors	Aluminum	Air – outdoor	Loss of conductor strength due to corrosion	None - for Aluminum Conductor Aluminum Alloy Reinforced (ACAR)	None
VI.A.LP-38	VI.A-16(LP-08)	Transmission conductors	Aluminum; steel	Air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for Aluminum Conductor Steel Reinforced (ACSR)	Yes, plant-specific
VI.A.LP-47	VI.A-16(LP-08)	Transmission conductors	Aluminum; Steel	Air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for ACAR and ACSR	Yes, plant-specific
VI.A.LP-48	VI.A-16(LP-08)	Transmission connectors	Aluminum; steel	Air – outdoor	Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific

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B. EQUIPMENT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Systems, Structures, and Components

The Nuclear Regulatory Commission (NRC) has established nuclear station environmental qualification (EQ) requirements in 10 CFR Part 50 Appendix A, Criterion 4, and in 10 CFR 50.49. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments (i.e., those areas of the plant that could be subject to the harsh environmental effects of a loss of coolant accident [LOCA], high energy line breaks [HELBs] or post-LOCA radiation) are qualified to perform their safety function in those harsh environments after the effects of inservice aging. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. Components in the EQ program have a qualified life, and the components are replaced at the end of that qualified life if it is shorter than the current operating term. The qualified life may be extended by methods such as refurbishment or reanalysis, but the licensee is required by the EQ regulation (10 CFR 50.49) to replace the component when its qualified life has expired.

Similarly, some nuclear power plants have mechanical equipment that was qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50.

System Interfaces

Equipment subject to 10 CFR 50.49 environmental qualification requirements functionally interfaces with all plant systems that rely on electric power or instrumentation and control.

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VI B	ELECTRICAL COMPONENTS Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VI.B.L-05	VI.B-1(L-05)	Electrical equipment subject to 10 CFR 50.49 EQ requirements	Various polymeric and metallic materials	Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	Various aging effects due to various mechanisms in accordance with 10 CFR 50.49	EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.E1, "Environmental Qualification (EQ) of Electric Components," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	Yes, TLAA

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CHAPTER VII

AUXILIARY SYSTEMS

OAGI0001390_00330

MAJOR PLANT SECTIONS

A1. New Fuel Storage

A2. Spent Fuel Storage

A3. Spent Fuel Pool Cooling and Cleanup (PWR)

A4. Spent Fuel Pool Cooling and Cleanup (BWR)

A5. Suppression Pool Cleanup System (BWR)

B. Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

C1. Open-Cycle Cooling Water System (Service Water System)

C2. Closed-Cycle Cooling Water System

C3. Ultimate Heat Sink

D. Compressed Air System

E1. Chemical and Volume Control System (PWR)

E2. Standby Liquid Control System (BWR)

E3. Reactor Water Cleanup System (BWR)

E4. Shutdown Cooling System (Older BWR)

E5. Waste Water Systems

F1. Control Room Area Ventilation System

F2. Auxiliary and Radwaste Area Ventilation System

F3. Primary Containment Heating and Ventilation System

F4. Diesel Generator Building Ventilation System

G. Fire Protection

H1. Diesel Fuel Oil System

H2. Emergency Diesel Generator System

I. External Surfaces of Components and Miscellaneous Bolting

J. Common Miscellaneous Material/Environment Combinations

OAGI0001390_00331

A1. NEW FUEL STORAGE

Systems, Structures, and Components

This section discusses those structures and components used for new fuel storage which include carbon steel new fuel storage racks located in the auxiliary building or the fuel handling building. The racks are exposed to the temperature and humidity in the auxiliary building. The racks are generally painted with a protective coating. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components used for new fuel storage are governed by Group C Quality Standards.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

System Interfaces

No other systems discussed in this report interface with those used for new fuel storage.

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VII A1	AUXILIARY SYSTEMS New Fuel Storage						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.A1.A-94	VII.A1-1(A-94)	Structural steel	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No

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A2. SPENT FUEL STORAGE

Systems, Structures, and Components

This section discusses those structures and components used for spent fuel storage and includes stainless steel spent fuel storage racks and neutron-absorbing materials (e.g., Boraflex, Boral®, or boron-steel sheets, if used) submerged in chemically treated oxygenated boiling water reactor (BWR) or borated pressurized water reactor (PWR) water. The intended function of a spent fuel rack is to separate spent fuel assemblies. Boraflex sheets fastened to the storage cells provide for neutron absorption and help maintain subcriticality of spent fuel assemblies in the spent fuel pool.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components used for spent fuel storage are governed by Group C Quality Standards. In some plants, the Boraflex has been replaced by Boral® or boron steel.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

No other systems discussed in this report interface with those used for spent fuel storage.

