3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

Review Responsibilities

Primary - Branch responsible for structural engineering
Secondary - None

3.5.1 Areas of Review

This review plan section addresses the aging management review (AMR) for structures and component supports. For a recent vintage plant, the information related to structures and component supports is contained in Chapter 3, "Design of Structures, Components, Equipment, and 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). For older vintage plants, the location of applicable information is plant-specific because their FSAR may have predated NUREG-0800. The scope of this section is PWR and BWR containment structures; Class I structures; and component supports. The PWR containment structures consist of concrete (reinforced or prestressed) and steel containments. The BWR containment structures consist of Mark I steel containments, Mark II concrete (reinforced or prestressed) and steel containments, and Mark III concrete and steel containments (Ref. 2).

The Class I structures are organized into nine groups: Group 1: BWR reactor building, PWR shield building, control room/building; Group 2: BWR reactor building with steel superstructure; Group 3: auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, auxiliary feedwater pump house, utility/piping tunnels; Group 4: containment internal structures, excluding refueling canal; Group 5: fuel storage facility, refueling canal; Group 6: water-control structures (e.g., intake structure, cooling tower, and spray pond); Group 7: concrete tanks; Group 8: steel tanks; and Group 9: BWR unit vent stack (Ref. 2).

The component supports are organized into seven groups: Group B1.1: supports for ASME Class I piping and components; Group B1.2: supports for ASME Class 2 and 3 piping and components; Group B1.3: supports for ASME Class MC components; Group B2: supports for cable tray, conduit, HVAC ducts, tube track, instrument tubing, non-ASME piping and components; Group B3: anchorage of racks, panels, cabinets, and enclosures for electrical equipment and instrumentation; Group B4: supports for miscellaneous equipment (e.g., EDG, HVAC components); and Group B5: supports for miscellaneous structures (e.g., platforms, pipe whip restraints, jet impingement shields, masonry walls) (Ref. 2).

The staff has issued the 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:

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

The 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 GALL 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.

3.5.1.2 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 should focus on augmented programs for license renewal.

3.5.1.3 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 certain components and aging effects. If an 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.

3.5.1.4 FSAR Supplement

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

3.5.2 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.

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

Acceptable methods for managing aging of structures and component supports are described and evaluated in Chapters II and III of the GALL report (Ref. 2). In referencing this report, the 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 GALL report. The applicant should also verify that the approvals set forth in the GALL report for generic programs apply to the applicant's programs. The applicant may reference appropriate programs as described and evaluated in the GALL report.

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

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

3.5.2.2.1 PWR and BWR Containments

3.5.2.2.1.1 Aging of Inaccessible Concrete Areas

Cracking, spalling, and increases in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack; and cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel could occur in inaccessible areas of PWR concrete and steel containments; BWR Mark II concrete containments; and Mark III concrete and steel containments. The GALL report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if specific criteria defined in the GALL report cannot be satisfied.

3.5.2.2.1.2 Cracking, Distortion, and Increase in Component Stress Level due to Settlement; Reduction of Foundation Strength due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program

Cracking, distortion, and increase in component stress level due to settlement could occur in PWR concrete and steel containments and BWR Mark II concrete containments and Mark III concrete and steel containments. Also, reduction of foundation strength due to erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. Some plants may rely on a de-watering system to lower the site ground water level. If the plant's CLB credits a de-watering system, the GALL report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL report recommends no further evaluation if this activity is included in the scope of the applicant's structures monitoring program.

3.5.2.2.1.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

Reduction of strength and modulus of elasticity due to elevated temperatures could occur in PWR concrete and steel containments and BWR Mark II concrete containments and Mark III concrete and steel containments. The GALL report recommends further evaluation if any portion of the concrete containment components exceeds specified temperature limits, i.e., general area temperature 66°C (150°F) and local area temperature 93°C (200°F).

3.5.2.2.1.4 Loss of Material due to Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate

Loss of material due to corrosion could occur in inaccessible areas of the steel containment shell or the steel liner plate for all types of PWR and BWR containments. The GALL report recommends further evaluation of plant-specific programs to manage this aging effect for inaccessible areas if specific criteria defined in the GALL report cannot be satisfied.

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

Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a 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 4.5 of this standard review plan.

3.5.2.2.1.6 Cumulative Fatigue Damage

If included in the current licensing basis, fatigue analyses of containment steel liner plates and steel containment shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6 of this standard review plan.

