CHAPTER VIII

(August 2000)

STEAM AND POWER CONVERSION SYSTEM

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A. Steam Turbine System

System, Structures, and Components

The system, structures, and components included in this table comprise the piping and fittings in steam turbine system for both pressurized water reactors (PWRs) and boiling water reactors (BWRs) and consist of the moisture separator/reheater (MSR) lines from the high-pressure turbine to the MSR and from MSR to low-pressure turbine. 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 steam turbine system are classified as Group D Quality Standards.

The steam turbine is an active component and should be covered by the plant maintenance program. Any elastomer/rubber expansion joints between the turbine and main condenser should also be covered as a part of the plant maintenance program.

System Interfaces

The systems that interface with the steam turbine system include the main steam system (Tables VIII B1 and B2), extraction steam system (Table VIII C), and condensate system (Table VIII E).

VIII STEAM AND POWER CONVERSION SYSTEM
A. STEAM TURBINE SYSTEM

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
A.1.1, A.1.2	Piping and Fittings	Piping from HP Turbine to MSR, Piping from MSR to LP Turbine	Carbon Steel (CS)	Steam	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
A.2.1	Valves (Stop, Control or Governor, Intermediate Stop and Control or Combined Intermediate, Bypass or Steam Dumps, Atmospheric Dumps, Main Steam Safety, or Safety/Relief)	Body & Bonnet	CS	Steam	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the steam lines from HP turbine to MSR (A.1.1) and from MSR to LP turbine (A.1.2).*

VIII STEAM AND POWER CONVERSION SYSTEM
A. STEAM TURBINE SYSTEM

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
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

B1 Main Steam System (PWR)

B1.1 Piping and Fittings

B1.1.1 Steam Lines from Steam Generator to Isolation Valves (Group B or C)

B1.1.2 Steam Lines from Isolation Valves to Main Turbine (Group D)

B1.1.3 Lines to Feedwater (FW) and Auxiliary Feedwater (AFW) Pump Turbines

B1.1.4 Lines to Moisture Separator/Reheater (MSR)

B1.1.5 Turbine Bypass

B1.1.6 Steam Drains

B1.2 Valves (Check, Control, Hand, Motor Operated, Safety, and Containment Isolation Valves)

B1.2.1 Body and Bonnet

B1 Main Steam System (Pressurized Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the main steam system for pressurized water reactors (PWRs) extending from the steam generator to the steam turbine, including turbine bypass to condenser, lines to main feedwater (FW) and auxiliary feedwater (AFW) pump turbines, steam drains, and valves including the containment isolation valves on main steam and lines to AFW pump turbines. 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," the portion of the main steam system extending from the steam generator up to the second containment isolation valve is classified as Group B or C and all other components in the main steam system located downstream of the isolation valves are classified as Group D Quality Standards.

The 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 main steam system include PWR concrete or steel containment structures (Table II A1, Table II A2), and common components (Table II A3), steam generator (Tables IV D1 and D2), steam turbine system (Table VIII A), feedwater system (Table VIII D1), condensate system (Table VIII E), and auxiliary feedwater system (Table VIII G).

VIII STEAM AND POWER CONVERSION SYSTEM
B1. MAIN STEAM SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
B1.1.1, B1.1.2	Piping and Fittings	Steam Lines from Steam Generator to Isolation Valve; Steam Lines from Isolation Valve to Main Turbine	Carbon Steel (CS)	Up to 300°C (572°F) Steam	Loss of Material	Crevice and Pitting Corrosion	EPRI TR–102134, (Rev. 3 or later updates or revisions of the above report)
B1.1.1	Piping and Fittings	Steam Lines from Steam Generator to Isolation Valves	CS	Up to 300°C (572°F) Steam	Cumulative Fatigue Damage	Fatigue	Design code of record or later approved Codes
B1.1.1 through B1.1.6	Piping and Fittings	Steam Lines from Steam Generator to Isolation Valve; Steam Lines from Isolation Valve to Main Turbine; Lines to FW and AFW Pump Turbines; Lines to MSR; Turbine Bypass; Steam Drains	CS	Up to 300°C (572°F) Steam	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
B1.2.1	Valves (Check, Control, Hand, Motor Operated, Safety, and Containment Isolation Valves)	Body & Bonnet	CS	Up to 300°C (572°F) Steam	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of Crevice and Pitting Corrosion on the piping and fittings in steam lines from steam generator to steam turbines (B1.1.1 and B1.1.2)*

VIII STEAM AND POWER CONVERSION SYSTEM
B1. MAIN STEAM SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material due to crevice or pitting corrosion.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M11 "Water Chemistry."	No
Components have been designed or evaluated for fatigue for a 40 y design life based on postulated cycles, according to 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; check Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. 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.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 Crevice and Pitting Corrosion on the piping and fittings in steam lines from steam generator to steam turbines (B1.1.1 and B1.1.2)	*Same as for the effect of Crevice and Pitting Corrosion on the piping and fittings in steam lines from steam generator to steam turbines (B1.1.1 and B1.1.2). See Chapter XI.M11, "Water Chemistry."*	No