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VII AUXILIARY SYSTEMS
A2 Spent Fuel Storage

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A2.AP-79	VII.A2-1(AP-79)	Piping, piping components, and piping elements	Steel (with stainless steel cladding); stainless steel	Treated borated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
VII.A2.A-96	VII.A2-6(A-96)	Spent fuel storage racks (BWR)	Stainless steel	Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No
VII.A2.A-97	VII.A2-7(A-97)	Spent fuel storage racks (PWR)	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No
VII.A2.A-87	VII.A2-2(A-87)	Spent fuel storage racks: neutron-absorbing sheets (BWR)	Boraflex	Treated water	Reduction of neutron-absorbing capacity due to boraflex degradation	Chapter XI.M22, “Boraflex Monitoring”	No
VII.A2.AP-236	VII.A2-3(A-89)	Spent fuel storage racks: neutron-absorbing sheets (BWR)	Boral®; boron steel, and other materials (excluding Boraflex)	Treated water	Reduction of neutron-absorbing capacity; change in dimensions and loss of material due to effects of SFP environment	Chapter XI.M40, "Monitoring of Neutron-Absorbing Materials other than Boraflex"	No
VII.A2.A-86	VII.A2-4(A-86)	Spent fuel storage racks: neutron-absorbing sheets (PWR)	Boraflex	Treated borated water	Reduction of neutron-absorbing capacity due to boraflex degradation	Chapter XI.M22, “Boraflex Monitoring”	No

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VII AUXILIARY SYSTEMS
A2 Spent Fuel Storage

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A2.AP-235	VII.A2-5(A-88)	Spent fuel storage racks: neutron-absorbing sheets (PWR)	Boral®; boron steel, and other materials (excluding Boraflex)	Treated borated water	Reduction of neutron-absorbing capacity; change in dimensions and loss of material due to effects of SFP environment	Chapter XI.M40, "Monitoring of Neutron-Absorbing Materials other than Boraflex"	No

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A3. SPENT FUEL POOL COOLING AND CLEANUP (PRESSURIZED WATER REACTOR)

Systems, Structures, and Components

This section discusses the pressurized water reactor (PWR) spent fuel pool cooling and cleanup system and consists of piping, valves, heat exchangers, filters, linings, demineralizers, and pumps. The system contains borated water. The system removes heat from the spent fuel pool and transfers heat to the closed-cycle cooling water system, which in turn transfers heat to the open-cycle cooling water system. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the PWR spent fuel pool cooling and cleanup system are governed by Group C Quality Standards.

With respect to filters, these items are to be addressed consistent with the Nuclear Regulatory Commission (NRC) position on consumables, provided in the NRC letter from Christopher I. Grimes to Douglas J. Walters of the Nuclear Energy Institute (NEI), dated March 10, 2000. Specifically, components that function as system filters are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from an aging management review under 10 CFR 54.21(a)(1)(ii). As part of the methodology description, the application should identify the standards that are relied on for replacement, for example, National Fire Protection Association (NFPA) standards for fire protection equipment.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the PWR spent fuel cooling and cleanup system are the PWR emergency core cooling system (V.D1), the closed-cycle cooling water system (VII.C2), and the PWR chemical and volume control system (VII.E1).

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VII AUXILIARY SYSTEMS
A3 Spent Fuel Pool Cooling and Cleanup (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A3.AP-100	VII.A3-1(A-15)	Elastomers, linings	Elastomers	Treated borated water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
VII.A3.A-79	VII.A3-2(A-79)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
VII.A3.AP-189	VII.A3-3(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.A3.AP-1	VII.A3-4(AP-1)	Piping, piping components, and piping elements	Aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
VII.A3.AP-199	VII.A3-5(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.A3.AP-43	VII.A3-6(AP-43)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.A3.AP-31	VII.A3-7(AP-31)	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No

VII AUXILIARY SYSTEMS
A3 Spent Fuel Pool Cooling and Cleanup (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A3.AP-107	VII.A3-9(A-39)	Piping, piping components, and piping elements	Steel (with elastomer lining)	Treated water	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.A3.AP-79	VII.A3-8(AP-79)	Piping, piping components, and piping elements	Steel (with stainless steel cladding); stainless steel	Treated borated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
VII.A3.A-56	VII.A3-10(A-56)	Piping, piping components, and piping elements	Steel (with stainless steel or nickel-alloy cladding)	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No

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A4. SPENT FUEL POOL COOLING AND CLEANUP (BOILING WATER REACTOR)

Systems, Structures, and Components

This section discusses the boiling water reactor (BWR) spent fuel pool cooling and cleanup system and consists of piping, valves, heat exchangers, filters, linings, demineralizers, and pumps. The system contains chemically treated oxygenated water. The system removes heat from the spent fuel pool and transfers the heat to the closed-cycle cooling water system, which in turn transfers the heat to the open-cycle cooling water system. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the BWR spent fuel pool cooling and cleanup system are governed by Group C Quality Standards.

With respect to filters, these items are to be addressed consistent with the Nuclear Regulatory Commission (NRC) position on consumables, provided in the NRC letter from Christopher I. Grimes to Douglas J. Walters of the Nuclear Energy Institute (NEI), dated March 10, 2000. Specifically, components that function as system filters are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from an aging management review under 10 CFR 54.21(a)(1)(ii). As part of the methodology description, the application should identify the standards that are relied on for replacement, for example, National Fire Protection Association (NFPA) standards for fire protection equipment.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the BWR spent fuel cooling and cleanup system are the closed-cycle cooling water system (VII.C2) and the condensate system (VIII.E).

