CHAPTER V

(August 2000)

ENGINEERED SAFETY FEATURES

Major Plant Sections

A. Containment Spray System (Pressurized Water Reactor)

B. Standby Gas Treatment System (Boiling Water Reactor)

C. Containment Isolation Components

D1. Emergency Core Cooling System (Pressurized Water Reactor)

D2. Emergency Core Cooling System (Boiling Water Reactor)

E. Carbon Steel Components

A Containment Spray System (Pressurized Water Reactor)

A.1 Containment Spray System

A.1.1 Piping and Fittings up to Isolation Valve

A.1.2 Flow Orifice/Elements

A.1.3 Temperature Elements/Indicators

A.1.4 Bolting

A.1.5 Eductors

A.2 Header and Spray Nozzles System

A.2.1 Piping and Fittings

A.2.2 Flow Orifice

A.2.3 Headers

A.2.4 Spray Nozzles

A.3 Pumps

A.3.1 Bowl/Casing

A.3.2 Bolting

A.4 Valves (Hand, Control, Check, Motor-Operated) in Containment Spray System

A.4.1 Body and Bonnet

A.4.2 Bolting

A.5 Valves (Hand, Control) in Header and Spray Nozzle System

A.5.1 Body and Bonnet

A.5.2 Bolting

A.6 Containment Spray Heat Exchanger

A.6.1 Bonnet/Cover

A.6.2 Tubing

A.6.3 Shell

A.6.4 Case/Cover

A.6.5 Bolting

A. Containment Spray System (Pressurized Water Reactors)

System, Structures, and Components

The system, structures, and components included in this table comprise the containment spray system for pressurized water reactors (PWRs) designed to lower the pressure and 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 the containment isolation valves, flow elements and orifices, pumps, spray nozzles, eductors, and containment spray system heat exchanger (some plants). Based on the Nuclear Regulatory Commission Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components in the containment spray system outside or inside the containment are classified as Group B Quality Standards.

The pumps and valves internals are considered to be active components. They 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, and are not subject to aging management review pursuant to 10 CFR 54.21(a)(1)(i and ii).

System Interfaces

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

V ENGINEERED SAFETY FEATURES

A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.1.1 – A.1.3	Containment Spray System	Piping and Fittings up to Isolation Valve, Flow Orifice/ Elements, Temperature Elements/ Indicators	Stainless Steel (SS)	Chemically Treated Borated Water (CTBW) at Maximum Design Temperature of ≈205°C (400°F)	Crack Initiation and Growth	Stress Corrosion Cracking (SCC)	ASME Section XI, (1989 or later edition as approved in 10 CFR 50.55a) Reg. Guide 1.44. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. EPRI TR-105714. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC, and water chemistry program for minimizing impurities by monitoring and maintaining water chemistry conditions based on guidelines of EPRI TR-105714 for primary water chemistry and plant technical specifications for refueling water storage tank water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of containment spray system components. ***(2) Preventive Actions:*** Control of halogens, sulfates, and oxygen in the primary water is in accordance with the EPRI guidelines of TR-105714 Rev. 3 or later updates/revisions. However, inadvertent introduction of contaminants into the coolant system can occur, e.g., contaminants in the boric acid, or introduced through the free surface of spent fuel pool [NRC Information Notice (IN) 84–18], or from water from the sump. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. Other means of mitigation include selection of material in compliance with the guidelines of Regulatory Guide 1.44 for reduced sensitization of SS. ***(3) Parameters Monitored/Inspected:*** The AMP monitors the effects of SCC on the intended function of the piping by control of primary water chemistry and by detection and sizing of cracks by ISI. Concentrations of corrosive impurities are monitored and water quality is maintained in accordance with the EPRI water chemistry guidelines. Inspection requirements of IWC 2500-1 category C-F-1, specify for circumferential and longitudinal welds in each pipe or branch run NPS 4 or larger, volumetric and surface examination of ID region, and surface examination of OD surface. Surface examination is conducted for circumferential and longitudinal welds in each pipe or branch run less than NPS 4. ***(4) Detection of Aging Effects:*** Degradation of piping and fittings due to SCC can not occur without crack initiation; inspection schedule assures detection of cracks before the loss of intended function of the piping. ***(5) Monitoring and Trending:*** Inspection schedule in accordance with IWC-2400 should provide timely detection of cracks. System leakage test is conducted once every inspection period (40 months), and hydrostatic test at or near the end of each inspection interval. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. Supplementary surface examination may be performed on interior and/or exterior surfaces when flaws are detected in volumetric examination. ***(7) Corrective Actions:*** Repairs are in conformance with IWA-4000, replacement according to IWA-7000, and reexamination in accordance with requirements of IWA-2200. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B,	No

V ENGINEERED SAFETY FEATURES

A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.1.4	Containment Spray System	Bolting	Carbon Steel (CS), Low-Alloy Steel (LAS)	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	NRC GL 88-05. ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), NRC IN 86-108 S3.
A.1.5	Containment Spray System	Eductors	SS	CTBW	Crack Initiation and Growth	SCC	*Same as for the effect of SCC on containment spray system components (A.1.1-A.1.3).*
A.2.1 - A.2.4	Header and Spray Nozzles System	Piping and Fittings, Flow Orifice, Headers, Spray Nozzles	CS	Air	Loss of Material	General Corrosion, Pitting, and Crevice Corrosion	-
A.3.1	Pump	Bowl/Casing	SS	CTBW	Crack Initiation and Growth	SCC	ASME Section XI, (1989 or later edition as approved in 10 CFR 50.55a). Reg. Guide 1.44. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. EPRI TR-105714 Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** SCC has occurred in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), instrument nozzles in safety injection tanks (IN 91-05), and safety-related SS piping systems which contain oxygenated, stagnant, or essentially stagnant borated water (IN 97-19).	
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
Same as for the effect of SCC on containment spray system components (A.1.1-A.1.3).	*Same as for the effect of SCC on containment spray system components (A.1.1-A.1.3).*	No
Plant specific aging management program.	Plant specific aging management program is to be evaluated.	Yes, plant specific
Inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC, and water chemistry program for minimizing impurities by monitoring and maintaining water chemistry conditions based on guidelines of EPRI TR-105714 for primary water chemistry and plant technical specifications for refueling water storage tank water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of containment spray system components. ***(2) Preventive Actions:*** Control of halogens, sulfates, and oxygen in the primary water is in accordance with the EPRI guidelines of TR-105714 Rev. 3 or later updates/revisions. However, inadvertent introduction of contaminants into the coolant system can occur, e.g., contaminants in the boric acid, or introduced through the free surface of spent fuel pool [NRC Information Notice (IN) 84–18], or from water from the sump. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. Other means of mitigation include selection of material in compliance with the guidelines of Regulatory Guide 1.44 for reduced sensitization of SS. ***(3) Parameters Monitored/Inspected:*** The AMP monitors the effects of SCC on the intended function of the piping by control of primary water chemistry and by detection and sizing of cracks by ISI. Concentrations of corrosive impurities are monitored and water quality is maintained in accordance with the EPRI water chemistry guidelines. Inspection requirements of IWC 2500-1 category C-G, specifies surface examination of either the inside or outside surface of all welds extending 1/2 in. on either side of the weld. In a group of multiple pumps of similar design, size, function, and service in a system, examination of only one pump is required to detect the loss of intended function of the	No

V ENGINEERED SAFETY FEATURES

A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.3.2	Pump	Bolting	CS, LAS	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion on containment spray system bolting (A.1.4)*