3.5.2.2.1.7 Cracking due to Cyclic Loading and SCC

Cracking of containment penetrations (including penetration sleeves, penetration bellows, and dissimilar metal welds) due to cyclic loading or SCC could occur in all types of PWR and BWR containments. Cracking could also occur in vent line bellows, vent headers and downcomers due to SCC for BWR containments. A visual VT-3 examination would not detect such cracks. The GALL report recommends further evaluation of the inspection methods implemented to detect these aging effects.

3.5.2.2.2 Class I Structures

3.5.2.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The GALL report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) scaling, cracking, and spalling due to repeated freeze-thaw for Groups 1-3, 5, 7-9 structures; (2) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack for Groups 1-5, 7-9 structures; (3) expansion and cracking due to reaction with aggregates for Groups 1-5, 7-9 structures; (4) cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel for Groups 1-5, 7-9 structures; (5) cracks, distortion, and increase in component stress level due to settlement for Groups 1-3, 5, 7-9 structures; (6) reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures; (7) loss of material due to corrosion of structural steel components for Groups 1-5, 7-8 structures; (8) loss of strength and modulus of concrete structures due to elevated temperatures for Groups 1-5; and (9) crack initiation and growth due to SCC and loss of material due to crevice corrosion of stainless steel liner for Groups 7 and 8 structures. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

Technical details of the aging management issue are presented in Subsection 3.5.2.2.1.2 for items (5) and (6) and Subsection 3.5.2.2.1.3 for item (8).

3.5.2.2.2.2 Aging Management of Inaccessible Areas

Cracking, spalling, and increases in porosity and permeability due to aggressive chemical attack and cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas. The GALL report recommends further evaluation to manage these aging effects in inaccessible areas of Groups 1-3, 5, 7-9 structures, if specific criteria defined in the GALL report cannot be satisfied.

3.5.2.2.3 Component Supports

3.5.2.2.3.1 Aging of Supports Not Covered by Structures Monitoring Program

The GALL report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; (2) loss of material due to environmental corrosion, for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

3.5.2.2.3.2 Cumulative Fatigue Damage due to Cyclic Loading

Fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this standard review plan.

3.5.2.2.4 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.)

3.5.2.3 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.)

3.5.2.4 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 are managed during the period of extended operation.

3.5.3 Review Procedures

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

3.5.3.1 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 GALL 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 structures and component supports 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 stated 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 structures and component supports are summarized in Table 3.5-1 of this review plan section. No further staff evaluation is necessary if so recommended in the GALL report.

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

3.5.3.2.1 PWR and BWR Containments

3.5.3.2.1.1 Aging of Inaccessible Concrete Areas

The GALL report recommends further evaluation of programs to manage aging effects in inaccessible areas. Possible effects due to leaching of calcium hydroxide and aggressive chemical attack are cracking, spalling, and increases in porosity and permeability. Possible effects due to corrosion of embedded steel in PWR concrete and steel containments and BWR Mark II concrete containments and Mark III concrete and steel containments are cracking, spalling, loss of bond, and loss of material. The current aging management programs that involve detecting aging effects in inaccessible areas consist of Section XI, Subsection IWL examinations of 1992 or later edition of ASME code (Ref. 3), which is in accordance with the requirements of, and is approved in, 10 CFR 50.55a. However, Subsection IWL exempts from examination portions of the concrete containments that are inaccessible (e.g., foundation, exterior walls below grades, concrete covered by liner).

To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the licensee evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. In addition, the GALL report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if specific criteria defined in the GALL report cannot be satisfied. The reviewer reviews the applicant's proposed aging management program to verify that, where

appropriate, an effective inspection program will be implemented to ensure that the aging effects in inaccessible areas are adequately managed during the period of extended operation.

3.5.3.2.1.2 Cracking, Distortion, and Increases in Component Stress Level due to Settlement; Reduction of Foundation Strength due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program

If applicable to the applicant's plant, the GALL report recommends aging management of (1) cracking, distortion, and increases in component stress level due to settlement for PWR concrete and steel containments and BWR Mark II concrete containments and Mark III concrete and steel containments and (2) reduction of foundation strength due to erosion of porous concrete subfoundations for all types of PWR and BWR containments If a de-watering system is relied upon for control of settlement and erosion, then proper functioning of the de-watering system should be monitored for the period of extended operation. The reviewer verifies that, if the applicant's plant credits a de-watering system in its CLB, the applicant has committed to monitor the functionality of the de-watering system under the applicant's structures monitoring program. If not, the reviewer evaluates the plant-specific program for monitoring the de-watering system during the period of extended operation.