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VII AUXILIARY SYSTEMS
A4 Spent Fuel Pool Cooling and Cleanup (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A4.AP-101	VII.A4-1(A-16)	Elastomers, linings	Elastomers	Treated water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
VII.A4.AP-111	VII.A4-2(A-70)	Heat exchanger components	Stainless steel; steel with stainless steel cladding	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.A4.AP-189	VII.A4-3(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.A4.AP-139	VII.A4-4(AP-62)	Heat exchanger tubes	Stainless steel	Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection"	No
VII.A4.AP-130	VII.A4-5(AP-38)	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.A4.AP-199	VII.A4-6(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.A4.AP-140	VII.A4-7(AP-64)	Piping, piping components, and piping elements	Copper alloy	Treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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VII AUXILIARY SYSTEMS
A4 Spent Fuel Pool Cooling and Cleanup (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.A4.AP-43	VII.A4-8(AP-43)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.A4.AP-32	VII.A4-9(AP-32)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.A4.AP-31	VII.A4-10(AP-31)	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.A4.AP-110	VII.A4-11(A-58)	Piping, piping components, and piping elements	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.A4.AP-108	VII.A4-12(A-40)	Piping, piping components, and piping elements	Steel (with elastomer lining or stainless steel cladding)	Treated water	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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A5. SUPPRESSION POOL CLEANUP SYSTEM (BOILING WATER REACTOR)

Systems, Structures, and Components

This section discusses the suppression pool cleanup system, which maintains water quality in the suppression pool in boiling water reactors (BWRs). The components of this system include piping, filters, valves, and pumps. These components are fabricated of carbon, low-alloy, or austenitic stainless steel. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the components that comprise the suppression pool cleanup system are governed by the same Group C Quality Standards Group as the corresponding components in the spent fuel pool cooling and cleanup system (VII.A4).

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The system that interfaces with the suppression pool cleanup system is the BWR containments (II.B), or BWR emergency core cooling system (V.D2).

Evaluation Summary

There are no tables associated with this section because the suppression pool cleanup system in BWRs is similar to the spent fuel pool cooling and cleanup system (VII.A4), and the components in the two systems are identical or very similar. Therefore, the reader is referred to the section for the spent fuel storage pool system for a listing of aging effects, aging mechanisms, and aging management programs that are to be applied to the suppression pool cleanup system components. (The only component in VII.A4 that may not be applicable to the suppression pool cleanup system is the heat exchanger [AMR line-items VII.A4.AP-111, VII.A4.4AP-139, VII.A4.AP-189].)

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B. OVERHEAD HEAVY LOAD AND LIGHT LOAD (RELATED TO REFUELING) HANDLING SYSTEMS

Systems, Structures, and Components

Most commercial nuclear facilities have between fifty and one hundred cranes. Many of these cranes are industrial grade cranes that must meet the requirements of 29 CFR Volume XVII, Part 1910, and Section 1910.179. They do not fall within the scope of 10 CFR Part 54.4 and therefore are not required to be part of the integrated plant assessment (IPA). Normally fewer than ten cranes fall within the scope of 10 CFR Part 54.4. These cranes must comply with the requirements provided in 10 CFR Part 50.65 and Reg. Guide 1.160 for monitoring the effectiveness of maintenance at nuclear power plants.

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (the Program) must demonstrate that the testing and the monitoring of the maintenance programs have been completed to ensure that the structures, systems, and components of these cranes are capable of sustaining their rated loads during the period of extended operation. The inspection is also to evaluate whether the usage of the cranes or hoists has been sufficient to warrant additional fatigue analysis. It should be noted that many of the systems and components of these cranes can be classified as moving parts or as components which change configuration, or they may be subject to replacement based on a qualified life. In any of these cases, they will not fall within the scope of this Aging Management Review (AMR). The primary components that this program is concerned with are the structural girders and beams that make up the bridge and the trolley.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the overhead heavy load and light load handling systems are governed by Group C Quality Standards.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

System Interfaces

No other systems discussed in this report interface with the overhead heavy load and light load (related to refueling) handling systems. Physical interfaces exist with the supporting structure. The direct interface is at the connection to the structure.

