3.3 AGING MANAGEMENT OF AUXILIARY SYSTEMS

Review Responsibilities

Primary - Branch responsible for materials and chemical engineering
Secondary - Branch responsible for mechanical engineering

3.3.1 Areas of Review

This review plan section addresses the aging management review (AMR) of the auxiliary systems for license renewal. For a recent vintage plant, the information related to the auxiliary systems is contained in Chapter 9, "Auxiliary Systems," of the plant's FSAR consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800) (Ref. 1). The auxiliary systems contained in this review plan section are generally consistent with those contained in NUREG-0800 except for refueling water, chilled water, heat removal, condenser circulating water, and condensate storage system. For older plants, the location of applicable information is plant-specific because their FSAR may have predated NUREG-0800. Typical auxiliary systems that are subject to an AMR for license renewal are new fuel storage, spent fuel storage, spent fuel pool cooling and cleanup (BWR/PWR), suppression pool cleanup (BWR), overhead heavy load and light load (related to refueling) handling, open-cycle cooling water, closed-cycle cooling water, ultimate heat sink, compressed air, chemical and volume control (PWR), standby liquid control (BWR), reactor water cleanup (BWR), shutdown cooling (older BWR), control room area ventilation, auxiliary and radwaste area ventilation, primary containment heating and ventilation, diesel generator building ventilation, fire protection, diesel fuel oil, and emergency diesel generator.

Aging management is reviewed, following the guidance in Section 3.1, for portions of the chemical and volume control system for PWRs, and for standby liquid control, reactor water cleanup, and shutdown cooling systems extending up to the first isolation valve outside of containment for BWRs (the shutdown cooling systems for older BWRs). The following systems have portions that are classified as Group B quality standard: open-cycle cooling water (service water system), closed-cycle cooling water, compressed air, standby liquid control, shutdown cooling system (older BWR), control room area ventilation and auxiliary and radwaste area ventilation. Aging management for these portions is reviewed following the guidance in Section 3.3. The aging management program for the cooling towers is reviewed following the guidance in Section 3.5 for "Group 6" structures.

The staff has issued a GALL report addressing aging management for license renewal (Ref. 2). The GALL report documents the staff's basis for determining whether generic existing programs are adequate to manage aging without change, or generic existing programs should be augmented for license renewal. The GALL report may be referenced in a license renewal application, and should be treated in the same manner as an approved topical report.

Because a license renewal applicant may or may not be able to reference the GALL report as explained below, the following areas are reviewed:

3.3.1.1 Aging Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal

An applicant may reference the GALL report in a license renewal application to demonstrate that the applicant's programs at its facility correspond to those reviewed and approved in the

report, and that no further staff review is required. If the material presented in the GALL report is applicable to the applicant's facility, the staff should find the applicant's reference to the report acceptable. In making this determination, the staff should consider whether the applicant has identified specific programs described and evaluated in the GALL report. The staff, however, should not repeat its review of the substance of the matters described in the report. Rather, the staff should ensure that the applicant verifies that the approvals set forth in the GALL report for generic programs apply to the applicant's programs.

3.3.1.2 Further Evaluation of Aging Management as Recommended by the GALL Report

The GALL report provides the basis for identifying those programs that warrant further evaluation during the staff review of a license renewal application. The staff review focus should be on augmented programs for license renewal.

3.3.1.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report

The GALL report provides a generic staff evaluation of certain aging management programs. If an applicant does not rely on a particular program for license renewal, or if the applicant indicates that the generic staff evaluation of the elements of a particular program does not apply to its plant, the staff should review each such aging management program to which the GALL report does not apply. The GALL report provides a generic staff evaluation of programs for certain components and aging effects. If the applicant has identified particular components subject to an AMR for its plant that are not addressed in the GALL report, or particular aging effects for a component that are not addressed in the GALL report, the staff should review the applicant's aging management programs applicable to these particular components and aging effects.

3.3.1.4 FSAR Supplement

The FSAR supplement summarizing the programs and activities for managing the effects of aging for the period of extended operation is reviewed.

3.3.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.3.2.1 Aging Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal

Acceptable methods for managing aging of the auxiliary systems are described and evaluated in Chapter VII of the GALL report (Ref. 2). In referencing this report, an applicant should indicate that the material presented in the GALL report is applicable to the specific plant involved, and provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. An applicant should also verify that the approvals set forth in the GALL report for generic programs apply to the applicant's programs. An applicant may reference appropriate programs as described and evaluated in the GALL report.