3.5.3.2.1.3 Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature

The GALL report recommends further evaluation of programs to manage reduction of strength and modulus of concrete structures due to elevated temperature for PWR concrete and steel containments and BWR Mark II concrete containments and Mark III concrete and steel containments. The GALL report notes that the implementation of Subsection IWL examinations and 10 CFR 50.55a would not be able to detect the reduction of concrete strength and modulus due to elevated temperature and also notes that no mandated aging management exists for managing this aging effect.

The GALL report recommends that a plant-specific evaluation be performed if any portion of the concrete containment components exceeds specified temperature limits, viz., general temperature 66°C (150°F) and local area temperature 93°C (200°F). The reviewer verifies that the applicant's discussion in the renewal application indicates that the affected PWR and BWR containment components are not exposed to temperature that exceeds the temperature limits [operating temperature <66°C (150°F), local area temperature <93°C (200°F)]. For concrete containment components that operate above these temperature limits, the reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that the effects of elevated temperature will be managed during the period of extended operation.

3.5.3.2.1.4 Loss of Material due to Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate

The GALL report identifies programs to manage loss of material due to corrosion of the steel containment shell or the steel liner plate for all types of PWR and BWR containments. The aging management program consists of ASME Section XI, Subsection IWE (Ref. 4) and the requirements of 10 CFR 50.55a for inaccessible areas. Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel containment shells, piping, and valves penetrating or attaching to the containment.

To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the licensee shall evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. In addition, the GALL report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if specific criteria defined in the GALL report cannot be satisfied. The reviewer reviews the applicant's proposed aging management program to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects in inaccessible areas are adequately managed.

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

The GALL report identifies loss of prestress as a TLAA to be performed for the period of license renewal. The reviewer reviews the evaluation of this TLAA separately, following the guidance in Section 4.5 of this standard review plan.

3.5.3.2.1.6 Cumulative Fatigue Damage

Fatigue analyses included in current licensing basis for the containment liner plate and penetrations are TLAAs 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 4.6 of this standard review plan.

3.5.3.2.1.7 Cracking due to Cyclic Loading and SCC

The GALL report recommends further evaluation of programs to manage cracking of containment penetrations (including penetration sleeves, penetration bellows, and dissimilar metal welds) due to cyclic loading or SCC for all types of PWR and BWR containments. A similar recommendation for further evaluation of programs to manage cracking of vent line bellows, vent headers and downcomers due to SCC is also provided for BWR containments. Containment ISI and leak rate testing may not be sufficient to detect cracks. The reviewer evaluates the applicant's proposed programs to verify that adequate inspection methods will be implemented to ensure that cracks are detected.

3.5.3.2.2 Class I Structures

3.5.3.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The GALL report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) scaling, cracking, and spalling due to repeated freeze-thaw for Groups 1-3, 5, 7-9 structures; (2) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack for Groups 1-5, 7-9 structures; (3) expansion and cracking due to reaction with aggregates for Groups 1-5, 7-9 structures; (4) cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel for Groups 1-5, 7-9 structures; (5) cracks, distortion, and increase in component stress level due to settlement for Groups 1-3, 5, 7-9 structures; (6) reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures; (7) loss of material due to corrosion of structural steel components for Groups 1-5, 7-8 structures; (8) loss of strength and modulus of concrete structures due to elevated temperatures for Groups 1-5; and (9) crack initiation and growth due to SCC and loss of material due to crevice corrosion of stainless steel liner for Groups 7 and 8

structures. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

The aging management program consists of a structures monitoring program to verify that the CLB is maintained through periodic testing and inspection of critical plant structures, systems, and components. The reviewer verifies that the applicant has identified the structure/aging effect combinations not within the scope of the applicant's structures monitoring program developed in accordance with the guidance provided in NUMARC 93-01, Rev. 2 (Ref. 5) and RG 1.160, Rev. 2 (Ref. 6). The applicant may choose to expand the scope of its structures monitoring program to include these structure/aging effect combinations. Otherwise, the reviewer evaluates the applicant's proposed program in accordance with the guidance in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan.)

3.5.3.2.2.2 Aging Management of Inaccessible Areas

The GALL report recommends further evaluation of aging management for inaccessible concrete areas, such as foundation and exterior walls below grade exposed to ground water, if specific criteria defined in the GALL report cannot be satisfied. The reviewer reviews the aging management program on a case-by-case basis to ensure that the intended functions will be maintained during the period of the extended operation. The following degradations are managed: cracking, spalling, and increases in porosity and permeability due to aggressive chemical attack; cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel for Groups 1-3, 5, 7-9 structures.