VIII STEAM AND POWER CONVERSION SYSTEM
B1. MAIN STEAM SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
B1.2.1	Valves (Check, Control, Hand, Motor Operated, Safety, and Containment Isolation Valves)	Body & Bonnet	CS	300°C (572°F) Steam	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the steam lines to FW and AFW pump turbines (B1.1.3), lines to MSR (B1.1.4),, turbine bypass (B1.1.5), and steam drains (B1.1.6).*

VIII STEAM AND POWER CONVERSION SYSTEM
B1. MAIN STEAM SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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

B2 Main Steam System (BWR)

B2.1 Piping and Fittings

B2.1.1 Steam Lines to Main Turbine (Group B)

B2.1.2 Steam Lines to Main Turbine (Group D)

B2.1.3 Lines to FW Pump Turbines

B2.1.4 Turbine Bypass

B2.1.5 Steam Drains

B2.1.6 Steam Line to HPCI Turbine

B2.1.7 Steam Line to RCIC Turbine

B2.2 Valves (Check, Control, Hand, Motor-Operated, Safety Valves)

B2.2.1 Body and Bonnet

B2. Main Steam System (Boiling Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the main steam system for boiling water reactors (BWRs) extending from the outermost containment isolation valve to the steam turbines, including turbine bypass to condenser, steam drains, and lines to main feedwater (FW), high pressure coolant injection (HPCI), and reactor core isolation cooling (RCIC) turbines. 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," portions of the main steam system extending from the outermost containment isolation valve up to and including the turbine stop and bypass valves, and connected piping up to and including the first valve that is either normally closed or capable of automatic closure during all modes of normal reactor operation, are classified as Group B Quality Standards and the remainder as Group D. For BWRs containing a shutoff valve in addition to the two containment isolation valves in the main steam line, Group B standards are applied to only those portions of the system extending from the outermost containment isolation valves up to and including the shutoff valve.

The portion of the main steam system extending from the reactor pressure vessel up to the second isolation valve and including the containment isolation valves is classified as Group A standard and is covered in Table IV C1.

The valve 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 main steam system include the BWR Mark 1, Mark 2, or Mark 3 containment structures (Table II B1, B2, B3) and common components (Table II B4); the reactor coolant pressure boundary (Table IV C1), steam turbine system (Table VIII A), feedwater system (Table VIII D2), and condensate system (Table VIII E).

VIII STEAM AND POWER CONVERSION SYSTEM
B2. MAIN STEAM SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
B2.1.1, B2.1.2	Piping and Fittings	Steam Lines to Main Turbine (Group B); Steam Lines to Main Turbine (Group D)	Carbon Steel (CS)	288°C (550°F) Steam	Loss of Material	Crevice and Pitting Corrosion	EPRI TR–103515, (Rev. 3 or later update)
B2.1.1 through B2.1.7	Piping and Fittings	Steam Lines to Main Turbine (Group B); Steam Lines to Main Turbine (Group D); Lines to FW Pump Turbines; Turbine Bypass; Steam Drains; Steam Line to HPCI Turbine; Steam Line to RCIC Turbine	CS	288°C (550°F) Steam	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
B2.2.1	Valves (Check, Control, Hand, Motor Operated, Safety Valves)	Body & Bonnet	CS	288°C (550°F) Steam	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the steam lines to FW pump turbines (B2.1.3); for turbine bypass (B2.1.4); and steam drains (B2.1.5); and to HPCI (B2.1.6) and RCIC (B2.1.7) turbines.*

VIII STEAM AND POWER CONVERSION SYSTEM
B2. MAIN STEAM SYSTEM (Boiling Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-103515 for water chemistry in BWRs to manage the effects of loss of material due to crevice or pitting corrosion.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M11, "Water Chemistry."	No
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
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

VIII STEAM AND POWER CONVERSION SYSTEM
B2. MAIN STEAM SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
B2.2.1	Valves (Check, Control, Hand, Motor Operated, Safety Valves)	Body & Bonnet	Carbon Steel (CS)	288°C (550°F) Steam	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of Crevice, and Pitting Corrosion on the piping and fittings in the steam lines to Main Turbine, Group B (B2.1.1), and to Main Turbine, Group D (B2.1.2),*

VIII STEAM AND POWER CONVERSION SYSTEM
B2. MAIN STEAM SYSTEM (Boiling Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Same as for the effect of Crevice, and Pitting Corrosion on the piping and fittings in the steam lines to Main Turbine, Group B (B2.1.1), and to Main Turbine, Group D (B2.1.2),	*Same as for the effect of Crevice, and Pitting Corrosion on the piping and fittings in the steam lines to Main Turbine, Group B (B2.1.1), and to Main Turbine, Group D(B2.1.2), See Chapter XI.M11, "Water Chemistry."*	No

C. Extraction Steam System

C.1 Piping and Fittings

C.1.1 Lines to Feedwater Heaters

C.1.2 Steam Drains

C.2 Valves

C.2.1 Body and Bonnet

C. Extraction Steam System

System, Structures, and Components

The system, structures, and components included in this table comprise the extraction steam lines for both pressurized water reactors (PWRs) and boiling water reactors (BWRs) extending from the steam turbine to feedwater heaters, including the drain lines. 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 extraction steam system are classified as Group D Quality Standards.