3.3.2.2 Further Evaluation of Aging Management as Recommended by the GALL Report

The GALL report indicates that further evaluation should be performed for:

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

1. Loss of material due to general, pitting, and crevice corrosion could occur in the channel head and access cover, tubes, and tubesheets of the heat exchanger in the spent fuel pool cooling and cleanup. The water chemistry program relies on monitoring and control of reactor water chemistry based on EPRI guidelines of BWRVIP-29 (TR-103515) (Ref. 3) for water chemistry in BWRs, TR-105714 (Ref. 4) for primary water chemistry in PWRs, and TR-102134 (Ref. 5) for secondary water chemistry in PWRs to manage the effects of loss of material from general, pitting or crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to pitting and crevice corrosion could occur in the filter housing, valve bodies, and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system (PWR), in the piping, filter housing, valve bodies, and shell and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system (BWR), and in the piping and pump casing in the shutdown cooling system (older BWR). The water chemistry program relies on monitoring and control of reactor water chemistry based on EPRI guidelines of BWRVIP-29 (TR-103515) (Ref. 3) for water chemistry in BWRs, TR-105714 (Ref. 4) for primary water chemistry in PWRs, and TR-102134 (Ref. 5) for secondary water chemistry in PWRs to manage the effects of loss of material from pitting or crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting, or crevice corrosion. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage loss of material from pitting and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.2 Hardening and Cracking or Loss of Strength due to Elastomer Degradation or Loss of Material due to Wear

Hardening and cracking due to elastomer degradation could occur in elastomer linings of the filter, valve, and ion exchangers in spent fuel pool cooling and cleanup systems (BWR and PWR). Hardening and loss of strength due to elastomer degradation could occur in the collars and seals of the duct and in the elastomer seals of the filters in the control room area, auxiliary and radwaste area, and primary containment heating ventilation systems and in the collars and seals of the duct in the diesel generator building ventilation system. Loss of material due to wear could occur in the collars and seals of the duct in the ventilation systems. The GALL report recommends further evaluation to ensure that these aging effects are adequately managed.

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.3.2.2.3 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this standard review plan.

3.3.2.2.4 Crack Initiation and Growth due to Cracking or Stress Corrosion Cracking

Crack initiation and growth due to SCC could occur in the regenerative and non-regenerative heat exchanger components in the reactor water cleanup system (BWR) and due to cracking in the high-pressure pump in the chemical and volume control system (PWR). The GALL report recommends further evaluation to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

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

Loss of material due to general, pitting, and crevice corrosion could occur in the piping and filter housing and supports in the control room area, the auxiliary and radwaste area, the primary containment heating and ventilation systems, in the piping of the diesel generator building ventilation system, in the aboveground piping and fittings, valves, and pumps in the diesel fuel oil system and in the diesel engine starting air, combustion air intake, and combustion air exhaust subsystems in the emergency diesel generator system. Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion (MIC) could occur in the duct fittings, access doors, and closure bolts, equipment frames and housing of the duct, due to pitting and crevice corrosion could occur in the heating/cooling coils of the air handler heating/cooling, and due to general corrosion could occur on the external surfaces of all carbon steel structures and components, including bolting exposed to operating temperatures less than 212°F in the ventilation systems. The GALL report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

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

Loss of material due to general, galvanic, pitting, and crevice corrosion could occur in tanks, piping, valve bodies, and tubing in the reactor coolant pump oil collection system in fire protection. The fire protection program relies on a combination of visual and volumetric examinations in accordance with the guidelines of 10 CFR Part 50 Appendix R and Branch Technical Position 9.5-1 to manage loss of material from corrosion. However, corrosion may occur at locations where water from wash downs may accumulate. Therefore, verification of the effectiveness of the program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage loss of material due to general, galvanic, pitting, and crevice corrosion to verify the effectiveness of the program. A one-time inspection of the bottom half of the interior surface of the tank of the reactor coolant pump oil collection system is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.7 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Biofouling

Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling could occur in the internal surface of tanks in the diesel fuel oil system and due to general, pitting, and crevice corrosion and MIC in the tanks of the diesel fuel oil system in the emergency diesel generator system. The existing aging management program relies on the fuel oil chemistry program for monitoring and control of fuel oil contamination in accordance with the guidelines of ASTM Standards D4057, D1796, D2709 and D2276 to manage loss of material due to corrosion or biofouling. Corrosion or biofouling may occur at locations where contaminants accumulate. Verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage corrosion/biofouling to verify the effectiveness of the program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.3.2.2.8 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2, of this standard review plan.)