3.5.3.2.3 Component Supports

3.5.3.2.3.1 Aging of Supports Not Covered by Structures Monitoring Program

The GALL report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; (2) loss of material due to environmental corrosion, for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

The aging management program consists of a structures monitoring program to verify that the CLB is maintained through periodic testing and inspection of critical plant structures, systems, and components. The reviewer verifies that the applicant has identified the component support/aging effect combinations not within the scope of the applicant's structures monitoring program developed in accordance with the guidance provided in NUMARC 93-01, Rev. 2 (Ref. 5) and RG 1.160, Rev. 2 (Ref. 6). The applicant may choose to expand the scope of its structures monitoring program to include these component support/aging effect combinations. Otherwise, the reviewer evaluates the applicant's proposed program in accordance with the guidance in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

3.5.3.2.3.2 Cumulative Fatigue Damage

Fatigue of support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists.

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

3.5.3.2.4 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, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address these 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.

3.5.3.3 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).

3.5.3.4 FSAR Supplement

The reviewer verifies that the applicant has provided information, equivalent to that in Table 3.5-2, in the FSAR supplement for aging management of the Structures and Component Supports for license renewal. The reviewer also verifies that the applicant has provided information, equivalent to that in Table 3.5-2, in the FSAR supplement for Subsection 3.5.3.3, "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 3.5-2, 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.

3.5.4 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 structures and component supports will be adequately managed so that there is reasonable assurance that these structures and component supports 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 structures and component supports as reflected in the license condition.

3.5.5 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.

3.5.6 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) Report," U.S. Nuclear Regulatory Commission, April 2001.

3. American Society of Mechanical Engineers, ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWL, Requirements for Class CC Concrete Components of Light-Water Cooled Power Plants, 1992 edition with 1992 addenda, or 1995 edition with 1996 addenda. The ASME Boiler and Pressure Vessel Code, The American Society of Mechanical Engineers, New York, NY.

4. American Society of Mechanical Engineers, ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWE, Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants, 1992 edition with 1992 addenda, or 1995 edition with 1996 addenda. The ASME Boiler and Pressure Vessel Code, The American Society of Mechanical Engineers, New York, NY.

5. NUMARC 93-01, Rev. 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" [Line-In/Line-Out Version], Nuclear Energy Institute, April 1996.

6. NRC Regulatory Guide 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997.

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
Common Components of All Types of PWR and BWR Containment				
BWR/PWR	Penetration sleeves, penetration bellows, and dissimilar metal welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see Subsection 3.5.2.2.1.6)
BWR/PWR	Penetration sleeves, bellows, and dissimilar metal welds.	Cracking due to cyclic loading, or crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Yes, detection of aging effects is to be evaluated (see Subsection 3.5.2.2.1.7)
BWR/PWR	Penetration sleeves, penetration bellows, and dissimilar metal welds	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No
BWR/PWR	Personnel airlock and equipment hatch	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No
BWR/PWR	Personnel airlock and equipment hatch	Loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanism	Containment leak rate test and Plant Technical Specifications	No
BWR/PWR	Seals, gaskets, and moisture barriers	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and Containment leak rate test	No
PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment				
BWR/PWR	Concrete elements: foundation, walls, dome.	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and corrosion of embedded steel	Containment ISI	Yes, if aging mechanism is significant for inaccessible areas (see Subsection 3.5.2.2.1.1)

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Concrete elements: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)
BWR/PWR	Concrete elements: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)
BWR/PWR	Concrete elements: foundation, dome, and wall	Reduction of strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete containment that exceed specified temperature limits (see Subsection 3.5.2.2.1.3)
BWR/PWR	Prestressed containment: tendons and anchorage components	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see Subsection 3.5.2.2.1.5)
BWR/PWR	Steel elements: liner plate, containment shell	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and Containment leak rate test	Yes, if corrosion is significant for inaccessible areas (see Subsection 3.5.2.2.1.4)
BWR	Steel elements: vent header, drywell head, torus, downcomers, pool shell	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see Subsection 3.5.2.2.1.6)
BWR/PWR	Steel elements: protected by coating	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	No
BWR/PWR	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	No