The 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 extraction steam system include the steam turbine system (Table VIII A), feedwater system (Tables VIII D1 and D2), and condensate system (Table VIII E).

VIII STEAM AND POWER CONVERSION SYSTEM
C. EXTRACTION STEAM SYSTEM

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
C.1.1, C.1.2	Piping and Fittings	Lines to Feedwater Heaters, Steam Drains	Carbon Steel (CS)	Up to 300°C (572°F) Steam	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
C.2.1	Valves	Body & Bonnet	CS	Up to 300°C (572°F) Steam	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the steam lines to feedwater heaters (C.1.1) and steam drains (C.1.2).*

VIII STEAM AND POWER CONVERSION SYSTEM
C. EXTRACTION STEAM SYSTEM

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
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

D1. Feedwater System (PWR)

D1.1 Main Feedwater Line

D1.1.1 Pipe and Fittings

D1.2 Valves (Control, Check, Hand, Safety and Containment Isolation Valves)

D1.2.1 Body and Bonnet

D1.3 Feedwater Pump (Steam Turbine- and Motor-Driven)

D1.3.1 Casing

D1.3.2 Suction and Discharge Lines

D1. Feedwater System (Pressurized Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the main feedwater system for pressurized water reactors (PWRs) extending from the condensate system to the steam generator, and consist of the main feedwater lines, feedwater pumps, and valves including the containment isolation valves. 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," the portion of the feedwater system extending from the secondary side of the steam generator up to the second containment isolation valve is classified as Group B or C standards and all other components in the feedwater system located downstream from the isolation valves are classified as Group D 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 feedwater system include the PWR concrete or steel containment structures (Table II A1, Table II A2), and common components (Table II A3), steam generator (Table IV D1 and D2), main steam system (Table VIII B1), extraction steam system (Table VIII C), condensate system (Table VIII E), and auxiliary feedwater system (Table VIII G).

VIII STEAM AND POWER CONVERSION SYSTEM
D1. FEEDWATER SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.1.1	Main Feedwater Line	Piping and Fittings (Group B, C, or D)	Carbon Steel (CS)	Treated Water	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
D1.1.1	Main Feedwater Line	Piping and Fittings (From Steam Generator to Isolation Valves)	CS	Treated Water	Cumulative Fatigue Damage	Fatigue	Design Code of Record or later approved Codes.
D1.1.1	Main Feedwater Line	Piping and Fittings (Group B, C, or D)	CS	Treated Water	Loss of Material	General, Crevice, and Pitting, Corrosion	EPRI TR–102134. (Rev. 3 or later updates or revisions of the above report)
D1.2.1	Valves (Control, Check, and Hand Valves, Safety, and Containment Isolation Valves)	Body and Bonnet	CS	Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the main feedwater lines (D1.1.1).*

VIII STEAM AND POWER CONVERSION SYSTEM
D1. FEEDWATER SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
Components have been designed or evaluated for fatigue for a 40 y design life based on postulated cycles, according to 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
The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material due to crevice or pitting corrosion. However, crevice or pitting corrosion may occur at locations of stagnant flow conditions, and verification of the effectiveness of the chemistry control program should ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period. An acceptable verification program consists of a one–time inspection of select component and susceptible locations in the system.	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
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

VIII STEAM AND POWER CONVERSION SYSTEM
D1. FEEDWATER SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D1.2.1	Valves (Control, Check, and Hand Valves, Safety, and Containment Isolation Valves)	Body and Bonnet	Carbon Steel (CS)	Treated Water	Loss of Material	General, Crevice, and Pitting, Corrosion	*Same as for the effect of General, Crevice, & Pitting Corrosion on the piping and fittings in the main feedwater lines (D1.1.1).*
D1.3.1, D1.3.2	Feedwater Pump (Steam Turbine- and Motor-Driven)	Casing, Suction and Discharge Lines	CS	Treated Water	Wall Thinning	Flow Accelerated Corrosion (FAC)	*Same as for the effect of FAC on the piping and fittings in the main feedwater lines (D1.1.1).*
D1.3.1, D1.3.2	Feedwater Pump (Steam Turbine- and Motor-Driven)	Casing, Suction and Discharge Lines	CS	Treated Water	Loss of Material	General, Crevice, and Pitting, Corrosion	*Same as for the effect of General, Crevice, & Pitting Corrosion on the piping and fittings in the main feedwater lines (D1.1.1).*

VIII STEAM AND POWER CONVERSION SYSTEM
D1. FEEDWATER SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Same as for the effect of General, Crevice, and Pitting, Corrosion on the piping and fittings in the main feedwater lines (D1.1.1).	*Same as for the effect of General, Crevice, and Pitting, Corrosion on the piping and fittings in the main feedwater lines (D1.1.1). See Chapter XI.M11, "Water Chemistry."*	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 the piping and fittings in the main feedwater lines (D1.1.1).	*Same as for the effect of General, Crevice, and Pitting, Corrosion on the piping and fittings in the main feedwater lines (D1.1.1). See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated

D2. Feedwater System (BWR)

D2.1 Main Feedwater Line

D2.1.1 Pipe and Fittings

D2.2 Valves (Control, Check, and Hand Valves)

D2.2.1 Body and Bonnet

D2.3 Feedwater Pump (Steam Turbine- and Motor-Driven)

D2.3.1 Casing

D2.3.2 Suction and Discharge Lines

D2. Feedwater System (Boiling Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the main feedwater system for boiling water reactors (BWRs) extending from the condensate and condensate booster system to the outermost feedwater isolation valve on the feedwater lines to the reactor vessel, and consist of the main feedwater lines, feedwater pumps, and valves. 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," portions of the feedwater system extending from the outermost containment isolation valves up to and including the shutoff valve or the first valve that is either normally closed or capable of closure during all modes of normal reactor operation are classified as Group B quality standards, and the remainder as Group D.

The portion of the feedwater system extending from the reactor vessel up to the second containment isolation valve and including the isolation valves is classified as Group A standard and is 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 feedwater system include the BWR Mark 1, Mark 2, or Mark 3 containment structures (Table II B1, B2, B3) and common components (Table II B4); reactor coolant pressure boundary (Table IV C1), main steam system (Table VIII B2), extraction steam system (Table VIII C), and condensate system (Table VIII E).

VIII STEAM AND POWER CONVERSION SYSTEM
D2. FEEDWATER SYSTEM (Boiling Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
D2.1.1	Main Feedwater Line (Group B & D)	Piping and Fittings	Carbon Steel (CS)	Treated Water	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28 NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
D2.1.1	Main Feedwater Line (Group B & D)	Piping and Fittings	CS	Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR-103515. (Rev. 3 or later updates or revisions of the above report)
D2.2.1	Valves (Control, Check, and Hand Valves)	Body & Bonnet	CS	Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the main feedwater lines (D2.1.1).*
D2.2.1	Valves (Control, Check, and Hand Valves)	Body & Bonnet	CS	Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR-103515. (Rev. 3 or later updates or revisions of the above report)
D2.3.1, D2.3.2	Feedwater Pump (Steam Turbine- and Motor-Driven)	Casing, Suction and Discharge Lines	CS	Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the main feedwater lines (D2.1.1).*
D2.3.1, D2.3.2	Feedwater Pump (Steam Turbine- and Motor-Driven)	Casing, Suction and Discharge Lines	CS	Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR-103515. (Rev. 3 or later updates or revisions of the above report)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
For description of the AMP, see Chapter XI.11 “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
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
For description of the AMP, see Chapter XI.11 “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
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
For description of the AMP, see Chapter XI.11 “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

E. Condensate System

E.1 Condensate Lines

E.1.1 Piping and Fittings

E.2 Valves

E.2.1 Body and Bonnet

E.3 Condensate Pumps (Main and Booster Pumps)

E.3.1 Casing

E.4 Condensate Coolers/Condensers

E.4.1 Tubes

E.4.2 Tubesheet

E.4.3 Channel Head

E.4.4 Shell

E.5 Condensate Storage

E.5.1 Tank

E.6 Condensate Cleanup System

E.6.1 Piping and Fittings

E.6.2 Demineralizer

E.6.3 Strainer

E.6.4 Filter

E. Condensate System

System, Structures, and Components

The system, structures, and components included in this table comprise the condensate system for both pressurized water reactors (PWRs) and boiling water reactors (BWRs) extending from the condenser hotwells to the suction of feedwater pumps, including condensate and condensate booster pumps, condensate coolers, condensate cleanup system, and condensate storage tanks. 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 condensate system are classified as Group D 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 condensate system include the steam turbine system (Table VIII A), main steam system (Tables VIII B1 and B2), feedwater system (Tables VIII D1 and D2), auxiliary feedwater system (Table VIII G, PWR only), reactor water cleanup system (Table VII E3, BWR and PWR if used), open or closed cycle cooling water systems (Table VII C1 or C2), and condensate storage facility.

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Item	Structure and Component	Region of Interest	Material	Environment	Aging Effect	Aging Mechanism	References
E.1.1	Condensate Lines	Piping and Fittings	Carbon Steel (CS)	Treated Water (BWRs: Reactor Coolant; PWRs: Secondary Side Water)	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18. Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
E.2.1	Valves	Body & Bonnet	CS	Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the condensate lines (E.1.1).*
E.3.1	Condensate Pumps (Main and Booster Pumps)	Casing	CS	Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the condensate lines (E.1.1).*
E.4.1 through E.4.4	Condensate Coolers / Condensers (Serviced by Open-Cycle Cooling Water)	Tubes, Tubesheet, Channel Head, Shell	Tubes: Stainless Steel (SS), Tubesheet: CS, Channel Head: CS, Shell: CS	Treated Water on One Side; Open-Cycle Cooling Water (Raw Water) on the Other Side	Loss of Material	General and Microbiologically Influenced (MIC) Corrosion	NRC GL 89-13. NRC GL 89-13, Suppl. 1. NRC IN 81-21. NRC IN 85-24. NRC IN 85-30. NRC IN 86-96.
E.4.1 through E.4.4	Condensate Coolers / Condensers (Serviced by Open Cycle Cooling Water)	Tubes, Tubesheet, Channel Head, Shell	Tubes: SS, Tubesheet: CS, Channel Head: CS, Shell: CS	Treated Water on One Side; Open-Cycle Cooling Water (Raw Water) on the Other Side	Buildup of Deposit	Biofouling	*Same as for the effect of general and MIC on condensate coolers / condensers tubes (E.4.1), tubesheet (E.4.2), channel head (E.4.3), and shell (E.4.4) serviced by open-cycle cooling water.*