V ENGINEERED SAFETY FEATURES

A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(Continued from previous page) pump. ***(4) Detection of Aging Effects:*** Degradation of piping and fittings due to SCC can not occur without crack initiation; inspection schedule assures detection of cracks before the loss of intended function of the piping. ***(5) Monitoring and Trending:*** Inspection schedule in accordance with IWC-2400 should provide timely detection of cracks. System leakage test is conducted once every inspection period (40 months), and hydrostatic test at or near the end of each inspection interval. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. Supplementary surface examination may be performed on interior and/or exterior surfaces when flaws are detected in volumetric examination. ***(7) Corrective Actions:*** Repairs are in conformance with IWA-4000, replacement according to IWA-7000, and reexamination in accordance with requirements of IWA-2200. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** SCC has occurred in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), instrument nozzles in safety injection tanks (IN 91-05), and safety-related SS piping systems which contain oxygenated, stagnant, or essentially stagnant borated water (IN 97-19).	No
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.4.1	Valves (Hand, Control, Check, and Motor-Operated Valves) in Containment Spray System	Body and Bonnet	SS	CTBW	Crack Initiation and Growth	SCC	ASME Section XI, (1989 or later edition as approved in 10 CFR 50.55a), Reg. Guide 1.44. NRC BL 89-02. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19 EPRI TR-105714. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC, and water chemistry program for minimizing impurities by monitoring and maintaining water chemistry conditions based on guidelines of EPRI TR-105714 for primary water chemistry and plant technical specifications for refueling water storage tank water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of containment spray system components. ***(2) Preventive Actions:*** Control of halogens, sulfates, and oxygen in the primary water is in accordance with the EPRI guidelines of TR-105714 Rev. 3 or later updates/revisions. However, inadvertent introduction of contaminants into the coolant system can occur, e.g., contaminants in the boric acid, or introduced through the free surface of spent fuel pool [NRC Information Notice (IN) 84–18], or from water from the sump. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. Other means of mitigation include selection of material in compliance with the guidelines of Regulatory Guide 1.44 for reduced sensitization of SS. ***(3) Parameters Monitored/Inspected:*** The AMP monitors the effects of SCC on the intended function of the piping by control of primary water chemistry and by detection and sizing of cracks by ISI. Concentrations of corrosive impurities are monitored and water quality is maintained in accordance with the EPRI water chemistry guidelines. Inspection requirements of Table IWC 2500-1, category C-G specify for all valves in each piping run examined under category C-F, surface examination of either the inside or outside surface of all welds extending 1/2 in. on either side of the weld. In a group of multiple valves of similar design, size, function, and service in a system, examination of only one valve is required. ***(4) Detection of Aging Effects:*** Degradation of piping and fittings due to SCC can not occur without crack initiation; inspection schedule assures detection of cracks before the loss of intended function of the piping. ***(5) Monitoring and Trending:*** Inspection schedule in accordance with IWC-2400 should provide timely detection of cracks. System leakage test is conducted once every inspection period (40 months), and hydrostatic test at or near the end of each inspection interval. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. Supplementary surface examination may be performed on interior and/or exterior surfaces when flaws are detected in volumetric examination. ***(7) Corrective Actions:*** Repairs are in conformance with IWA-4000, replacement according to IWA-7000, and reexamination in accordance with requirements of IWA-2200. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.4.2	Valves (Hand, Control, Check, and Motor-Operated Valves) in Containment Spray System	Bolting	CS, LAS	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion on containment spray system bolting (A.1.4)*
A.5.1	Valves (Hand and Control Valves) in Header and Spray Nozzles System	Body and Bonnet	CS	Air	Loss of Material	General, Pitting, and Crevice Corrosion	-
A.5.2	Valves (Hand and Control Valves) in Header and Spray Nozzles System	Bolting	CS, LAS	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion on containment spray system bolting (A.1.4)*
A.6.1 - A.6.4	Containment Spray Heat Exchanger (Serviced by Open-Cycle Cooling Water)	Bonnet/Cover, Tubing, Shell, Case/Cover,	CS, SS	CTBW on One Side and Open-Cycle Cooling Water (Raw Water) on the Other Side	Loss of Material	General and Microbio-logically influenced Corrosion	NRC GL 89-13. NRC GL 89-13, Supplement 1. NRC IN 81-21. NRC IN 85-24. NRC IN 85-30. NRC IN 86-96.
A.6.1 - A.6.4	Containment Spray Heat Exchanger (Serviced by Open Cycle Cooling Water)	Bonnet/Cover, Tubing, Shell, Case/Cover	CS, SS	CTBW on One Side and Open Cycle Cooling Water (Raw Water) on the Other Side	Buildup of Deposit	Biofouling	*Same as for the effect of general and microbiologically influenced corrosion on containment spray heat exchanger components (A.6.1-A.6.4).*

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(Continued from previous page) controls. ***(10) Operating Experience:*** SCC has occurred in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), instrument nozzles in safety injection tanks (IN 91-05), and safety-related SS piping systems which contain oxygenated, stagnant, or essentially stagnant borated water (IN 97-19).	
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
Plant specific aging management program.	Plant specific aging management program is to be evaluated.	Yes, plant specific
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
For description of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	No
For description of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	No

V ENGINEERED SAFETY FEATURES

A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.6.1 - A.6.4	Containment Spray Heat Exchanger (Serviced by Closed-Cycle Cooling Water)	Bonnet/Cover, Shell, Case/Cover, Tubing	CS, SS	CTBW on Tube Side and Closed-Cycle Cooling Water (Treated Water) on Shell Side.	Loss of Material	General Corrosion, pitting and Crevice Corrosion	NRC GL 89-13. NRC GL 89-13, Supplement 1. ASME OM S/G, Part 2.
A.6.3 - A.6.5	Containment Spray Heat Exchanger	Shell, Case/Cover, (External Surfaces); Bolting	CS, LAS	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion on containment spray system bolting (A.1.4).*

V ENGINEERED SAFETY FEATURES
A. CONTAINMENT SPRAY SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	No
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No

B Standby Gas Treatment System (Boiling Water Reactor)

B.1 Ductwork

B.1.1 Duct, Fittings, Access Doors, and Closure Bolts

B.1.2 Equipment Frames and Housing

B1.3 Seals between Ducts and Fan

B1.4 Seals in Dampers and Doors

B.2 Filters

B.2.1 Housing and Supports

B.2.2 Charcoal Absorber Filter

B.2.3 Elastomer Seals

B. Standby Gas Treatment System (Boiling Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the standby gas treatment system found in boiling water reactors (BWRs) and consist of ductwork, filters, and fans. Based on the Nuclear Regulatory Commission Regulatory Guide 1.26, “Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants,” all components in the standby gas treatment system are classified as Group B Quality Standards.

System Interfaces

No system interfaces with the standby gas treatment system.

V ENGINEERED SAFETY FEATURES
B. STANDBY GAS TREATMENT SYSTEMS (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
B.1.1, B.1.2	Ductwork	Fittings, Access Doors, and Closure Bolts; Equipment Frames and Housing	Carbon steel (CS)	Internal: Occasional exposure to Moist Air; External: Ambient Plant Air Environ-ment	Loss of Material	General, Crevice, and Pitting Corrosion	-
B.1.3, B.1.4	Ductwork	Seals between Ducts and Fan, Seals in Dampers and Doors	Elastomer (Neoprene)	Internal: Occasional exposure to Moist Air; External: Ambient Plant Air Environ-ment	Hardening and Loss of Strength	Elastomer Degrada-tion	-
B.2.1	Filters	Housing and Supports	CS, Stainless Steel (SS)	Internal: Occasional exposure to Moist Air; External: Ambient Plant Air Environ-ment	Loss of Material	General, Crevice, and Pitting Corrosion	-
B.2.2	Filters	Charcoal Absorber Filter	Activated Charcoal	Occasional exposure to Moist Air	Loss of Iodine Retention Capacity	Absorption of Moisture	-
B.2.3	Filters	Elastomer Seals	Elastomers (neoprene and similar materials)	Occasional exposure to Moist Air	Hardening and Loss of Strength	Elastomer Degrada-tion	-

V ENGINEERED SAFETY FEATURES
B. STANDBY GAS TREATMENT SYSTEMS (Boiling Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific

C. Containment Isolation Components

C.1 Purge/Vent Valve

C.1.1 Valve Disc Seal

C.2 Isolation Barriers

C.2.1 Valve Body and Bonnet

C.2.2 Pipe Penetrations

C. Containment Isolation Components

System, Structures, and Components

The system, structures, and components included in this table comprise the containment isolation components found in all designs of boiling water reactors (BWR) and pressurized water reactors (PWR) in the U.S. The system consists of purge and vent valves, and isolation barriers in lines for BWR and PWR non-safety systems such as plant heating, waste gas, plant drain, liquid waste, and cooling water. Based on the Nuclear Regulatory Commission Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components in the containment isolation components are classified as Group A or B Quality Standards. The aging management programs for hatchways, hatch doors, penetration sleeves, penetration bellows, and seals, gaskets and anchors are addressed in Tables II A and II B. The containment isolation valves for in-scope systems are addressed in Chapters IV, VII and VIII.