3.3.2.2.9 Crack Initiation and Growth due to Stress Corrosion Cracking and Cyclic Loading

Crack initiation and growth due to SCC and cyclic loading could occur in the channel head and access cover, tubesheet, tubes, shell and access cover, and closure bolting of the regenerative heat exchanger and in the channel head and access cover, tubesheet, and tubes of the letdown heat exchanger in the chemical and volume control system (PWR). The water chemistry program relies on monitoring and control of water chemistry based on the guidelines of TR-105714 (Ref. 4) for primary water chemistry in PWRs to manage the effects of crack initiation and growth due to SCC and cyclic loading. Verification of the effectiveness of the chemistry control program should be performed to ensure that crack initiation and growth are not occurring. The GALL report recommends further evaluation to manage crack initiation and growth from SCC and cyclic loading for these systems to verify the effectiveness of the water chemistry program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that crack initiation and growth are not occurring and that the components' intended function will be maintained during extended operations.

3.3.2.2.10 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion

Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of the spent fuel storage rack in the spent fuel storage. The GALL report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

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

Loss of material due to general, pitting, and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system (service water system) and in the diesel fuel oil system. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

3.3.2.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.3.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR supplement should be appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation.

3.3.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.3.3.1 Aging Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal

The applicant may reference the GALL report in its license renewal application, as appropriate. The staff should not repeat its review of the substance of the matters described in the report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL report, the staff should find the applicant's reference to the report in a license renewal application acceptable. In making this determination, the reviewer verifies that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also verifies that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL report. The reviewer verifies that the applicant has identified those aging effects for the auxiliary system components that are contained in the report as applicable to its plant. In addition, the reviewer verifies that the applicant has stated that the plant programs covered by the applicant's reference contain the same program elements that the staff evaluated and relied upon in approving the corresponding generic program in the GALL report.

The reviewer should verify that the applicant has stated that certain of its aging management programs contain the same program elements as the corresponding generic program described in the GALL report, and upon which the staff relied in its evaluation. The reviewer should also verify that the applicant has state that the GALL report is applicable to its plant with respect to

these programs. The reviewer verifies that the applicant has identified the appropriate programs as described and evaluated in the GALL report. Programs evaluated in the report regarding the auxiliary system components are summarized in Table 3.3-1 of this review plan section. No further staff evaluation is necessary if so recommended in the GALL report.

3.3.3.2 Further Evaluation of Aging Management as Recommended by the GALL Report

The GALL report indicates that further evaluation should be performed for:

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

1. The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of the channel head and access cover, tubes, and tubesheets of the heat exchanger in the spent fuel pool cooling and cleanup to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry based on EPRI guidelines of BWRVIP-29 (TR-103515) for water chemistry in BWRs, TR-105714 for primary water chemistry in PWRs, and TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material from general, pitting or crevice corrosion (Ref. 3-5). However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting or crevice corrosion. Therefore, verification of the effectiveness of the water chemistry control program should be performed to ensure that corrosion is not occurring and that the component's intended function would be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques (Ref. 6, 7).

2. The GALL report recommends further evaluation of programs to manage loss of material due to pitting and crevice corrosion of the filter housing, valve bodies, and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system (PWR), of the piping, filter housing, valve bodies, and shell and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system (BWR) and of the piping and pump casing in the shutdown cooling system (older BWR) to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry based on EPRI guidelines of BWRVIP-29 (TR-103515) for water chemistry in BWRs, TR-105714 for primary water chemistry in PWRs, and TR-102134 for secondary water chemistry in PWRs to manage the effects of loss of material from pitting or crevice corrosion (Ref. 3-5). However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting or crevice corrosion. Therefore, verification of the effectiveness of the water chemistry control program should be performed to ensure that corrosion is not occurring and that the component's intended function would be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques (Ref. 6, 7).