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
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
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
Implementation of the recommendations of Generic Letter 89-13 to ensure that open-cycle cooling water (OCCW) (or service water) system can be managed for an extended period of operation. The program includes surveillance and control techniques to manage flow blockage problems caused by biofouling, corrosion, erosion, protective coating failures, and silting, in OCCW systems or structures and components serviced by OCCW systems.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3 "Open Cycle Cooling Water System."	No
Same as for the effect of general and MIC on condensate coolers/condensers tubes (E.4.1), tubesheet (E.4.2), channel head (E.4.3), and shell (E.4.4) serviced by open-cycle cooling water.	*Same as for the effect of general and MIC on condensate coolers/condensers tubes (E.4.1), tubesheet (E.4.2), channel head (E.4.3), and shell (E.4.4) serviced by open-cycle cooling water. See Chapter XI.M3 "Open Cycle Cooling Water System*."	No

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
E.4.1 through E.4.4	Condensate Coolers / Condensers (Serviced by Closed-Cycle Cooling Water)	Tubes, Tubesheet, Channel Head, Shell	Tubes: SS, Tubesheet: CS, Channel Head: CS, Shell: CS	Treated Water on One Side; Closed-Cycle Cooling Water (Treated Water) on the Other Side	Loss of Material	General Corrosion	ASME OM S/G. Part 2. NRC GL 89-13. NRC GL 89-13, Suppl. 1. EPRI TR-107396.
E.5.1	Condensate Storage	Tank	CS (Coated), SS	<90°C (194°F) Treated Water	Loss of Material	Crevice and Pitting Corrosion	EPRI TR–102134. (Rev. 3 or later updates or revisions of the above report)
E.5.1	Condensate Storage	Tank, (Above Ground) (External Surface)	CS	Sun, Weather, Humidity and Moisture	Loss of Material	Corrosion	NRC IN 86-99. NRC IN 86-99, Supplement 1. NRC IN 89-79. NRC IN 89-79, Supplement 1. NRC GL 98-04.

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The program relies on preventive measures to minimize corrosion by maintaining corrosion inhibitors based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water (CCCW) systems, and performance and functional testing in accordance with the ASME OM Standards and Guides, Part 2 to ensure that the CCCW system or components serviced by the CCCW system are performing their function acceptably.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4 "Closed Cycle Cooling Water System."	No
The water chemistry program relies on monitoring and control of water chemistry based on TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material due to crevice or pitting corrosion. However, crevice or pitting corrosion may occur at locations of stagnant flow conditions, and verification of the effectiveness of the chemistry control program should 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 consists of a one–time inspection of select component and susceptible locations in the system.	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
The program includes preventive measures to mitigate corrosion by protecting the external surface of carbon steel components, per standard industry practice, with paint or coating, and periodic system walkdown to monitor degradation of the protective paint or coating. However, for components such as storage tanks that are supported on earthen or concrete foundations, corrosion may occur at inaccessible locations such as the tank bottom, and verification of the effectiveness of the program should ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M7 "Outer Surface of Above Ground Carbon Steel Tanks."	No

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
E.5.1	Condensate Storage	Tank, (Buried) (External Surface)	CS	Soil and Ground Water	Loss of Material	General, MIC, Pitting, and Crevice Corrosion	NACE-RP-01-69.
E.6.1 through E.6.4	Condensate Cleanup System	Piping and Fittings, De-mineralizer, Strainer, Filter	CS	Treated Water	Loss of Material	Crevice and Pitting Corrosion	*Same as for Crevice and Pitting Corrosion of Item E.5.1 condensate storage tank.*

VIII STEAM AND POWER CONVERSION SYSTEM
E. CONDENSATE SYSTEM

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The program includes preventive measures to mitigate corrosion by protecting the external surface of the buried piping and components, per standard industry practice, with external coating, wrapping, and a cathodic protection system, and surveillance.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M8 "Outer Surface of Buried Piping and Components."	No
Same as for Crevice and Pitting Corrosion of Item E.5.1 condensate storage tank.	*Same as for Crevice and Pitting Corrosion of Item E.5.1 condensate storage tank. See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated

F. Steam Generator Blowdown System (PWR)

F.1 Blowdown Lines

F.1.1 Pipe and Fittings (Group B)

F.1.2 Pipe and Fittings (Group D)

F.2 Valves (including Containment Isolation Valves)

F.2.1 Body and bonnet

F.3 Blowdown Pump

F.3.1 Casing

F.4 Blowdown Heat Exchanger

F.4.1 Tubes

F.4.2 Tubesheet

F.4.3 Channel Head and Access Cover

F.4.4 Shell and Access Cover

F. Steam Generator Blowdown System (Pressurized Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the steam generator blowdown system for pressurized water reactors (PWRs) extending from the steam generator through the blowdown condenser and including the containment isolation valves. 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," the portion of the blowdown system extending from the steam generator up to the isolation valve outside the containment and including the isolation valves is classified as Group B or C and the remainder as Group D 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 blowdown system include the steam generator (Tables IV D1 and D2), and open or closed cycle cooling water systems (Table VII C1 or C2).