System Interfaces

None of the systems addressed in this report interface with the containment isolation components addressed in this section.

V ENGINEERED SAFETY FEATURES

C. Containment Isolation Components

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
C.1.1	Purge/Vent Valve	Valve Disc Seal	Elastomers: Nitrile, Ethylene Propylene	Air; Occasional Leaking Borated Water (PWRs) or Oxygenated Water (BWRs)	Changes in Hardness, Compression Strength, & Physical Properties	Elastomer Degrada-tion	ASME Code Section XI (1992 or later edition. as approved in 10 CFR 50.55a). 10 CFR 50, Appendices B and J.
C.2.1 C.2.2	BWR and PWR Isolation Barriers	Valve Body and Bonnet, Pipe Penetrations (piping between two isolation valves)	CS Low-Alloy Steel, and SS	Inside Surface: Treated or Raw Water, Gaseous or Liquid Waste, Outside Surface: Ambient Air	Loss of Material	General, Pitting, and Crevice Corrosion, Microbiolog ically Influenced Corrosion	-
C.2.1 C.2.2	BWR and PWR Isolation Barriers	Valve Body and Bonnet, Pipe Penetrations (piping between two isolation valves)	CS Low-Alloy Steel, and SS	Inside Surface: Treated or Raw Water, Gaseous or Liquid Waste, Outside Surface: Ambient Air	Buildup of Deposit	Biofouling	.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Elastomeric components have been designed and evaluated for specific lifetimes within the initial 40-year licensing period under 10 CFR 50, Appendix B. A similar evaluation is needed for the additional license renewal time period. During the initial 40-year licensing period, the aging management program consists of periodic visual inspections and pressure leakage rate tests in accordance with ASME Section XI (1992 or later edition as approved in 10 CFR 50.55a), Subsection IWE. A visual examination is required prior to each 10 CFR 50, Appendix J, Type A leakage rate test.	***(1) Scope of Program:*** he program relies on periodic inspections to detect degradation of the containment isolation components and leak-rate testing to manage leak-tight integrity of the containment pressure boundary. ***(2) Preventive Actions:*** The program does not address prevention of component degradation, but instead focuses on its timely detection. Preventative actions are provided by routine plant-specific maintenance procedures. ***(3) Parameters Monitored/ Inspected:*** Periodic inspection in accordance with ASME Section XI (1992 or later edition as approved in 10 CFR 50.55a), Subsection IWE, monitors seal integrity of isolation components and leak rate tests verify the leak-tight integrity of the containment pressure boundary. ***(4) Detection of Aging Effects:*** Pressure and leakage rate tests detect the presence of leaks through the containment boundary components, including the elastomer seals. ***(5) Monitoring and Trending:*** A visual examination of the containment vessel pressure retaining boundary is required prior to each leakage rate test. ***(6) Acceptance Criteria:*** Any significant degradation is reported and required further evaluation in accordance with ASME Subsection IWE-3500. ***(7, 8 & 9) Corrective Actions, Confirmation Process and Administrative Controls:*** Site corrective actions program, QA procedures, site review and approval process, and administrative controls are implemented in accordance with Appendix B to 10 CFR Part 50 requirements and will continue to be adequate for license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions, confirmation process, and administrative controls. ***(10) Operating Experience:*** No significant failure problems reported.	No
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
Plant-specific aging management program.	Plant-specific aging management program is to be evaluated.	Yes, plant specific

D1. Emergency Core Cooling System (Pressurized Water Reactor)

D1.1 Piping & Fittings

D1.1.1 Core Flood System (CFS)

D1.1.2 Residual Heat Removal (RHR) or Shutdown Cooling (SDC)

D1.1.3 High Pressure Safety Injection (HPSI)

D1.1.4 Low Pressure Safety Injection (LPSI)

D1.1.5 Connecting lines to Chemical & Volume Control System (CVCS) & Spent Fuel Pool (SFP) Cooling

D1.1.6 Lines to Emergency Sump

D1.1.7 Bolting for Flange Connections

D1.2 HPSI & LPSI Pumps

D1.2.1 Bowl/Casing

D1.2.2 Bolting

D1.2.3 Orifice

D1.3 RWT Circulation Pump

D1.3.1 Bolting

D1.4 Valves

D1.4.1 Body and Bonnet

D1.4.2 Bolting

D1.5 Heat Exchangers (RCP, HPSI, & LPSI Pump Seals; & RHR)

D1.5.1 Bonnet/Cover

D1.5.2 Tubing

D1.5.3 Shell

D1.5.4 Case/Cover

D1.5.5 Bolting

D1.6 Heat Exchangers (RWT Heating)

D1.6.1 Bonnet/Cover

D1.6.2 Tubing

D1.6.3 Shell

D1.6.4 Bolting

D1.7 Safety Injection Tank (Accumulator)

D1.7.1 Shell

D1.7.2 Manway

D1.7.3 Penetrations/Nozzles

D1.8 Refueling Water Tank (RWT)

D1.8.1 Shell

D1.8.2 Manhole

D1.8.3 Penetrations/Nozzles

D1.8.4 Bolting

D1.8.5 Buried Portion of Tank

D1. Emergency Core Cooling System (Pressurized Water Reactors)

System, Structures, and Components

The system, structures, and components included in this table comprise 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. They consist of the core flood system (CFS), residual heat removal (RHR) or shutdown cooling (SDC), high–pressure safety injection (HPSI) system, low–pressure safety injection (LPSI) system, lines to chemical and volume control system (CVCS), spent fuel pool (SFP) cooling, and emergency sump, and HPSI and LPSI pumps, pump seal coolers, RHR heat exchanger, and refueling water tank (RWT). Stainless steel components are not subject to significant general, pitting, and crevice corrosion in borated water and, therefore, are not included in this table. Based on the Nuclear Regulatory Commission Regulatory Guide 1.26, “Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants,” all components in the emergency core cooling system are classified as Group B Quality Standards. Portions of the RHR, HPSI, LPSI systems and CVCS extending from the reactor coolant system up to and including the second containment isolation valve are classified as Group A and covered in Table IV C2.

The pumps and valves internals are considered to be active components. They 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, and are not subject to aging management review pursuant to 10 CFR 54.21(a)(1)(i and ii).