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VII AUXILIARY SYSTEMS
B Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.B.A-05	VII.B-1(A-05)	Cranes - rails	Steel	Air – indoor, uncontrolled (External)	Loss of material due to wear	Chapter XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No
VII.B.A-07	VII.B-3(A-07)	Cranes: rails and structural girders	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No
VII.B.A-06	VII.B-2(A-06)	Cranes: structural girders	Steel	Air – indoor, uncontrolled (External)	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for structural girders of cranes that fall within the scope of 10 CFR 54. See SRP-LR Sec. 4.7, "Other Plant-Specific Time-Limited Aging Analyses," for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1)).	Yes, TLAA

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C1. OPEN-CYCLE COOLING WATER SYSTEM (SERVICE WATER SYSTEM)

Systems, Structures, and Components

This section discusses the open-cycle cooling water (OCCW) (or service water) system, which consists of piping, heat exchangers, pumps, flow orifices, basket strainers, and valves, including containment isolation valves. Because the characteristics of an OCCW system may be unique to each facility, the OCCW system is defined as a system or systems that transfer heat from safety-related systems, structures, and components (SSCs) to the ultimate heat sink (UHS), such as a lake, ocean, river, spray pond, or cooling tower. The AMPs described in this section apply to any such system, provided the service conditions and materials of construction are identical to those identified in the section. The system removes heat from the closed-cycle cooling water system, and, in some plants, other auxiliary systems and components, such as steam turbine bearing oil coolers or miscellaneous coolers in the condensate system. The only heat exchangers addressed in this section are those removing heat from the closed-cycle cooling system. Heat exchangers for removing heat from other auxiliary systems and components are addressed in their respective systems, such as those for the steam turbine bearing oil coolers (VIII.A) and for the condensate system coolers (VIII.E).

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the open-cycle cooling water system are governed by Group C Quality Standards, with the exception of those forming part of the containment penetration boundary which are governed by Group B Quality Standards.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that may interface with the open-cycle cooling water system include the closed-cycle cooling water system (VII.C2), the ultimate heat sink (VII.C3), the emergency diesel generator system (VII.H2), the containment spray system (V.A), the PWR steam generator blowdown system (VIII.F), the condensate system (VIII.E), the auxiliary feedwater system (PWR) (VIII.G), the emergency core cooling system (PWR) (V.D1), and the emergency core cooling system (BWR) (V.D2).

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-75	VII.C1-1(AP-75)	Elastomer: seals and components	Elastomers	Raw water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-76	VII.C1-2(AP-76)	Elastomer: seals and components	Elastomers	Raw water	Loss of material due to erosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-179	VII.C1-3(A-65)	Heat exchanger components	Copper alloy	Raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.A-66	VII.C1-4(A-66)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Raw water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C1.AP-183	VII.C1-5(A-64)	Heat exchanger components	Steel	Raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-152		Heat exchanger components other than tubes	Titanium (ASTM Grades 1,2, 7, 11, or 12 that contains > 5% aluminum or more than 0.20% oxygen or any amount of tin)	Raw water	None	None	No
VII.C1.A-72	VII.C1-6(A-72)	Heat exchanger tubes	Copper alloy	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-187	VII.C1-7(AP-61)	Heat exchanger tubes	Stainless steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-153		Heat exchanger tubes	Titanium	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-173		Piping, piping components, and piping elements	Aluminum	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-237		Piping, piping components, and piping elements	Asbestos cement pipe	Soil or concrete	Cracking, spalling, corrosion of rebar due to exposure of rebar	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-178		Piping, piping components, and piping elements	Concrete	Soil or concrete	Cracking, spalling, corrosion of rebar due to exposure of rebar	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-177		Piping, piping components, and piping elements	Concrete cylinder piping	Soil or concrete	Cracking, spalling, corrosion of rebar due to exposure of rebar	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-253		Piping, piping components, and piping elements	Concrete; cementitious material	Air - outdoor	Changes in material properties due to aggressive chemical attack	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
VII.C1.AP-251		Piping, piping components, and piping elements	Concrete; cementitious material	Air - outdoor	Cracking due to settling	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
VII.C1.AP-252		Piping, piping components, and piping elements	Concrete; cementitious material	Air - outdoor	Loss of material due to abrasion, cavitation, aggressive chemical attack, and leaching	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
VII.C1.AP-250		Piping, piping components, and piping elements	Concrete; cementitious material	Raw Water	Changes in material properties due to aggressive chemical attack	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-248		Piping, piping components, and piping elements	Concrete; cementitious material	Raw Water	Cracking due to settling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-249		Piping, piping components, and piping elements	Concrete; cementitious material	Raw Water	Loss of material due to abrasion, cavitation, aggressive chemical attack, and leaching	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-133	VII.C1-8(AP-47)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-196	VII.C1-9(A-44)	Piping, piping components, and piping elements	Copper alloy	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-174		Piping, piping components, and piping elements	Copper Alloy	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.A-47	VII.C1-10(A-47)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Raw water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C1.AP-238		Piping, piping components, and piping elements	Fiberglass	Raw water (internal)	Cracking, blistering, change in color due to water absorption	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-176		Piping, piping components, and piping elements	Fiberglass	Soil or concrete	Cracking, blistering, change in color due to water absorption	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.A-51	VII.C1-11(A-51)	Piping, piping components, and piping elements	Gray cast iron	Raw water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No

VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.A-02	VII.C1-12(A-02)	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C1.AP-239		Piping, piping components, and piping elements	HDPE	Raw water (internal)	Cracking, blistering, change in color due to water absorption	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-175		Piping, piping components, and piping elements	HDPE	Soil or concrete	Cracking, blistering, change in color due to water absorption	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-206	VII.C1-13(AP-53)	Piping, piping components, and piping elements	Nickel alloy	Raw water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-156		Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	Air – outdoor	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-155		Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	Raw water	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-157		Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	Soil or concrete	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-138	VII.C1-14(AP-59)	Piping, piping components, and piping elements	Stainless steel	Lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.C1.A-54	VII.C1-15(A-54)	Piping, piping components, and piping elements	Stainless steel	Raw water	Loss of material due to pitting and crevice corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-137	VII.C1-16(AP-56)	Piping, piping components, and piping elements	Stainless steel	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No

VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-127	VII.C1-17(AP-30)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.C1.AP-194	VII.C1-19(A-38)	Piping, piping components, and piping elements	Steel (with coating or lining)	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion; lining/coating degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C1.AP-198	VII.C1-18(A-01)	Piping, piping components, and piping elements	Steel (with coating or wrapping)	Soil or concrete	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-172		Piping, piping components, and piping elements	Super austenitic	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C1.AP-171		Piping, piping components, and piping elements	Titanium	Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No

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VII AUXILIARY SYSTEMS
C1 Open-Cycle Cooling Water System (Service Water System)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C1.AP-161		Piping, piping components, and piping elements	Titanium (ASTM Grades 1,2, 7, 11, or 12 that contains > 5% aluminum or more than 0.20% oxygen or any amount of tin)	Raw water	None	None	No
VII.C1.AP-209		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.C1.AP-221		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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C2. CLOSED-CYCLE COOLING WATER SYSTEM

Systems, Structures, and Components

This section discusses the closed-cycle cooling water (CCCW) system, which consists of piping, radiation elements, temperature elements, heat exchangers, pumps, tanks, flow orifices, and valves, including containment isolation valves. The system contains chemically treated demineralized water. The closed-cycle cooling water system is designed to remove heat from various auxiliary systems and components such as the chemical and volume control system and the spent fuel cooling system to the open-cycle cooling water system (VII.C1). A CCCW system is defined as part of the service water system that does not reject heat directly to a heat sink, has water chemistry control, and is not subject to significant sources of contamination.

Based on RG 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components in the closed-cycle cooling water system are classified as Group C Quality Standards, with the exception of those forming part of the containment penetration boundary, which are Group B.

The aging management programs (AMPs) for the heat exchanger between the closed-cycle and the open-cycle cooling water systems are addressed in the open-cycle cooling water system (VII.C1). The AMPs for the heat exchangers between the closed-cycle cooling water system and the interfacing auxiliary systems are included in the evaluations of their respective systems, such as those for the pressurized water reactor (PWR) and boiling water reactor (BWR) spent fuel pool cooling and cleanup systems (VII.A3 and VII.A4, respectively) and the PWR chemical and volume control system (VII.E1).

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the closed-cycle cooling water system include the open-cycle cooling water system (VII.C1), the PWR spent fuel pool cooling and cleanup system (VII.A3), the BWR spent fuel pool cooling and cleanup system (VII.A4), the PWR chemical and volume control system (VII.E1), the BWR reactor water cleanup system (VII.E3), the shutdown cooling system (older BWR, VII.E4), the primary containment heating and ventilation system (VII.F3), fire protection (VII.G), the emergency diesel generator system (VII.H2), the PWR containment

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spray system (V.A), the PWR and BWR emergency core cooling systems (V.D1 and V.D2), the PWR steam generator blowdown system (VIII.F), the condensate system (VIII.E), and the PWR auxiliary feedwater system (VIII.G).

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VII AUXILIARY SYSTEMS
C2 Closed-Cycle Cooling Water System

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C2.AP-259		Elastomer seals and components	Elastomers	Closed-cycle cooling water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
VII.C2.AP-189	VII.C2-1(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-205	VII.C2-2(AP-80)	Heat exchanger tubes	Copper Alloy	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-188	VII.C2-3(AP-63)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-254		Piping, piping components, and piping elements	Aluminum	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-257		Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.C2.AP-199	VII.C2-4(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-133	VII.C2-5(AP-47)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No

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VII AUXILIARY SYSTEMS
C2 Closed-Cycle Cooling Water System

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C2.AP-43	VII.C2-6(AP-43)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C2.AP-32	VII.C2-7(AP-32)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C2.A-50	VII.C2-8(A-50)	Piping, piping components, and piping elements	Gray cast iron	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C2.AP-31	VII.C2-9(AP-31)	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C2.A-52	VII.C2-10(A-52)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-186	VII.C2-11(AP-60)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.C2.AP-138	VII.C2-12(AP-59)	Piping, piping components, and piping elements	Stainless steel	Lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No

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VII C2	AUXILIARY SYSTEMS Closed-Cycle Cooling Water System						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.C2.AP-127	VII.C2-13(AP-30)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.C2.AP-209		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.C2.AP-221		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.C2.AP-202	VII.C2-14(A-25)	Piping, piping components, and piping elements; tanks	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

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C3. ULTIMATE HEAT SINK

Systems, Structures, and Components

The ultimate heat sink (UHS) consists of a lake, ocean, river, spray pond, or cooling tower. The UHS provides sufficient cooling water for safe reactor shutdown and reactor cooldown via the residual heat removal system or other similar system. Due to the varying configurations of connections to lakes, oceans, and rivers, a plant-specific aging management program (AMP) is required. Appropriate AMPs shall be provided to trend and project (1) deterioration of earthen dams and impoundments; (2) rate of silt deposition; (3) meteorological, climatological, and oceanic data since obtaining the Final Safety Analysis Report (FSAR) data; (4) water level extremes for plants located on rivers; and (5) aging degradation of all upstream and downstream dams affecting the UHS.