VIII STEAM AND POWER CONVERSION SYSTEM
F. STEAM GENERATOR BLOWDOWN SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
F.1.1, F.1.2	Blowdown Lines	Piping and Fittings (Group B), Piping and Fittings (Group D)	Carbon Steel (CS)	Secondary Side Treated Water	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18, Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
F.1.1, F.1.2	Blowdown Lines	Piping and Fittings (Group B), Piping and Fittings (Group D)	CS	Secondary Side Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR–102134. (Rev. 3 or later update)
F.2.1	Valves (including containment isolation valves)	Body & Bonnet	CS	Secondary Side Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the blowdown lines (F.1.1 and F.1.2).*
F.2.1	Valves (including containment isolation valves)	Body & Bonnet	CS	Secondary Side Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR–102134. (Rev. 3 or later)
F.3.1	Blowdown Pump	Casing	CS	Secondary Side Treated Water	Wall Thinning	FAC	*Same as for the effect of FAC on the piping and fittings in the blowdown lines (F.1.1 and F.1.2).*

VIII STEAM AND POWER CONVERSION SYSTEM
F. STEAM GENERATOR BLOWDOWN SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material due to crevice or pitting corrosion. However, crevice or pitting corrosion may occur at locations of stagnant flow conditions, and verification of the effectiveness of the chemistry control program should ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period. An acceptable verification program consists of a one–time inspection of select component and susceptible locations in the system.	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
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 the piping and fittings in the blowdown lines (F.1.1 and F.1.2).	*Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings in the blowdown lines (F.1.1 and F.1.2). See Chapter XI.M11, "Water Chemistry."*	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

VIII STEAM AND POWER CONVERSION SYSTEM
F. STEAM GENERATOR BLOWDOWN SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
F.3.1	Blowdown Pump	Casing	CS	Secondary Side Treated Water	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR–102134 (Rev. 3 or later)
F.4.1 through F.4.4	Blowdown Heat Exchanger (Serviced by Open-Cycle Cooling Water)	Tubes, Tubesheet, Channel Head and Access Cover, Shell and Access Cover	Tubes: Stainless Steel (SS), Tubesheet: CS, Channel Head: CS	Secondary Side Treated Water on One Side; Open-Cycle Cooling Water (Raw Water) on the Other Side	Loss of Material	General and Microbio-logically Influenced Corrosion (MIC)	NRC GL 89-13. NRC GL 89-13, Suppl. 1. NRC IN 81-21. NRC IN 85-24. NRC IN 85-30. NRC IN 86-96.
F.4.1 through F.4.4	Blowdown Heat Exchanger (Serviced by Open Cycle Cooling Water)	Tubes, Tubesheet, Channel Head and Access Cover, Shell and Access Cover	Tubes: SS, Tubesheet: CS, Channel Head: CS	Secondary Side Treated Water on One Side; Open-Cycle Cooling Water (Raw Water) on the Other Side	Buildup of Deposit	Biofouling	*Same as for the effect of general and MIC on miscellaneous coolers tubes (F.4.1), tubesheet (F.4.2), channel head (F.4.3), and shell (F.4.4).*
F.4.1 through F.4.4	Blowdown Heat Exchanger (Serviced by Closed-Cycle Cooling Water)	Tubes, Tubesheet, Channel Head and Access Cover, Shell and Access Cover	Tubes: SS, Tubesheet: CS, Channel Head: CS	Secondary Side Treated Water on One Side; Closed-Cycle Cooling Water (Treated Water) on the Other Side	Loss of Material	General Corrosion	ASME OM S/G, Part 2. NRC GL 89-13. NRC GL 89-13, Suppl. 1. EPRI TR-107396.

VIII STEAM AND POWER CONVERSION SYSTEM
F. STEAM GENERATOR BLOWDOWN SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings in the blowdown lines (F.1.1 and F.1.2).	*Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings in the blowdown lines (F.1.1 and F.1.2). See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated
Implementation of the recommendations of Generic Letter 89-13 to ensure that open-cycle cooling water (OCCW) (or service water) system can be managed for an extended period of operation. The program includes surveillance and control techniques to manage flow blockage problems caused by biofouling, corrosion, erosion, protective coating failures, and silting, in OCCW systems or structures and components serviced by OCCW systems.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M3 "Open Cycle Cooling Water System."	No
Same as for the effect of general and MIC on miscellaneous coolers tubes (F.4.1), tubesheet (F.4.2), channel head (F.4.3), and shell (F.4.4).	*Same as for the effect of general and MIC on miscellaneous coolers tubes (F.4.1), tubesheet (F.4.2), channel head (F.4.3), and shell (F.4.4). See Chapter XI.M3 "Open Cycle Cooling Water System."*	No
The program relies on preventive measures to minimize corrosion by maintaining corrosion inhibitors based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water (CCCW) systems, and performance and functional testing in accordance with ASME OM Standards and Guides, Part 2 to ensure that the CCCW system or components serviced by the CCCW system are performing their function acceptably.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M4 "Closed Cycle Cooling Water System."	No