System Interfaces

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

V ENGINEERED SAFETY FEATURES

D1. EMERGENCY CORE COOLING SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.1.1-D1.1.6	Piping & Fittings	Core Flood System (CFS), Residual Heat Removal (RHR), High-Pressure Safety Injection (HPSI), Low-Pressure Safety Injection (LPSI), Connecting lines to Chemical & Volume Control System (CVCS) and Spent Fuel Pool (SFP) Cooling, Lines to Emergency Sump	Stainless Steel (SS)	25–340°C (77-644°F), Chemically Treated Borated Water (CTBW)	Crack Initiation and Growth	Stress Corrosion Cracking (SCC)	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. NRC RG 1.44. EPRI TR-105714. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Based on plant technical specifications, inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWB for pressure retaining welds in Class 1 piping, e.g., CFS and other components within the containment; Subsection IWC for pressure retaining welds in Class 2 SS piping, e.g., most of the safety injection piping; and Subsection IWD test and examination for systems in support of emergency core cooling, e.g., refueling water tank (RWT) heating system. Water chemistry program for minimizing impurities by monitoring and maintaining water chemistry conditions based on guidelines of EPRI TR-105714 for primary water chemistry and plant technical specifications for refueling water storage tank water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of emergency core cooling system piping and fittings. ***(2) Preventive Actions:*** Selection of material in compliance with the guidelines of RG 1.44 prevents or mitigates SCC. Control of halogens, sulfates, and oxygen in the primary water to less than 0.05, 0.05, and 0.005 ppm, respectively, during operation, and monitor and control of water chemistry during shut down, mitigate potential of SCC. However, inadvertent introduction of contaminants into the coolant system can occur, e.g., contaminants in the boric acid, or introduced through the free surface of spent fuel pool [NRC IN 84–18], or from water from the sump. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. ***(3) Parameters Monitored/Inspected:*** The AMP monitors the effects of SCC on the intended function of the piping by control of system water chemistry and by detection and sizing of cracks by ISI. Inspection requirements of Subsections IWB and IWC specify for circumferential and longitudinal welds in each pipe or branch run NPS 4 or larger, volumetric and surface examination of ID region extending 1/4 in. on either side of the weld and 1/3 wall thickness deep, and surface examination of OD surface extending 1/2 in. on either side. Surface examination is conducted for circumferential and longitudinal welds in each pipe or branch run less than NPS 4. For socket welds, surface examination is specified of OD surface extending 1 in. on the buttered side and 1/2 in. on the other. Requirements for training and qualification of personnel and performance demonstration for procedures and equipment is according to ASME Section XI Appendices VII and VIII, or any other formal program approved by the NRC. ***(4) Detection of Aging Effects:*** Degradation of piping and fittings due to SCC can not occur without crack initiation; inspection schedule assures detection of cracks before the loss of intended function of the piping. ***(5) Monitoring and Trending:*** Inspection schedule in accordance with Subsections IWB, IWC, or IWD for Class 1, 2, or 3 piping, respectively, should provide timely detection of cracks. System leakage test is conducted once every inspection period (40 months), and hydrostatic test at or near the end of each inspection interval. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWB-3100 by comparing ISI results with the acceptance standards of IWB-3400 and IWB-3500 or IWC-3400 and IWC-3500. Planar and liner flaws are sized according to IWA-3300 and IWA-3400. Supplementary surface examination may be performed on interior and/or exterior surfaces when flaws are detected in volumetric examination. ***(7) Corrective Actions:*** Repair and replacement are in conformance with Subsections IWA and IWB, and reexamination in accordance with Subsection IWA. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions.	No

V ENGINEERED SAFETY FEATURES

D1. EMERGENCY CORE COOLING SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.1.1-D1.1.6	Piping & Fittings	Core Flood System (CFS), Residual Heat Removal (RHR), High-Pressure Safety Injection (HPSI), Low-Pressure Safety Injection (LPSI), Connecting lines to Chemical & Volume Control System (CVCS) and Spent Fuel Pool (SFP) Cooling, Lines to Emergency Sump	Cast Austenitic Stainless Steel (CASS)	25–340°C (77-644°F), CTBW	Loss of Fracture Toughness	Thermal Aging Embrittle-ment	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). Letter from Christopher I. Grimes (NRC) to Douglas J. Walters (NEI) dated 5/19/2000.
D1.1.1-D1.1.4	Piping & Fittings	CFS, RHR or SDC, HPSI, LPSI	SS	25–340°C, (77-644°F), CTBW	Cumulative Fatigue Damage	Fatigue	Design Code of Record or later approved Codes.
D1.1.7	Piping & Fittings	Bolting for Flange Connections in Items D1.1.1 through D1.1.6	Nuts: Carbon Steel (CS), Bolts/Studs Alloy steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC GL 88-05. NRC IN 86-108.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(continued from previous page) ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** Although the primary pressure boundary piping of PWRs have generally not been found to be affected by SCC because of low dissolved oxygen levels and control of primary water chemistry, potential of SCC exists from inadvertent introduction of contaminants into the primary coolant system (IN 84–18). SCC has been observed in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), and instrument nozzles in safety injection tanks (IN 91-05).	
For description of the AMP, see Chapter XI.M1, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M1, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).”	No
Components have been designed or evaluated for fatigue for a 40 y design life based on postulated cycles, according to the requirements of the Code of record or later approved Codes.	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of license renewal. See the Standard Review Plan, Section 4.3 “Metal Fatigue” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
For description of the AMP, see Chapter XI.M5, “Boric Acid Corrosion.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, “Boric Acid Corrosion.”	No

V ENGINEERED SAFETY FEATURES

D1. EMERGENCY CORE COOLING SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.2.1	HPSI & LPSI Pumps	Bowl/Casing	SS, CS with SS Cladding	25–340°C (77-644°F), CTBW	Crack Initiation and Growth	SCC	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC RG 1.44. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. EPRI TR-105714. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Based on plant technical specifications, inservice inspection in conformance with ASME Section (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC for pressure retaining welds in pumps. Water chemistry program based on EPRI guidelines of TR-105714 for minimizing impurities by monitoring and maintaining primary water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of emergency core cooling system components. (***2) Preventive Actions:*** Selection of material in compliance with the recommendations of Regulatory Guide (RG) 1.44 prevents or mitigates SCC. Control of halogens, sulfates, and oxygen in the primary water to less than 0.05, 0.05, and 0.005 ppm, respectively, during operation, and monitor and control of water chemistry during shut down, mitigate potential of SCC. However, inadvertent introduction of contaminants into the coolant system can occur. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. ***(3) Parameters Monitored/ Inspected:*** The AMP monitors the effects of SCC on the intended function of the pump by control of primary water chemistry and by detection and sizing of cracks by ISI. Inspection requirements of Subsection IWC specifies surface examination of either the inside or outside surface of all welds extending 1/2 in. on either side of the weld. In a group of multiple pumps of similar design, size, function, and service in a system, examination of only one pump is required. (***4) Detection of Aging Effects:*** Degradation of pumps due to SCC can not occur without crack initiation and growth; ISI schedule assures detection of cracks or degradation of pump performance before the loss of intended function of the pump. (***5) Monitoring and Trending:*** Inspection schedule in accordance with Subsection IWC should provide timely detection of cracks. Surface examination of welds is conducted during each inspection interval. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. (***7) Corrective Actions:*** Repair and replacement are in conformance with IWA-4000 and IWB-4000, and reexamination in accordance with requirements of IWA-2200. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. (***8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** Although the primary pressure boundary piping of PWRs have generally not been found to be affected by SCC because of low dissolved oxygen levels, potential of SCC exists from inadvertent introduction of contaminants into the primary coolant system (IN 84–18). SCC has been observed in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), and instrument nozzles in safety injection tanks (IN 91-05).	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.2.1, D1.2.2	HPSI & LPSI Pumps	Bowl/Casing (External Surfaces), Bolting	Casing: CS with SS cladding; Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	Same as for the effect of Boric Acid corrosion on Item D1.1.7, bolting for flange connections in Items D1.1.1 through D1.1.6.
D1.2.3	HPSI & LPSI Pumps)	Orifice (Miniflow Recirculation)	SS	CTBW	Loss of Material	Erosion	-
D1.3.1	RWT Circulation Pump	Bolting	Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	Same as for the effect of Boric Acid corrosion on Item D1.1.7, bolting for flange connections in Items D1.1.1 through D1.1.6.
D1.4.1	Valves (Check, Control, Hand, Motor Operated, and Relief Valves)	Body and Bonnet	SS, CS with SS Cladding	25–340°C (77-644_F), CTBW	Cumulative Fatigue Damage	Fatigue	Design Code of Record or later approved Codes.
D1.4.1	Valves (Check, Control, Hand, Motor Operated, and Relief Valves)	Body and Bonnet	SS, CS with SS Cladding	25–340°C (77-644_F), CTBW	Crack Initiation and Growth	SCC	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC RG 1.44. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19, EPRI TR-105714 Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
Plant-specific aging management program is needed to manage erosion of the orifice because of extended use of the centrifugal HPSI pump for normal charging.	Plant-specific aging management program is to be evaluated.	Yes, plant specific
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
Components have been designed or evaluated for fatigue for a 40 y design life based on postulated cycles, according to the requirements of the Code of record or later approved Codes.	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of license renewal. See the Standard Review Plan, Section 4.3 "Metal Fatigue" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA
Based on plant technical specifications, inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsections IWB and IWC for pressure retaining welds in Class 1 and Class 2 valves, respectively. Water chemistry program for minimizing impurities by monitoring and maintaining water chemistry conditions based on guidelines of EPRI TR-105714 for primary water chemistry.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of emergency core cooling system components. ***(2) Preventive Actions:*** Selection of material in compliance with the recommendations of Regulatory Guide (RG) 1.44 prevents or mitigates SCC. Control of halogens, sulfates, and oxygen in the primary water to less than 0.05, 0.05, and 0.005 ppm, respectively, during operation, and monitor and control of water chemistry during shut down, mitigate potential of SCC. However, inadvertent introduction of contaminants into the coolant system can occur. The AMP must therefore rely upon ISI in accordance with ASME Section XI to detect possible degradation. ***(3) Parameters Monitored/Inspected:*** The AMP monitors the effects of SCC on the intended function of the valves by detection and sizing of cracks by ISI. Inspection requirements of Subsection IWB for pressure	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(Continued from previous page) retaining welds in Class 1 valves: For all welds NPS 4 or larger, volumetric examination extending 1/2 in. on either side of the weld and through wall thickness, and for welds smaller than NPS 4, surface examination of OD surface extending 1/2 in. on either side of the weld, and visual VT-3 examination of internal surfaces of the valve. Inspection requirements for Subsection IWC for pressure retaining welds in Class 2 valves include surface examination of either the inside or outside surface of all welds extending 1/2 in. on either side of the weld. In a group of multiple valves of similar design, size, function, and service in a system, examination of only one valve is required. ***(4) Detection of Aging Effects:*** Degradation of valves due to SCC can not occur without crack initiation and growth; ISI schedule assures detection of cracks or degradation of valve performance before the loss of intended function of the valves. ***(5) Monitoring and Trending:*** Inspection schedule in accordance with IWB-2400 or IWC-2400 should provide timely detection of cracks. All welds are inspected each inspection period from at least one valve in each group with similar design and performing similar functions in the system. Visual examination is required only when the valve is disassembled for maintenance, repair, or volumetric examination, but at least once during the period. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWB-3400 and IWB-3500 or IWC-3400 and IWC-3500. ***(7) Corrective Actions:*** Repair and replacement are in conformance with IWA-4000 and IWB-4000. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. (***8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** Although the primary pressure boundary piping of PWRs have generally not been found to be affected by SCC because of low dissolved oxygen levels and control of primary water chemistry, significant potential of SCC exists from inadvertent introduction of contaminants into the primary coolant system (IN 84–18). SCC has been observed in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), and instrument nozzles in safety injection tanks (IN 91-05).	