The systems, structures, and components included in this section consist of piping, valves, and pumps. The cooling tower is addressed in this report on water-control structures (III.A6). The ultimate heat sink absorbs heat from the residual heat removal system or other similar system. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the piping and valves used for the ultimate heat sink are governed by Group C Quality Standards.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the ultimate heat sink include the open-cycle cooling water system (VII.C1) and the PWR and BWR emergency core cooling systems (V.D1 and V.D2).

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VII AUXILIARY SYSTEMS
C3 Ultimate Heat Sink

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C3.AP-187	VII.C3-1(AP-61)	Heat exchanger tubes	Stainless steel	Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C3.AP-195	VII.C3-2(A-43)	Piping, piping components, and piping elements	Copper alloy	Raw water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C3.A-47	VII.C3-3(A-47)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Raw water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C3.A-51	VII.C3-4(A-51)	Piping, piping components, and piping elements	Gray cast iron	Raw water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C3.A-02	VII.C3-5(A-02)	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.C3.AP-206	VII.C3-6(AP-53)	Piping, piping components, and piping elements	Nickel alloy	Raw water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C3.A-53	VII.C3-7(A-53)	Piping, piping components, and piping elements	Stainless steel	Raw water	Loss of material due to pitting and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C3.AP-137	VII.C3-8(AP-56)	Piping, piping components, and piping elements	Stainless steel	Soil	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No

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VII AUXILIARY SYSTEMS
C3 Ultimate Heat Sink

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.C3.AP-194	VII.C3-10(A-38)	Piping, piping components, and piping elements	Steel (with coating or lining)	Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion; lining/coating degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	No
VII.C3.AP-198	VII.C3-9(A-01)	Piping, piping components, and piping elements	Steel (with coating or wrapping)	Soil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No
VII.C3.AP-209		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.C3.AP-221		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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D. COMPRESSED AIR SYSTEM

Systems, Structures, and Components

This section discusses the compressed air system, which consists of piping, valves (including containment isolation valves), air receivers, pressure regulators, filters, and dryers. The system components and piping are located in various buildings at most nuclear power plants. Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components of the compressed air system are classified as Group D Quality Standards, with the exception of those forming part of the containment penetration boundary, which are Group B. However, the cleanliness of these components and high air quality is to be maintained because the air provides the motive power for instruments and active components (some of them safety-related) that may not function properly if nonsafety Group D equipment is contaminated.

With respect to filters, these items are to be addressed consistent with the Nuclear Regulatory Commission (NRC) position on consumables, provided in the NRC letter from Christopher I. Grimes to Douglas J. Walters of the Nuclear Energy Institute (NEI), dated March 10, 2000. Specifically, components that function as system filters are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from an aging management review under 10 CFR 54.21(a)(1)(ii). As part of the methodology description, the application should identify the standards that are relied on for replacement, for example, National Fire Protection Association (NFPA) standards for fire protection equipment.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

Various other systems discussed in this report may interface with the compressed air system.

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VII AUXILIARY SYSTEMS
D Compressed Air System

Item	Link	Structure and/ or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.D.AP-121	VII.D-1(A-103)	Closure bolting	Steel; stainless steel	Condensation	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No
VII.D.A-80	VII.D-3(A-80)	Piping and components (External surfaces)	Steel	Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No
VII.D.AP-240		Piping, piping components, and piping elements	Copper alloy	Condensation	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M24, “Compressed Air Monitoring"	No
VII.D.AP-81	VII.D-4(AP-81)	Piping, piping components, and piping elements	Stainless steel	Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M24, “Compressed Air Monitoring”	No
VII.D.A-26	VII.D-2(A-26)	Piping, piping components, and piping elements: compressed air system	Steel	Condensation (Internal)	Loss of material due to general and pitting corrosion	Chapter XI.M24, “Compressed Air Monitoring”	No
VII.D.AP-209		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.D.AP-221		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated

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E1. CHEMICAL AND VOLUME CONTROL SYSTEM (PRESSURIZED WATER REACTOR)

Systems, Structures, and Components

This section discusses a portion of the pressurized water reactor (PWR) chemical and volume control system (CVCS). The portion of the PWR CVCS covered in this section extends from the isolation valves associated with the reactor coolant pressure boundary (and Code change as discussed below) to the volume control tank. This portion of the PWR CVCS consists of high- and low-pressure piping and valves (including the containment isolation valves), regenerative and letdown heat exchangers, pumps, basket strainers, and the volume control tank. The system contains chemically treated borated water; the shell side of the letdown heat exchanger contains closed-cycle cooling water (treated water).