3.3.3.2.2 Hardening and Cracking or Loss of Strength due to Elastomer Degradation or Loss of Material due to Wear

The GALL report recommends further evaluation of programs to manage the hardening and cracking due to elastomer degradation of valves in spent fuel pool cooling and cleanup system (BWR and PWR). The GALL report also recommends further evaluation of programs to manage the hardening and loss of strength due to elastomer degradation of the collars and seals of the duct and of the elastomer seals of the filters in the control room area, auxiliary and radwaste area, and primary containment heating and ventilation systems and of the collars and seals of the duct in the diesel generator building ventilation system. The GALL report also recommends further evaluation of programs to manage the loss of material due to wear of the collars and seals of the duct in the ventilation systems. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.3 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this standard review plan.

3.3.3.2.4 Crack Initiation and Growth due to Cracking or Stress Corrosion Cracking

The GALL report recommends further evaluation of programs to manage the crack initiation and growth due to SCC of the regenerative and non-regenerative heat exchanger components in the reactor water cleanup system (BWR) and due to cracking of the high-pressure pump in the chemical and volume control system (PWR). The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

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

The GALL report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of the piping and filter housing and supports in the control room area, the auxiliary and radwaste area, and the primary containment heating and ventilation systems, of the piping of the diesel generator building ventilation system, and of the aboveground piping and fittings, valves, and pumps in the diesel fuel oil system and of the diesel engine starting air, combustion air intake, and combustion air exhaust subsystems in the emergency diesel generator system. The GALL report also recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion and MIC of the duct fittings, access doors, and closure bolts, equipment frames and housing of the duct,

due to pitting and crevice corrosion of the heating/cooling coils of the air handler heating/cooling, and due to general corrosion of the external surfaces of all carbon steel structures and components, including bolting exposed to operating temperatures less than 212ºF in the ventilation systems. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

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

The GALL report recommends further evaluation of programs to manage the loss of material due to general, galvanic, pitting, and crevice corrosion of tanks, piping, valve bodies, and tubing in the reactor coolant pump oil collection system in fire protection. The fire protection program relies on a combination of visual and volumetric examinations in accordance with the guidelines of 10 CFR Part 50 Appendix R and Branch Technical Position 9.5-1 to manage loss of material from corrosion. However, corrosion may occur at locations where water from wash downs may accumulate. Therefore, verification of the effectiveness of the program should be performed to ensure that degradation is not occurring and that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time visual inspection of the bottom half of the interior of the tank, the inspection would be performed to ensure that corrosion is not occurring. If corrosion is identified, a volumetric examination would then be conducted on any problematic areas. The results of examinations will be used as a leading indicator of other susceptible components. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface examination techniques (Ref. 6, 7).

3.3.3.2.7 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Biofouling

The Gall report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC and to biofouling of the internal surface of tanks in the diesel fuel oil system and due to general, pitting, crevice, and MIC of the tanks of the diesel engine fuel oil system in the emergency diesel generator system. The fuel oil chemistry program relies on monitoring and control of fuel oil contamination in accordance with the guidelines of ASTM Standards D4057, D1796, D2709 and D2276 to manage loss of material due to corrosion or biofouling. Corrosion or biofouling may occur at locations where contaminants accumulate. Verification of the effectiveness of the fuel oil program should be performed to ensure that corrosion/biofouling is not occurring and that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that corrosion/biofouling is not occurring and that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion/biofouling is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques (Ref. 6, 7).

3.3.3.2.8 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.3.3.2.9 Crack Initiation and Growth due to Stress Corrosion Cracking and Cyclic Loading

The GALL report recommends further evaluation of programs to manage the crack initiation and growth due to SCC and cyclic loading of the channel head and access cover, tubesheet, tubes, shell and access cover, and closure bolting of the regenerative heat exchanger and in the channel head and access over, tubesheet, and tubes of the letdown heat exchanger in the chemical and volume control system (PWR) to verify the effectiveness of the water chemistry program. The water chemistry program relies on monitoring and control of reactor water chemistry based on TR-105714 for primary water chemistry in PWRs to manage the effects of crack initiation and growth from SCC and cyclic loading (Ref. 4). The effectiveness of the water chemistry control program should be performed to verified that cracking is not occurring and that the component's intended function would be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that cracking is not occurring and that the component's intended function will be maintained during extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed by using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques (Ref. 6, 7).