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.4.1, D1.4.2	Valves (Check, Control, Hand, Motor Operated, and Relief Valves)	Body and Bonnet (External Surfaces), Bolting	Body and Bonnet: CS; Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion of Item D1.1.7 Bolting for flange connections in Items D1.1.1 through D1.1.6.*
D1.5.1-D1.5.4	Heat Exchangers (Reactor Coolant Pump Seal, HPSI Pump Seal, LPSI Pump Seal, RHR or SDC)	Bonnet/Cover, Tubing, Shell, Case/Cover	Bonnet/ Cover & Tubing: SS, Shell: CS, Case/Cover: Cast iron	CTBW; and Treated Component Cooling Water (TCCW)	Loss of Material	Crevice and Pitting Corrosion	NRC GL 89-13. NRC GL 89-13, S1. ASME OM S/G, Part 2. EPRI TR-107396.
D1.5.3-D1.5.5	Heat Exchangers (RCP Seal, HPSI Pump Seal, LPSI Pump Seal, RHR or SDC)	Shell, Case/Cover, (External Surfaces); Bolting	Shell: CS; Case/Cover: Cast iron; Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion of Item D1.1.7 Bolting for flange connections in Items D1.1.1 through D1.1.6.*
D1.6.1-D1.6.3	Heat Exchanger (RWT Heating) Serviced by Closed-Cycle Cooling Water	Bonnet and Cover, Tubing, Shell	Bonnet/ Cover & Tubing: SS, Shell: CS	CTBW and TCCW	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of Pitting and Crevice Corrosion of Item D1.5.1 through D.1.5.4 heat exchangers for RHR and seals for reactor coolant, HPSI, and LPSI pumps.*
D1.6.1-D1.6.3	Heat Exchanger (RWT Heating) Serviced by Open-Cycle Cooling Water	Bonnet and Cover, Tubing, Shell	CS, SS	CTBW on One Side and Open-Cycle Cooling Water (Raw Water) on the Other Side	Loss of Material	General and Microbio-logically Influenced Corrosion	NRC GL 89-13. NRC GL 89-13, Supplement 1. NRC IN 81-21. NRC IN 85-24. NRC IN 85-30. NRC IN 86-96.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
For description of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	No
For description of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
For description of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4, "Closed-Cycle Cooling Water System."	No
For description of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.6.1-D1.6.3	Heat Exchanger (RWT Heating) Serviced by Open-Cycle Cooling Water	Bonnet and Cover, Tubing, Shell	CS, SS	CTBW on One Side and Open-Cycle Cooling Water (Raw Water) on the Other Side	Buildup of Deposit	Biofouling	*Same as for the effect of general and microbiologically influenced corrosion on refueling water tank heat exchanger components (Items D1.6.1 through D1.6.3).*
D1.6.3, D1.6.4	Heat Exchanger (RWT Heating)	Shell (External Surface), Bolting	Shell: CS, Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion of Item D1.1.7 Bolting for flange connections in Items D1.1.1 through D1.1.6.*
D1.7.1-D1.7.3	Safety Injection Tank (Accumulator)	Shell, Manway, Penetrations/ Nozzles (All External Surface)	CS with SS Cladding	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion of Item D1.1.7 Bolting for flange connections in Items D1.1.1 through D1.1.6.*
D1.7.3	Safety Injection Tank (Accumulator)	Penetrations/ Nozzles	CS with SS cladding	CTBW	Crack Initiation and Growth	SCC	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC RG 1.44. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, "Open Cycle Cooling Water System."	No
For description of the AMP, see Chapter XI.M5**,** **"**Boric Acid Corrosion**.**"	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5**,** **"**Boric Acid Corrosion**.**"	No
For description of the AMP, see Chapter XI.M5**,** **"**Boric Acid Corrosion**.**"	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5**,** **"**Boric Acid Corrosion**.**"	No
Based on plant technical specifications, inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC examination of pressure retaining Class 2 components, and water chemistry control program based on plant technical specifications.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of the Safety Injection Tank. ***(2) Preventive Actions:*** Selection of material in compliance with the recommendations of Regulatory Guide (RG) 1.44 prevents or mitigates SCC. ***(3) Parameters Monitored/ Inspected:*** The AMP monitors the effects of SCC on the intended function of the Safety Injection Tank by detection of leakage. Inspection requirements of ASME Section XI specify visual VT-2 (IWA-5240) examination during system leakage test and system hydrostatic test of all pressure retaining Class 2 components required to operate or support the safety function, according to Table IWC 2500-1 category C-H. ***(4) Detection of Aging Effects:*** Degradation of the component due to SCC can not occur without leakage of coolant. However, visual VT-2 examination will not detect cracks. An acceptable alternative AMP consists of the following: A one-time inspection of select components and most susceptible locations in the system to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. Selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. Inspection is performed in accordance with the requirements of ASME Code, 10CFR50 Appendix B, and ASTM standards, using a variety of nondestructive techniques including visual, ultrasonic, and surface techniques. ***(5) Monitoring and Trending:*** System leakage test is conducted once every inspection period (40 months), and hydrostatic test at or near the end of each inspection	Yes, detection of aging effects should be further evaluated