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the CVCS are governed by Group C Quality Standards. Portions of the CVCS extending from the reactor coolant system up to and including the isolation valves associated with reactor coolant pressure boundary are governed by Group A Quality Standards and covered in IV.C2.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the chemical and volume control system include the reactor coolant system (IV.C2), the emergency core cooling system (V.D1), the spent fuel pool cooling system (VII.A3), and the closed-cycle cooling water system (VII.C2).

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VII AUXILIARY SYSTEMS
E1 Chemical and Volume Control System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E1.A-79	VII.E1-1(A-79)	External surfaces	Steel	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No
VII.E1.AP-203	VII.E1-2(AP-34)	Heat exchanger components	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E1.AP-65	VII.E1-3(AP-65)	Heat exchanger components	Copper alloy (>15% Zn or >8% Al)	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E1.AP-118	VII.E1-5(A-84)	Heat exchanger components	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E1.AP-189	VII.E1-6(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E1.A-100	VII.E1-4(A-100)	Heat exchanger components and tubes	Stainless steel	Treated borated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
VII.E1.AP-119	VII.E1-5(A-84)	Heat exchanger components and tubes	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No

VII AUXILIARY SYSTEMS
E1 Chemical and Volume Control System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E1.A-69	VII.E1-9(A-69)	Heat exchanger components, non-regenerative	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking; cyclic loading	Chapter XI.M2, "Water Chemistry." The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes, plant-specific
VII.E1.AP-115	VII.E1-7(A-76)	High-pressure pump, casing	Stainless steel	Treated borated water	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No
VII.E1.AP-114	VII.E1-7(A-76)	High-pressure pump, casing	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No
VII.E1.AP-122	VII.E1-8(A-104)	High-pressure pump, closure bolting	Steel, high-strength	Air with steam or water leakage	Cracking due to stress corrosion cracking; cyclic loading	Chapter XI.M18, "Bolting Integrity"	No
VII.E1.AP-1	VII.E1-10(AP-1)	Piping, piping components, and piping elements	Aluminum	Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No
VII.E1.AP-199	VII.E1-11(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No

VII AUXILIARY SYSTEMS
E1 Chemical and Volume Control System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E1.AP-133	VII.E1-12(AP-47)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.E1.AP-43	VII.E1-13(AP-43)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E1.AP-31	VII.E1-14(AP-31)	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E1.AP-138	VII.E1-15(AP-59)	Piping, piping components, and piping elements	Stainless steel	Lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.E1.A-57	VII.E1-16(A-57)	Piping, piping components, and piping elements	Stainless steel	Treated borated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

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VII AUXILIARY SYSTEMS
E1 Chemical and Volume Control System (PWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E1.A-34	VII.E1-18(A-34)	Piping, piping components, and piping elements	Steel	Air - indoor, uncontrolled	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
VII.E1.AP-127	VII.E1-19(AP-30)	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.E1.AP-79	VII.E1-17(AP-79)	Piping, piping components, and piping elements	Steel (with stainless steel cladding); stainless steel	Treated borated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No
VII.E1.AP-209		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.E1.AP-221		Piping, piping components, and piping elements; tanks	Stainless steel	Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated
VII.E1.AP-82	VII.E1-20(AP-82)	Piping, piping components, and piping elements; tanks	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No

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VII E1	AUXILIARY SYSTEMS Chemical and Volume Control System (PWR)						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.E1.AP-85	VII.E1-21(AP-85)	Pump Casings	Steel (with stainless steel or nickel-alloy cladding)	Treated borated water	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes, verify that plant-specific program addresses clad cracking

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E2. STANDBY LIQUID CONTROL SYSTEM (BOILING WATER REACTOR)

Systems, Structures, and Components

This section discusses the portion of the standby liquid control (SLC) system extending from the containment isolation valve to the solution storage tank. The system serves as a backup reactivity control system in all boiling water reactors (BWRs). The major components of this system are the piping, the solution storage tank, the solution storage tank heaters, valves, and pumps. All of the components from the storage tank to the explosive actuated discharge valve operate in contact with a sodium pentaborate ($Na_2B_{10}O_{16}{\cdot}10H_2O$) solution.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the standby liquid control system are governed by Group B Quality Standards. The portions of the standby liquid control system extending from the reactor coolant pressure boundary up to and including the containment isolation valves are governed by Group A Quality Standards and are covered in IV.C1.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The system that interfaces with the SLC system is the BWR reactor pressure vessel (IV.A1). If used, the SLC system would inject sodium pentaborate solution into the pressure vessel near the bottom of the reactor core.