3.3.3.2.10 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion

The GALL report recommends further evaluation of programs to manage reduction of neutron-absorbing capacity and loss of material due to general corrosion of the neutron-absorbing sheets of the spent fuel storage rack in the spent fuel storage. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

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

The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC of the underground piping and fittings in the open-cycle cooling water system (service water system) and in the diesel fuel oil system to verify the effectiveness of the buried piping and tanks inspection program. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that corrosion is not occurring and that the component's intended function will be maintained during extended operation.

3.3.3.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report

Review procedures are described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan.)

3.3.3.4 FSAR Supplement

The reviewer verifies that the applicant has provided information, equivalent to that in Table 3.3-2, in the FSAR supplement for aging management of the auxiliary systems for license renewal. The reviewer also verifies that the applicant has provided information, equivalent to that in Table 3.3-2, in the FSAR supplement for Subsection 3.3.3.3, "Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59.

As noted in Table 3.3-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.3.4 Evaluation Findings

The reviewer verifies that the applicant has provided information sufficient to satisfy the provisions of this review plan section and that the staff's evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

> The staff concludes that the applicant has demonstrated that the aging effects associated with the auxiliary systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in

accordance with the current licensing basis during the period of extended operation. The staff also concludes that the FSAR supplement contains an appropriate summary description of the programs and activities for managing the effects of aging for the auxiliary systems as reflected in the license conditions.

3.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.3.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, April 2001.

3. BWRVIP-29 (EPRI TR-103515), BWR Water Chemistry Guidelines-Revision 3, Normal and Hydrogen Water Chemistry, Electric Power Research Institute, Palo Alto, CA, February 1994.

4. EPRI TR-105714, PWR Primary Water Chemistry Guidelines-Revision 3, Electric Power Research Institute, Palo Alto, CA, Nov. 1995.

5. EPRI TR-102134, PWR Secondary Water Chemistry Guideline-Revision 3, Electric Power Research Institute, Palo Alto, CA, May 1993.

6. 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 CFR 50.55a, The American Society of Mechanical Engineers, New York, NY.

7. ASTM D95-83, Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation, American Society for Testing and Materials, West Conshohocken, PA, 1983.

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated (see subsections 3.3.2.2.1.1 and 3.3.2.2.1.2)
BWR/PWR	Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening, cracking and loss of strength due to elastomer degradation; loss of material due to wear	Plant specific	Yes, plant specific (see subsection 3.3.2.2.2)
BWR/PWR	Components in load handling, chemical and volume control system (PWR), and reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see subsection 3.3.2.2.3)
BWR/ PWR	Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth due to SCC or cracking	Plant specific	Yes, plant specific (see subsection 3.3.2.2.4)
BWR/PWR	Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion, and MIC	Plant specific	Yes, plant specific (see subsection 3.3.2.2.5)
BWR/PWR	Components in reactor coolant pump oil collect system of fire protection	Loss of material due to galvanic, general, pitting, and crevice corrosion	One-time inspection	Yes, detection of aging effects is to be further evaluated (see subsection 3.3.2.2.6)
BWR/PWR	Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel oil chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated (see subsection 3.3.2.2.7)

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR	Piping, pump casing, and valve body and bonnets in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated (see subsection 3.3.2.2.1.2)
PWR	Heat exchangers in chemical and volume control system	Crack initiation and growth due to SCC and cyclic loading	Water chemistry and a plant-specific verification program	Yes, plant specific (see subsection 3.3.2.2.9)
BWR/PWR	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant specific	Yes, plant specific (see subsection 3.3.2.2.10)
BWR/PWR	New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures monitoring	No
BWR/PWR	Spent fuel storage racks and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to stress corrosion cracking	Water chemistry	No
BWR/PWR	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex monitoring	No
BWR/PWR	Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No
BWR/PWR	Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and crevice corrosion, and MIC	Closed-cycle cooling water system	No
BWR/PWR	Cranes including bridge and trolleys and rail system in load handling system	Loss of material due to general corrosion and wear	Overhead heavy load and light load handling systems	No
BWR/PWR	Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, detection of aging effects and operating experience are to be further evaluated (see subsection 3.3.2.2.11)
BWR/PWR	Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed air monitoring	No
BWR/PWR	Components (doors and barrier penetration seals) and concrete structures in fire protection	Loss of material due to wear; hardnening and shrinkage due to weathering	Fire protection	No
BWR/PWR	Components in water-based fire protection	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling	Fire water system	No
BWR/PWR	Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire protection and fuel oil chemistry	No
BWR/PWR	Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Aboveground carbon steel tanks	No
BWR/PWR	Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting integrity	No
BWR	Components in contact with sodium pentaborate solution in standby liquid control system (BWR)	Crack initiation and growth due to SCC	Water chemistry	No
BWR	Components in reactor water cleanup system	Crack initiation and growth due to SCC and IGSCC	Reactor water cleanup system inspection	No