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.8.1-D1.8.3	Refueling Water Tank (RWT)	Shell, Manhole, Penetrations/ Nozzles	SS	CTBW	Crack Initiation and Growth	SCC	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). NRC RG 1.44. NRC BL 89-02. NRC IN 80-38. NRC IN 84-18. NRC IN 91-05. NRC IN 94-63. NRC IN 97-19. Plant Technical Specifications.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(continued from previous page) interval. The results of one-time inspection should be usedto dictate the frequency of future inspections. ***(6) Acceptance Criteria:*** Any relevant conditions that may be detected during the leakage and hydrostatic tests are evaluated in accordance with IWC-3100 and acceptance standards of IWC-3400 and IWB-3500. Any evidence of aging effects or unacceptable results is evaluated. ***(7) Corrective Actions:*** Repair and replacement are in conformance with IWA-4000 and IWB-4000. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** SCC has been observed in safety injection lines (IN 97-19 & 84-18), charging pump casing cladding (INs 80-38 and 94-63), and instrument nozzles in safety injection tanks (IN 91-05).	No
ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWD for test and examination of systems in support of emergency core cooling, and water chemistry control program based on plant technical specifications.	***(1) Scope of Program:*** The program includes preventive measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and inservice inspection (ISI) to monitor the effects of SCC on the intended function of the RWT. ***(2) Preventive Actions:*** Selection of material in compliance with the recommendations of Regulatory Guide (RG) 1.44 prevents or mitigates SCC. Control of water chemistry is based on plant technical specifications. ***(3) Parameters Monitored/ Inspected:*** The AMP monitors the effects of SCC on intended function of the RWT by detection of leakage. Inspection requirements of ASME Section XI, Table IWD 2500-1, category D-B specify visual VT-2 (IWA-5240) examination during system leakage and hydrostatic tests of all pressure retaining Class 3 components in support of emergency core cooling. ***(4) Detection of Aging Effects:*** Degradation of the component due to SCC can not occur without leakage of coolant. However, visual VT-2 examination will not detect cracks. An acceptable alternative AMP consists of the following: A one-time inspection of select components and most susceptible locations in the system to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. Selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. Inspection is performed in accordance with the requirements of ASME Code, 10CFR50 Appendix B, and ASTM standards, using a variety of nondestructive techniques including visual, ultrasonic, and surface techniques. ***(5) Monitoring and Trending:*** Inspection schedule of ASME Section XI should provide for timely detection of leakage. System leakage test is conducted once every inspection period	Yes, detection of aging effects should be further evaluated

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.8.4	Refueling Water Tank (RWT)	Bolting	Nuts: CS, Bolts/Studs: Alloy Steel	Air, Leaking CTBW	Loss of Material	Boric Acid Corrosion	*Same as for the effect of Boric Acid Corrosion of Item D1.1.7 Bolting for flange connections in Items D1.1.1 through D1.1.6.*
D1.8.5	Refueling Water Tank (RWT)	Buried Portion of Tank (Outer Surface)	SS	Moisture, Water	Loss Of Material	Pitting and Crevice Corrosion.	-

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(40 months), and hydrostatic test at or near the end of each of each inspection interval. The results of one-time inspection should be used to dictate the frequency of future inspections. ***(6) Acceptance Criteria:*** Any relevant conditions that may be detected during the leakage and hydrostatic tests are evaluated in accordance with IWD-3000 for Class 3 components. Any evidence of aging effects or unacceptable results is evaluated. ***(7) Corrective Actions:*** Repair and replacement are in conformance with IWA-4000 and IWB-4000. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** SCC has been observed in safety injection lines (IN 97-19 and 84-18), charging pump casing cladding (INs 80-38 and 94-63), internal bolting in swing check valves (BL 89-02), and instrument nozzles in safety injection tanks (IN 91-05).	
For description of the AMP, see Chapter XI.M5**, “**Boric Acid Corrosion**.”**	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5**, “**Boric Acid Corrosion**.”**	No
Plant-specific aging management program is needed to manage 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.	Plant-specific aging management program is to be evaluated.	Yes, plant specific

D2. Emergency Core Cooling System (BWR)

D2.1 Piping & Fittings

D2.1.1 High Pressure Coolant Injection (HPCI)

D2.1.2 Reactor Core Isolation Cooling (RCIC)

D2.1.3 High-Pressure Core Spray (HPCS)

D2.1.4 Low-Pressure Core Spray (LPCS)

D2.1.5 Low Pressure Coolant Injection (LPCI) and Residual Heat Removal (RHR)

D2.1.6 Lines to Suppression Chamber (SC)

D2.1.7 Lines to Drywell and Suppression Chamber Spray System (DSCSS)

D2.1.8 Automatic Depressurization System (ADS)

D2.1.9 Lines to HPCI and RCIC Pump Turbine

D2.1.10 Lines from HPCI and RCIC Pump Turbines to Condenser

D2.2 Pumps (HPCS or HPCI Main & Booster, LPCS, LPCI or RHR, & RCIC)

D2.2.1 Bowl/Casing

D2.2.2 Suction Head

D2.2.3 Discharge Head

D2.3 Valves (Check, Control, Hand, Motor Operated, & Relief Valves)

D2.3.1 Body and Bonnet

D2.4 Heat Exchangers (RHR & LPCI)

D2.4.1 Tubes

D2.4.2 Tubesheet

D2.4.3 Channel Head

D2.4.4 Shell

D2.5 Drywell and Suppression Chamber Spray System (DSCSS)

D2.5.1 Piping and Fittings

D2.5.2 Flow Orifice

D2.5.3 Headers

D2.5.4 Spray Nozzles

D2. Emergency Core Cooling System (Boiling Water Reactors)

System, Structures, and Components

The system, structures, and components included in this table comprise 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. They consist of the high–pressure coolant injection (HPCI), reactor core isolation cooling (RCIC), high-pressure core spray (HPCS), automatic depressurization system (ADS), low-pressure core spray (LPCS), low-pressure coolant injection (LPCI) and residual heat removal (RHR), including various pumps and valves, RHR heat exchangers, and drywell and suppression chamber spray system (DSCSS). Based on the Nuclear Regulatory Commission Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants," all components in the emergency core cooling system outside the containment are classified as Group B Quality Standards and the portion of the CSS inside the containment up to the isolation valve is classified Group A Quality Standard. 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 classified as Group A and are covered in Table IV C1.

The pumps and valves internals are considered to be active components. They 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, and are not subject to aging management review pursuant to 10 CFR 54.21(a)(1)(i and ii).

System Interfaces

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

V ENGINEERED SAFETY FEATURES
D2. EMERGENCY CORE COOLING SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D2.1.1-D2.1.7	Piping & Fittings	High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), High-Pressure Core Spray (HPCS), Low-Pressure Core Spray (LPCS), Low Pressure Coolant Injection (LPCI) and Residual Heat Removal (RHR), Lines to Suppression Chamber (SC), Lines to Drywell and Suppression Chamber Spray System (DSCSS)	Carbon Steel (CS)	25–288°C, (77-550°F) Demineralized Water	Loss of Material	General, Crevice, and Pitting Corrosion	ASME Section XI, (1989 or later edition as approved in 10 CFR 50.55a). BWRVIP-29 (EPRI TR-103515, Rev. 1).
D2.1.1	Piping & Fittings	HPCI	CS, Stainless Steel (SS)	25–288°C (77-550°F) Demi-neralized Water	Cumulative Fatigue Damage	Fatigue	Design Code of Record or later approved code
D2.1.1-D2.1.7	Piping & Fittings	HPCI, RCIC, HPCS, LPCS, LPCI and RHR, Lines to SC, Lines to DSCSS	SS	25–288°C (77-550°F) Demi-neralized Water	Crack Initiation and Growth	Stress Corrosion Cracking (SCC), Inter-granular Stress Corrosion Cracking (IGSCC)	NUREG-0313, Rev. 2. NRC GL 88-01. ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). BWRVIP-29 (EPRI TR-103515, Rev. 1). NRC RG 1.45.