G. Auxiliary Feedwater (AFW) System (PWR)

G.1 Auxiliary Feedwater Piping

G.1.1 Pipe and Fittings (Above Ground)

G.1.2 Pipe and Fittings (Buried)

G.2 AFW Pumps (Steam Turbine- and Motor-Driven)

G.2.1 Casing

G.2.2 Suction and Discharge Lines

G.3 Valves (Control, Check, Hand, Containment Isolation Valves)

G.3.1 Body and Bonnet

G.4 Condensate Storage (Emergency)

G.4.1 Tank

G.5 Bearing Oil Coolers

G.5.1 Shell

G.5.2 Tubes

G.5.3 Tubesheet

G. Auxiliary Feedwater System (Pressurized Water Reactor)

System, Structures, and Components

The system, structures, and components included in this table comprise the auxiliary feedwater (AFW) system for pressurized water reactors (PWRs) extending from the condensate storage or backup water supply system to the steam generator or to main feedwater (MFW) line, and consist of auxiliary feedwater piping, auxiliary feedwater pumps, pump turbine oil coolers, and valves, including the containment isolation valves. 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," portion of the auxiliary feedwater system extending from the secondary side of the steam generator up to the second isolation valve and including the containment isolation valves, is classified as Group B standard. Portions of the auxiliary feedwater system that are required for their safety functions and that either do not operate during any mode of normal reactor operation or cannot be tested adequately, should be classified as Group B quality standards, and the remainder classified as Group C.

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 auxiliary feedwater system include the steam generator (Tables IV D1 and D2), main steam system (Table VIII B1), PWR feedwater system (Table VIII D1), condensate system (Table VIII E), and open or closed cycle cooling water systems (Table VII C1 or C2).

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
G.1.1	Auxiliary Feedwater (AFW) Piping	Piping and Fittings (Above Ground) (for Plants with Preheated Steam Generators)	Carbon Steel (CS)	>90°C (194°F) Treated Water	Wall Thinning	Flow Accelerated Corrosion (FAC)	NSAC-202L-R2. NUREG-1344. NRC GL 89-08. NRC BL 87-01. NRC IN 81-28. NRC IN 89-53. NRC IN 91-18. NRC IN 91-18. Suppl. 1. NRC IN 92-35. NRC IN 93-21. NRC IN 95-11. NRC IN 97-84.
G.1.1, G.1.2	Auxiliary Feedwater Piping	Piping and Fittings (Above Ground), Piping and Fittings (Buried)	CS	<90°C (194°F) Treated Water (>90°C, 194°F, Treated Water for Plants with Preheated Steam Generators)	Loss of Material	General, Crevice, and Pitting Corrosion	EPRI TR–102134. (Revision 3 or later updates or revisions of the above report)
G.1.1, G.1.2	Auxiliary Feedwater Piping	Piping and Fittings (Above Ground), Piping and Fittings (Buried)	CS	Untreated Water from Backup Water Supply	Loss of Material	General and Microbio-logically Influenced Corrosion (MIC)	-
G.1.1, G.1.2	Auxiliary Feedwater Piping	Piping and Fittings (Above Ground), Piping and Fittings (Buried)	CS	Untreated Water from Backup Water Supply	Buildup of Deposit	Biofouling	-

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
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
The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material due to crevice or pitting corrosion. However, crevice or pitting corrosion may occur at locations of stagnant flow conditions, and verification of the effectiveness of the chemistry control program should 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 consists of a one–time inspection of select component and susceptible locations in the system.	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
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

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environ-ment	Aging Effect	Aging Mechanism	References
G.1.2	Auxiliary Feedwater (AFW) Piping	Piping and Fittings (Buried) (External Surface)	CS	Soil	Loss of Material	General , Galvanic. and Microbio-logically-Influenced Corrosion (MIC)	NACE-RP-01-69.
G.2.1, G.2.2	AFW Pumps (Steam Turbine- and Motor-Driven)	Casing, Suction and Discharge Lines	CS	<90°C (194°F) Treated Water	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings for the AFW lines (G.1.1 and G.1.2).*
G.3.1	Valves (Control, Check, Hand, and Containment Isolation Valves)	Body	CS	<90°C (194°F) Treated Water	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the AFW lines (G.1.1 and G.1.2).*
G.4.1	Condensate Storage (Emergency)	Tank	CS (Coated), Stainless Steel (SS)	<90°C (194°F) Treated Water	Loss of Material	Crevice and Pitting Corrosion	*Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the AFW lines (G.1.1 and G.1.2).*
G.4.1	Condensate Storage (Emergency)	Tank, (Above-ground) (External Surface)	CS	Sun, Weather, Humidity and Moisture	Loss of Material	Corrosion	NRC IN 86-99. NRC IN 86-99, Supplement 1. NRC IN 89-79. NRC IN 89-79, Supplement 1. NRC GL 98-04.