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR	Components in shutdown cooling system (older BWR)	Crack initiation and growth due to SCC	BWR stress corrosion cracking and water chemistry	No
BWR	Components in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion, and MIC	Closed-cycle cooling water system	No
BWR/ PWR	Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems, and ultimate heat sink	Loss of material due to selective leaching	Selective leaching of materials	No
BWR/ PWR	Fire barriers, walls, ceilings and floors in fire protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire protection and structures monitoring	No

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems

Program	Description of Program	Implementation Schedule*
Bolting integrity (BWR/PWR)	This program consists of guidelines on materials selection, strength and hardness properties, installation procedures, lubricants and sealants, corrosion considerations in the selection and installation of pressure-retaining bolting for nuclear applications, and enhanced inspection techniques. This program relies on the 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 in EPRI TR-104213 for pressure retaining bolting and structural bolting.	Existing program
Boraflex monitoring (BWR/PWR)	The program consists of (1) neutron attenuation testing ("blackness testing") to determine gap formation, (2) sampling for the presence of silica in the spent fuel pool along with boron loss, and (3) monitoring and analysis of criticality to assure that the required 5% subcriticality margin is maintained. This program is implemented in response to GL 96-04.	Existing program
Boric acid corrosion (PWR)	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program
BWR vessel internals (BWR)	The program includes (1) inspection and flaw evaluation in conformance with the guidelines of applicable and staff-approved boiling water reactor vessel and internals project (BWRVIP) documents and (2) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-29 (EPRI TR-103515) to ensure the long-term integrity and safe operation of boiling water reactor (BWR) vessel internal components.	Existing program
Closed-cycle cooling water system (BWR/PWR)	The program relies on preventive measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water systems.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems (continued)

Program	Description of Program	Implementation Schedule*
Compressed air monitoring (BWR/PWR)	The program consists of inspection, monitoring, and testing of the entire system, including (1) frequent leak testing valves, piping, and other system components, especially those made of carbon steel; and (2) preventive monitoring that checks air quality at various locations in the system to ensure that oil, water, rust, dirt, and other contaminants are kept within the specified limits. This program is in response to NRC GL 88-14 and INPO's Significant Operating Experience Report (SOER) 88-01. It also relies on the ASME OM Guide Part 17, and ISA-S7.0.1-1996 as guidance for testing and monitoring air quality and moisture.	Existing program
Fire protection (BWR/PWR)	The program includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform the intended function. The AMP also includes periodic inspection and test of halon/carbon dioxide fire suppression system.	Existing program
Fire water system (BWR/PWR)	To ensure no fouling has occurred in the fire protection system, periodic full flow flush test and system performance test are conducted to prevent corrosion from biofouling of components. Also, the system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately detected and corrective actions initiated. The AMP relies on testing of water based fire protection system piping and components in accordance with applicable NFPA commitments. In addition, this program will be modified to included (1) portions of the fire protection sprinkler system that are subjected to full flow tests prior to the period of extended operation and (2) portions of the fire protection system exposed to water are internally visually inspected.	Program should be modified before the period of extended operation
Fuel oil chemistry (BWR/PWR)	The AMP relies on a combination of surveillance and maintenance procedures. Monitoring and controlling fuel oil contamination in accordance with the guidelines of ASTM Standards D1796, D2276, D2709, and D4057, maintains the fuel oil quality. Exposure to fuel oil contaminants such as water and microbiological organisms is minimized by periodic cleaning/draining of tanks and by verifying the quality of new oil before its introduction into the storage tanks.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems (continued)