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M11, "Water Chemistry."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M11, "Water Chemistry."	Yes, detection of aging effects should be further evaluated
Components have been designed or evaluated for fatigue for a 40 y design life based on postulated cycles, according to the requirements of the Code of record or later approved Codes.	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of license renewal. See the Standard Review Plan, Section 4.3, "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21 (c).	Yes, TLAA
Program delineated in NUREG-0313, Rev. 2 and measures recommended in NRC Generic letter (GL) 88-01, and inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Subsection IWC for inspection of pressure retaining welds in Class 2 stainless steel piping, and testing for system leakage. Coolant water chemistry is monitored and maintained in accordance with EPRI guidelines in BWRVIP-29 (EPRI TR-103515, Rev. 1) to minimize the potential of crack initiation and growth.	***(1) Scope of Program:*** The program is focused on managing and implementing the counter measures to mitigate IGSCC and inservice inspection (ISI) to monitor IGSCC and its effects on the intended function of austenitic stainless steel (SS) piping 4 in. or larger in diameter and contains water at a temperature above 93°C (200°F) during power operation regardless of Code classification. NUREG-0313 and GL 88-01, respectively, describe the technical basis and staff guidance regarding mitigating IGSCC in BWRs. ***(2) Preventive Actions:*** Based on NUREG-0313, mitigation of IGSCC is by selection of material considered resistant to sensitization and IGSCC, e.g., low-carbon grades of austenitic SSs and weld metal, with a maximum carbon of 0.03% and minimum 7.5% ferrite in weld metal, and by special processing such as solution heat treatment, heat sink welding, and induction heating or mechanical stress improvement. Coolant water chemistry is monitored and maintained in accordance with EPRI guidelines in BWRVIP-29 to minimize the potential of crack initiation and growth. ***(3) Parameters Monitored/ Inspected:*** The AMP monitors IGSCC of austenitic SS piping by detection and sizing of cracks by implementing the inspection	No

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
	(continued from previous page) guidelines delineated in GL 88-01 including guidelines for inspection schedule, methods, personnel, sample expansion, and leak detection guidelines. ***(4) Detection of Aging Effects:*** Aging degradation of the piping can not occur without crack initiation and growth; extent and schedule of inspection as delineated in GL 88-01 is adequate and assures timely detection of cracks before the loss of intended function of austenitic SS piping and fittings. ***(5) Monitoring and Trending:*** Inspection schedule and sample size specified in Table 1 of GL 88-01 are based on the IGSCC susceptibility of each weld and are adequate for timely detection of cracks. Welds of resistant material are as a minimum examined according to an extent and frequency comparable to those of ASME Section XI. Inspection extent and schedule are enhanced for welds of non-resistant materials, or such welds that have been treated by mechanical stress improvement or reinforced by weld overlay. ***(6) Acceptance Criteria:*** Any IGSCC degradation is evaluated in accordance with IWB-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. Planar and liner flaws are evaluated according to IWA-3300 and IWA-3400. ***(7) Corrective Actions:*** The guidance for weld overlay repair, stress improvement or replacement is provided in GL 88-01, Code Case N 504-1, or ASME Section XI. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** IGSCC has occurred in small- and large-diameter BWR piping made of austenitic SSs. Significant cracking has occurred in RHR system and reactor water cleanup system piping welds. The AMP delineated in GL 88-01 has been effective in managing the effects of IGSCC in SS piping.	

V ENGINEERED SAFETY FEATURES
D2. EMERGENCY CORE COOLING SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D2.1.1-D2.1.7	Piping & Fittings	HPCI, RCIC, HPCS, LPCS, LPCI and RHR, Lines to SC, Lines to DSCSS	Cast Austenitic Stainless Steel (CASS)	25–288°C (77-550°F) Demi-neralized Water	Loss of Fracture Toughness	Thermal Aging Embrittle-ment	ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). Letter from Christopher I. Grimes (NRC) to Douglas J. Walters (NEI) dated 5/19/2000.
D2.1.8	Piping & Fittings	Automatic Depressuri-zation System (ADS)	CS, SS	Moist Contain-ment Atmosphere (Air/Nitro-gen), Steam, or Demineraliz ed Water	Loss of Material	General, Crevice, and Pitting Corrosion	-
D2.1.9, D2. 1.10	Piping & Fittings	Lines to HPCI & RCIC Pump Turbine, Lines from HPCI & RCIC Pump Turbine to Torus or Wetwell	CS	Air and Steam up to 320°C (608°F)	Wall Thinning	Flow-Accelerated Corrosion (FAC)	NUREG-1344. EPRI NSAC–202L–R2. NRC GL 89-08. NRC BL 87-01. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, S1, NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
D2.2.1-D2.2.3	Pumps HPCS or HPCI Main & Booster, LPCS, LPCI or RHR, & RCIC	Bowl/Casing, Suction Head, Discharge Head	CS Casting, CS	25–288°C (77-550°F) Demineraliz ed Water	Loss of Material	General, Crevice, and Pitting Corrosion	*Same as for the effect of General, Crevice and Pitting Corrosion on Emergency core cooling system piping and fittings (D2.1.1-D2.1.7).*
D2.3.1	Valves (Check, Control, Hand, Motor Operated, & Relief Valves)	Body and Bonnet	CS Forging, CS Casting	25–288°C (77-550°F) Demineraliz ed Water	Wall Thinning	FAC	*Same as for Flow-Accelerated Corrosion of Item D2.1.9 lines to HPCI & RCIC pump turbine and D2.1.10 lines from HPCI & RCIC pump turbine to condenser.*
D2.3.1	Valves (Check, Control, Hand, Motor Operated, & Relief Valves)	Body and Bonnet	CS Forging, CS Casting	25–288°C (77-550°F) Demineraliz ed Water	Loss of Material	General, Crevice, and Pitting Corrosion	*Same as for the effect of General, Crevice and Pitting Corrosion on emergency core cooling system piping and fittings (D2.1.1-D2.1.7).*

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M1, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M1, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).”	No
Plant specific aging management program.	Plant specific aging management program is to be evaluated.	Yes, plant specific
For description of the AMP, see Chapter XI.M6, “Flow Accelerated Corrosion.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M6, “Flow Accelerated Corrosion.”	No
Same as for the effect of General, Crevice and Pitting Corrosion on Emergency core cooling system piping and fittings (D2.1.1-D2.1.7)	*Same as for the effect of General, Crevice and Pitting Corrosion on Emergency core cooling system piping and fittings (D2.1.1-D2.1.7)*	Yes, detection of aging effects should be further evaluated
For description of the AMP, see Chapter XI.M6, “Flow Accelerated Corrosion.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M6, “Flow Accelerated Corrosion.”	No
Same as for the effect of General, Crevice and Pitting Corrosion on Emergency core cooling system piping and fittings (D2.1.1-D2.1.7)	*Same as for the effect of General, Crevice and Pitting Corrosion on Emergency core cooling system piping and fittings (D2.1.1-D2.1.7)*	Yes, detection of aging effects should be further evaluated

V ENGINEERED SAFETY FEATURES

D2. EMERGENCY CORE COOLING SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D2.3.1	Valves (Check, Control, Hand, Motor Operated, & Relief Valves)	Body and Bonnet	SS Forging, SS Casting	25–288°C (77-550°F) Demi-neralized Water	Crack Initiation and Growth	SCC	NUREG-0313, Rev. 2. NRC GL 88-01. NRC GL 88-01, Suppl. 1. ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a). BWRVIP-29 (EPRI TR-103515, Rev. 1).