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The program includes preventive measures to mitigate corrosion by protecting the external surface of the buried piping and components, per standard industry practice, with external coating, wrapping, and a cathodic protection system, and surveillance.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M8 "Outer Surface of Buried Piping and Components."	No
Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2).	*Same as for the effect of general, crevice, and pitting corrosion on the piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2). See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated
Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2).	*Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2). See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated
Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2).	*Same as for the effect of general, crevice, and pitting corrosion on the above-ground and buried piping and fittings for the auxiliary feedwater lines (G.1.1 and G.1.2). See Chapter XI.M11, "Water Chemistry."*	Yes, detection of aging effects should be further evaluated
The program includes preventive measures to mitigate corrosion by protecting the external surface of carbon steel tanks, per standard industry practice, with paint or coating, and periodic system walkdown to monitor degradation of the protective paint or coating. However, for components such as storage tanks that are supported on earthen or concrete foundations, corrosion may occur at inaccessible locations such as the tank bottom, and verification of the effectiveness of the program should ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M7 "Outer Surface of Above Ground Carbon Steel Tanks."	No

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Item	Structure and Component	Region of Interest	Material	Environment	Aging Effect	Aging Mechanism	References
G.4.1	Condensate Storage (Emergency)	Tank, (Buried) (External Surface)	CS	Soil and Ground Water	Loss of Material	General, MIC, Pitting, and Crevice Corrosion	NACE-RP-01-69.
G.5.1 through G.5.3	Bearing Oil Coolers (for Steam-Turbine Pump) (Serviced by Open-Cycle Cooling Water)	Shell, Tubes, Tubesheet	SS, CS	Open Cycle Cooling Water (Raw Water)	Loss of Material	General Corrosion and MIC	*Same as for the effect of general and MIC on AFW piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply.*
G.5.1 through G.5.3	Bearing Oil Coolers (for Steam-Turbine Pump) (Serviced by Open-Cycle Cooling Water)	Shell, Tubes, Tubesheet	SS, CS	Open Cycle Cooling Water (Raw Water)	Buildup of Deposit	Biofouling	*Same as for the effect of general and MIC on AFW piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply.*
G.5.1 through G.5.3	Bearing Oil Coolers (for Steam-Turbine Pump) (Serviced by Closed-Cycle Cooling Water)	Shell, Tubes, Tubesheet	SS, CS	Closed-Cycle Cooling Water (Treated Water)	Loss of Material	General Corrosion	ASME OM S/G, Part 2. NRC GL 89-13. NRC GL 89-13, Suppl. 1. EPRI TR-107396.
G.5.1 through G.5.3	Bearing Oil Coolers (for Steam-Turbine Pump)	Shell, Tubes, Tubesheet	SS, CS	Lubricating Oil (possibly contaminated with water)	Loss of Material	General Corrosion and MIC	-

VIII STEAM AND POWER CONVERSION SYSTEM
G. AUXILIARY FEEDWATER (AFW) SYSTEM (Pressurized Water Reactor)

Aging Management Program (AMP)	Evaluation and Technical Basis	Further Evaluation
The program includes preventive measures to mitigate corrosion by protecting the external surfaces of the buried piping and components, per standard industry practice, with external coating, wrapping, and a cathodic protection system, and surveillance.	For evaluation and technical basis of the 10 elements of the AMP, see Chapter XI.M8 "Outer Surface of Buried Piping and Components."	No
Same as for the effect of general and MIC on auxiliary feedwater piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply.	*Same as for the effect of general and MIC on auxiliary feedwater piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply. See Chapter XI.M3 "Open Cycle Cooling Water System."*	No
Same as for the effect of general and MIC on auxiliary feedwater piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply.	*Same as for the effect of general and MIC on auxiliary feedwater piping and fittings (G.1.1, G.1.2) exposed to untreated backup water supply. See Chapter XI.M3 "Open Cycle Cooling Water System."*	No
The program relies on preventive measures to minimize corrosion by maintaining corrosion inhibitors based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water (CCCW) systems, and performance and functional testing in accordance with the ASME OM Standards and Guides, Part 2 to ensure that the CCCW system or components serviced by the CCCW system are performing their function acceptably.	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

H. Carbon Steel Components

H.1 Carbon Steel Components

H.1.1 External Surfaces

H.2 Closure Bolting

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

H. 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 Steam and Power Conversion 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 Steam and Power Conversion Systems in PWRs and BWRs.

VIII STEAM AND POWER CONVERSION SYSTEM
H. CARBON STEEL COMPONENTS

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

VIII STEAM AND POWER CONVERSION SYSTEM
H. CARBON STEEL COMPONENTS

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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ASME Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*, The ASME Boiler and Pressure Vessel Code, 1989 or later edition as approved in 10 CFR50.55a, The American Society of Mechanical Engineers, New York, NY.

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NRC Information Notice 89-53, *Rupture of Extraction Steam Line on High Pressure Turbine*, June 13, 1989.

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