Program	Description of Program	Implementation Schedule*
ASME Section XI Inservice inspection (ISI) (BWR/PWR)	The program consists of periodic volumetric, surface, and/or visual examination of components and their supports for assessment, signs of degradation, and corrective actions. This program is in accordance with ASME Section XI, 1995 edition through the 1996 addenda.	Existing program
One-time inspection	To verify the effectiveness of the water chemistry control program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the that the intended function will be maintained during the period of extended operation, a one-time inspection of internal surfaces of carbon steel piping, valve bodies, pump casings, and tanks is performed using suitable techniques at the most susceptible locations to ensure that corrosion is not occurring. To verify the effectiveness of the fuel oil program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation, a one-time thickness measurement of the tank bottom is performed. To verify the effectiveness of the fire protection program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation, a one-time visual inspection of the bottom half of the inside of the tank is an acceptable option to ensure that corrosion is not occurring.	The inspection should be completed before the period of extended operation
Open-cycle cooling water system (BWR/PWR)	The program includes (1) surveillance and control of biofouling, (2) tests to verify heat transfer, (3) routine inspection and maintenance program, (4) system walk down inspection, and (5) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems (continued)

Program	Description of Program	Implementation Schedule*
Aboveground carbon steel tanks (BWR/PWR)	The program includes preventive measures to mitigate corrosion by protecting the external surface of carbon steel components, per standard industry practice, with sealant or caulking at the interface of concrete and component. Visual inspection during periodic system walk downs should be sufficient to monitor degradation of the protective paint, coating, calking, or sealant. Verification of the effectiveness of the program by measuring the thickness of the tank bottoms ensures that degradation is not occurring and that the component intended function will be maintained during the extended period of operation.	Existing program
Buried piping and tanks surveillance (BWR/PWR)	The program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, and a cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current. This program is based on standard industry practices as described in NACE-RP-0285-95 and RP-0169-96.	Existing program
Buried piping and tanks inspection	The program includes (1) preventive measures to mitigate corrosion, and (2) periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried carbon steel piping and tanks. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings and cathodic protection. As an alternative, buried piping and tanks are inspected visually for any evidence of damage when they are excavated during maintenance and when a pipe is dug up and inspected for any reason with a frequency that is based on operating experience.	Program should be implemented before the period of extended operation
Inspection of overhead heavy load and light load handling system (BWR/PWR)	The program evaluates the effectiveness of the maintenance monitoring program and the effects of past and future usage on the structural reliability of cranes and hoists. The number and magnitude of lifts made by the hoist or crane are also reviewed. Rails and girders are visually inspected on a routine basis for degradation. Functional tests are also performed to assure their integrity. These cranes must also comply with the maintenance rule requirements provided in 10 CFR Part 50.65.	Existing program
Plant-specific AMP	The description should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems (continued)

Program	Description of Program	Implementation Schedule*
Quality assurance	The 10 CFR Part 50, Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include nonsafety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation
Reactor water cleanup system (BWR)	The program includes inservice inspection (ISI) and monitoring and control of reactor coolant water chemistry. Related to the inspection guidelines for RWCU piping welds outboard of the second isolation valve, the program includes measures delineated in NUREG-0313, Rev. 2, and NRC Generic Letter (GL) 88-01 and ISI in conformance with the American Society of Mechanical Engineers (ASME) Section XI.	Existing program
Selective leaching of materials	The program includes a hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials is occurring and whether the process will affect the ability of the components to perform their intended function for the period of extended operation. For systems subjected to environments where water is not treated (i.e., the open-cycle cooling water system and the ultimate heat sinks), the program also follows the guidance in NRC GL 89-13.	Program should be implement before the period of extended operation
Structures monitoring (BWR/PWR)	The program consists of periodic inspection and monitoring the condition of structures and structure component supports to ensure that aging degradation leading to loss of intended functions will be detected and that the extent of degradation can be determined. This program is implemented in accordance with NEI 93-01, Rev. 2 and Regulatory Guide 1.160, Rev. 2.	Existing program

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems (continued)

Program	Description of Program	Implementation Schedule*
Water chemistry (BWR/PWR)	To mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits based on EPRI guidelines of BWRVIP-29 (TR-103515) for water chemistry in BWRs, TR-105714 for primary water chemistry in PWRs, and TR-102134 for secondary water chemistry in PWRs.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.