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Program delineated in NUREG-0313, Rev. 2 and measures recommended in NRC Generic letter (GL) 88-01, and inservice inspection in conformance with ASME Section XI (1989 or later edition as approved in 10 CFR 50.55a), Table IWC 2500-1. Coolant water chemistry is monitored and maintained in accordance with EPRI guidelines in BWRVIP-29 (EPRI TR-103515, Rev. 1) to minimize the potential of crack initiation and growth.	***(1) Scope of Program:*** The program includes implementing counter measures to mitigate stress corrosion cracking (SCC) of stainless steel (SS) and combination of inservice inspection (ISI) to monitor SCC and its effects on the intended function of valves. NUREG-0313 and GL 88-01, respectively, describe the technical basis and staff guidance regarding mitigating IGSCC in BWRs. ***(2) Preventive Actions:*** Based on NUREG-0313, mitigation of IGSCC is by selection of material considered resistant to sensitization and IGSCC, e.g., low-carbon grades of cast SSs and weld metal, with a maximum carbon of 0.03% and minimum 7.5% ferrite. Coolant water chemistry is monitored and maintained in accordance with the EPRI guidelines in BWRVIP-29 to minimize the potential of crack initiation and growth. ***(3) Parameters Monitored/Inspected:*** The AMP monitors SCC of valves by detection and sizing of cracks by implementing the inspection schedule, methods, personnel, sample expansion, and leak detection guidelines of GL 88-01. In a group of multiple valves of similar design, size, function, and service in a system, examination of only one valve is required. ***(4) Detection of Aging Effects:*** Degradation of valves due to SCC can not occur without crack initiation and growth; ISI schedule delineated in the AMP is adequate and will assure detection of cracks or degradation of valve performance before the loss of intended function of valves. ***(5) Monitoring and Trending:*** Inspection schedule and sample size specified in Table 1 of GL 88-01 are based on the IGSCC susceptibility of each weld and are adequate for timely detection of cracks. Welds of resistant material are as a minimum examined according to an extent and frequency comparable to those of ASME Section XI. Inspection extent and schedule are enhanced for welds of non-resistant materials, or such welds that have been treated by mechanical stress improvement or reinforced by weld overlay. ***(6) Acceptance Criteria:*** Any SCC degradation is evaluated in accordance with IWC-3100 by comparing ISI results with the acceptance standards of IWC-3400 and IWC-3500. ***(7) Corrective Actions:*** Repair is in conformance with IWA-4000 and replacement is in accordance with IWA-7000. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing corrective actions. ***(8 & 9) Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of license renewal. As discussed in the appendix to this report, the staff finds 10 CFR Part 50, Appendix B, acceptable in addressing confirmation process and administrative controls. ***(10) Operating Experience:*** The comprehensive AMP outlined in GL 88-01 addresses improvements in all three elements that cause SCC, e.g., a susceptible material, significant tensile stress, and an aggressive environment, and has provided effective means of ensuring structural integrity of BWR components.	No

V ENGINEERED SAFETY FEATURES

D2. EMERGENCY CORE COOLING SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environment	Aging Effect	Aging Mechanism	References
D2.4.1-D2.4.4	Heat Exchangers (RHR & LPCI) (Serviced by Open-Cycle Cooling Water)	Tubes, Tubesheet, Channel & Head, Shell	CS, SS	Demineralized Water on One Side; Open-Cycle Cooling Water (Raw Water) on the Other Side	Loss of Material	General Corrosion and Microbiologically Influenced Corrosion (MIC)	NRC GL 89-13. NRC GL 89-13, Supplement 1. NRC IN 81-21. NRC IN 85-24. NRC IN 85-30. NRC IN 86-96.
D2.4.1 - D2.4.4	Heat Exchangers (RHR & LPCI) (Serviced by Open Cycle Cooling Water)	Tubes, Tubesheet, Channel & Head, Shell	CS, SS	Demineralized Water on One Side; Open Cycle Cooling Water (Raw Water) on the Other Side.	Buildup of Deposit	Biofouling	*Same as for General Corrosion and MIC of Items D2.4.1 through D2.4.4 RHR and LPCI heat exchanger components*
D2.4.1-D2.4.4	Heat Exchangers (RHR & LPCI) (Serviced by Closed-Cycle Cooling Water)	Tubes, Tubesheet, Channel & Head, Shell	CS, SS	Demineralized Water on One Side; Closed-Cycle Cooling Water (Treated Water) on the Other Side	Loss of Material	General Corrosion, Pitting and Crevice Corrosion	NRC GL 89-13. NRC GL 89-13, Suppl. 1. EPRI TR-107396. ASME OM S/G, Part 2.
D2.5.1 - D2.5.4	Drywell and Suppression Chamber Spray System (DSCSS)	Piping and Fittings, Flow Orifice, Headers, Spray Nozzles	CS, SS	Air	Loss of Material	General, Pitting, and Crevice Corrosion	-

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
For description of the AMP, see Chapter XI.M3, “Open Cycle Cooling Water System.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, “Open Cycle Cooling Water System.”	No
For description of the AMP, see Chapter XI.M3, “Open Cycle Cooling Water System.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3, “Open Cycle Cooling Water System.”	No
For description of the AMP, see Chapter XI.M4, “Closed-Cycle Cooling Water System.”	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4, “Closed-Cycle Cooling Water System.”	No
Plant specific aging management program.	Plant specific aging management program is to be evaluated.	Yes, plant specific

E. Carbon Steel Components

E.1 Carbon Steel Components

E.1.1 External Surfaces

E.2 Closure Bolting

E.2.1 In High-Pressure or High-Temperature Systems

E. Carbon Steel Components

System, Structures, and Components

This table includes the aging management programs for the external surfaces of all carbon steel structures and components including closure boltings in the Engineered Safety Features System in the pressurized water reactors (PWRs) and boiling water reactors (BWRs).

System Interfaces

The structures and components covered in this table belong to the Engineered Safety Features Systems in PWRs and BWRs.

V ENGINEERED SAFETY FEATURES
E. CARBON STEEL COMPONENTS

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
E.1.1	Carbon Steel Components (PWRs)	External Surfaces	Carbon Steel (CS), Low-Alloy Steel (LAS)	Air, Leaking Chemically Treated Borated Water up to 340°C (644°F)	Loss of Material	Boric Acid Corrosion of External Surfaces	NRC GL 88-05. ASME Section XI, 1989 or later Edition as approved in 10 CFR 50 55a. NRC IN 86-108 S 3.
E.1.1	Carbon Steel Components (PWRs and BWRs)	External Surfaces	CS, LAS	Air, Moisture, and Humidity	Loss of Material	Atmo-spheric Corrosion	Reg. Guide 1.54. ASTM D5163-91.
E.2.1	Closure Bolting	In High-Pressure or High-Temperature Systems	CS, LAS	Air, Moisture, Humidity, and Leaking Fluid	Loss of Material	Atmo-spheric Corrosion	NUREG-1339. EPRI NP-5769. EPRI NP-5067. ASME Section XI, 1989 or later edition as approved in 10 CFR 50.55a. NRC GL 91-17. IEB 82-02.
E.2.1	Closure Bolting	In High-Pressure or High-Temperature Systems	CS, LAS	Air, Moisture, Humidity, and Leaking Fluid	Loss of Preload	Stress Relaxation	*Same as for the effect of atmospheric corrosion on Item H.2.1 closure bolting in high-pressure high-temperature systems.*
E.2.1	Closure Bolting	In High-Pressure or High-Temperature Systems	CS, LAS	Air, Moisture, Humidity, and Leaking Fluid	Crack Initiation and Growth	Cyclic Loading, Stress Corrosion Cracking	*Same as for the effect of atmospheric corrosion on Item H.2.1 closure bolting in high-pressure high-temperature systems.*

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Implementation of NRC Generic Letter 88-05 and inservice inspection (ISI) in conformance with ASME Section XI (1989 edition or later edition as approved in 10 CFR 50.55a), Subsection IWB, Table IWB 2500-1, to monitor the condition of the reactor coolant pressure boundary for occurrences of borated water leakage. Periodic visual inspection of adjacent structures, components and supports for evidence of leakage and corrosion should be an element of the applicant's GL 88-05 monitoring program.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M5, "Boric Acid Corrosion."	No
For description of the AMP, see Chapter XI.S8 "Coating Program."	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.S8 "Coating Program."	No
The program relies on recommendations for a comprehensive bolting integrity program delineated in NUREG–1339 and industry's recommendations delineated in EPRI NP-5769, with the exceptions noted in NUREG 1339, for safety related bolting, and EPRI NP-5067 for other bolting.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M12 "Bolting Integrity."	No
Same as for the effect of atmospheric corrosion on Item H.2.1 closure bolting in high-pressure high-temperature systems.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M12 "Bolting Integrity."	No
Same as for the effect of atmospheric corrosion on Item H.2.1 closure bolting in high-pressure high-temperature systems.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M12 "Bolting Integrity."	No

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