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VII AUXILIARY SYSTEMS
E2 Standby Liquid Control System (BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E2.AP-141	VII.E2-1(AP-73)	Piping, piping components, and piping elements	Stainless steel	Sodium pentaborate solution	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E2.AP-181	VII.E2-2(A-59)	Piping, piping components, and piping elements	Stainless steel	Sodium pentaborate solution >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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E3. REACTOR WATER CLEANUP SYSTEM (BOILING WATER REACTOR)

Systems, Structures, and Components

This section discusses the reactor water cleanup (RWCU) system, which provides for cleanup and particulate removal from the recirculating reactor coolant in all boiling water reactors (BWRs). Some plants may not include the RWCU system in the scope of license renewal, while other plants may include the RWCU system because it is associated with safety-related functions.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the portion of the RWCU system extending from the reactor coolant recirculation system up to and including the containment isolation valves are covered in IV.C1. The remainder of the system outboard of the isolation valves is governed by Group C Quality Standards. In this table, only aging management programs for RWCU-related piping and components outboard of the isolation valves are evaluated. The aging management program for containment isolation valves in the RWCU system is evaluated in IV.C1, which concerns the reactor coolant pressure boundary in BWRs.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the BWR reactor water cleanup system include the reactor coolant pressure boundary (IV.C1), the closed-cycle cooling water system (VII.C2), and the condensate system (VIII.E).

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VII AUXILIARY SYSTEMS
E3 Reactor Water Cleanup System

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E3.AP-191	VII.E3-1(A-67)	Heat exchanger components	Stainless steel; steel with stainless steel cladding	Closed-cycle cooling water	Loss of material due to microbiologically-influenced corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.AP-192	VII.E3-2(A-68)	Heat exchanger components	Stainless steel; steel with stainless steel cladding	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.AP-112	VII.E3-3(A-71)	Heat exchanger components	Stainless steel; steel with stainless steel cladding	Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E3.AP-189	VII.E3-4(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.AP-188	VII.E3-5(AP-63)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.AP-139	VII.E3-6(AP-62)	Heat exchanger tubes	Stainless steel	Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E3.AP-130	VII.E3-7(AP-38)	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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VII AUXILIARY SYSTEMS
E3 Reactor Water Cleanup System

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E3.AP-199	VII.E3-8(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.AP-140	VII.E3-9(AP-64)	Piping, piping components, and piping elements	Copper alloy	Treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E3.AP-43	VII.E3-10(AP-43)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E3.AP-32	VII.E3-11(AP-32)	Piping, piping components, and piping elements	Copper alloy (>15% Zn or >8% Al)	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E3.AP-31	VII.E3-12(AP-31)	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No
VII.E3.AP-186	VII.E3-13(AP-60)	Piping, piping components, and piping elements	Stainless steel	Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E3.A-62	VII.E3-14(A-62)	Piping, piping components, and piping elements	Stainless steel	Treated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA

VII AUXILIARY SYSTEMS
E3 Reactor Water Cleanup System

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E3.AP-110	VII.E3-15(A-58)	Piping, piping components, and piping elements	Stainless steel	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E3.AP-283	VII.E3-16(A-60)	Piping, piping components, and piping elements	Stainless steel	Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M25, “BWR Reactor Water Cleanup System”	No
VII.E3.A-34	VII.E3-17(A-34)	Piping, piping components, and piping elements	Steel	Air - indoor, uncontrolled	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA
VII.E3.AP-106	VII.E3-18(A-35)	Piping, piping components, and piping elements	Steel	Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E3.AP-120	VII.E3-19(A-85)	Regenerative heat exchanger components	Stainless steel	Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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E4. SHUTDOWN COOLING SYSTEM (OLDER BWR)

Systems, Structures, and Components

This section discusses the shutdown cooling (SDC) system for older vintage boiling water reactors (BWRs) and consists of piping and fittings, the SDC system pump, the heat exchanger, and valves.

Based on Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components that comprise the SDC system are governed by Group B Quality Standards. Portions of the SDC system extending from the reactor coolant pressure boundary up to and including the containment isolation valves are governed by Group A Quality Standards and are covered in IV.C1.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

The systems that interface with the SDC system include the reactor coolant pressure boundary (IV.C1) and the closed-cycle cooling water system (VII.C2).

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VII AUXILIARY SYSTEMS
E4 Shutdown Cooling System (Older BWR)

Item	Link	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
VII.E4.AP-191	VII.E4-1(A-67)	Heat exchanger components	Stainless steel; steel with stainless steel cladding	Closed-cycle cooling water	Loss of material due to microbiologically-influenced corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E4.AP-189	VII.E4-2(A-63)	Heat exchanger components	Steel	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E4.AP-188	VII.E4-3(AP-63)	Heat exchanger tubes	Stainless steel	Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E4.AP-130	VII.E4-4(AP-38)	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No
VII.E4.AP-199	VII.E4-5(AP-12)	Piping, piping components, and piping elements	Copper alloy	Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No
VII.E4.AP-133	VII.E4-6(AP-47)	Piping, piping components, and piping elements	Copper alloy	Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No
VII.E4.AP-140	VII.E4-7(AP-64)	Piping, piping components, and piping elements	Copper alloy	Treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No

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