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Concrete elements: foundation, dome, and wall	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	No
BWR	Steel elements: vent line bellows, vent headers, downcomers	Cracking due to cyclic loads or Crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Yes, detection of aging effects is to be evaluated (see Subsection 3.5.2.2.1.7)
BWR	Steel elements: Suppression chamber liner	Crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	No
BWR	Steel elements: drywell head and downcomer pipes	Fretting and lock up due to wear	Containment ISI	No
Class I Structures				
BWR/PWR	All Groups except Group 6: accessible interior/exterior concrete & steel components	All types of aging effects	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.2.1)
BWR/PWR	Groups 1-3, 5, 7-9: inaccessible concrete components, such as exterior walls below grade and foundation	Aging of inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	Plant-specific	Yes, if an aggressive below-grade environment exists (see Subsection 3.5.2.2.2.2)
BWR/PWR	Group 6: all accessible/inacce-ssible concrete, steel, and earthen components	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Group 5: liners	Crack initiation and growth from SCC and loss of material due to crevice corrosion	Water Chemistry Program and Monitoring of spent fuel pool water level	No
BWR/PWR	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint, shrinkage, creep, and aggressive environment	Masonry Wall	No
BWR/PWR	Groups 1-3, 5, 7-9: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)
BWR/PWR	Groups 1-3, 5-9: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)
BWR/PWR	Groups 1-5: concrete	Reduction of strength and modulus due to elevated temperature	Plant-specific	Yes, for any portions of concrete that exceed specified temperature limits (see Subsection 3.5.2.2.1.3)
BWR/PWR	Groups 7, 8: liners	Crack Initiation and growth due to SCC; Loss of material due to crevice corrosion	Plant-specific	Yes
Component Supports				
BWR/PWR	All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc.	Aging of component supports	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.3.1)
BWR/PWR	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see Subsection 3.5.2.2.3.2)

Table 3.5-1. Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
PWR	All Groups: support members: anchor bolts, welds	Loss of material due to boric acid corrosion	Boric acid corrosion	No
BWR/PWR	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	No
BWR/PWR	Group B1.1: high strength low-alloy bolts	Crack initiation and growth due to SCC	Bolting integrity	No

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports

Program	Description of Program	Implementation Schedule*
PWR and BWR Containment		
Containment inservice inspection (Containment ISI)	The ASME Section XI, Subsection IWL program consists of periodic visual inspection of concrete surfaces for reinforced and prestressed concrete containments, and periodic visual inspection and sample tendon testing of unbonded post-tensioning systems for prestressed concrete containments, for signs of degradation, assessment of damage and corrective actions. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1. The ASME Section XI, Subsection IWE program consists of periodic visual, surface, and volumetric inspection of pressure retaining components of steel and concrete containments for signs of degradation, assessment of damage and corrective actions. This program is in accordance with ASME Section XI, Subsections IWE and IWL, 1992 edition including 1992 addenda or 1995 edition, including 1996 addenda.	Existing program
Containment leak rate test (LRT)	This program consists of monitoring of leakage rates through containment liner/welds, penetrations, fittings, and other access openings for detecting degradation of containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. This program is implemented in accordance with 10 CFR Part 50 Appendix J, RG 1.163 and NEI 94-01, Rev. 0.	Existing program
Protective coating monitoring and maintenance	This program consists of guidance for selection, application, inspection, and maintenance of protective coatings. This program is implemented in accordance with RG 1.54, Rev. 0 or Rev. 1.	Existing program
Class I Structures		
Inspection of water-control structures	The program consists of inspection and surveillance program for dams, slopes, canals, intake structure and other water-control structures associated with emergency cooling water systems or flood protection based on RG 1.127, Rev. 1.	Existing program

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports (continued)

Program	Description of Program	Implementation Schedule*
Monitoring of leakage in fuel storage facility	This activity consists of periodic monitoring of leak chase system drain lines and leak detection sump of fuel storage facility and refueling channel to detect SCC and crevice corrosion of stainless steel liners. Alternately, the pool water level may be monitored for evidence of leakage. This activity augments the Water Chemistry Program for aging management of the spent fuel pool liner.	Existing program
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, sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-103515 for water chemistry in BWRs and TR-102134 for secondary water chemistry in PWRs.	Existing program
Masonry wall	This program consists of inspections, based on IE Bulletin 80-11 and plant-specific monitoring proposed by IN 87-67, for managing cracking of masonry walls.	Existing program
Component Supports		
Inservice inspection (ISI)	This program consists of periodic visual examination of component supports for signs of degradation, evaluation, and corrective actions. This program is in accordance with ASME Section XI, Subsection IWF, 1989 edition through 1995 edition, including 1996 addenda.	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

Table 3.5-2. FSAR Supplement for Aging Management of Structures and Component Supports (continued)

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
Class I Structures and Component Supports		
Structures monitoring	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 NUMARC 93-01, Rev. 2 and RG 1.160, Rev. 2.	Existing program
PWR and BWR Containment, Class I Structures, and Component Supports		
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

* 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.

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