3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

The changes marked in this section support the consolidation of tables in GALL Chapter III. No further bases are provided. The changes are marked using WORD revision tracking features.

3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

Review Responsibilities

Primary - Branch assigned responsibility by PM as described in SRP-LR section 3.0

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 an older plant's 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 and Class *2* structures are organized into three groups: Group 1: BWR reactor building, PWR shield building, control room/building; auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, yard structures (auxiliary feedwater pump house, utility/piping tunnels, security lighting poles, manholes, duct banks), SBO structures (transmission towers, startup transformer circuit breaker foundation, electrical enclosure), containment internal structures, excluding refueling canal, fuel storage facility, refueling canal; BWR unit vent stack; Group 2: water-control structures (e.g., intake structure, cooling tower, and spray pond); Group 3: Tanks (concrete and steel) and missile barriers, and (Ref. 2).

The component supports are organized into two groups: Group B1: supports for ASME piping and components and Class MC (BWR Containment Supports) components; Group B2: Other supports *(All other supports except as stated in Group B1)* (Ref. 2).

The responsible review organization is to review the following LRA AMR and AMP items assigned to it, per SRP-LR section 3.0, for review:

AMRs

- AMRs consistent with the GALL report, for which further evaluation is not recommended
- AMRs consistent with the GALL report, for which further evaluation is recommended
- AMRs not consistent with the GALL report

AMPs

- AMPs consistent with GALL AMPs (with or without exceptions)
- Plant-specific AMPs

FSAR Supplement

- In addition, the responsible review organization is to review the FSAR supplement associated with each assigned AMP.

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Deleted: or 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)

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 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The aging management review and acceptable aging management programs applicable to structures and component supports are described and evaluated in Chapters II and III of the GALL report (Ref. 2).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific AMR line-item and the associated AMP are consistent with the cited GALL AMR line-item. The staff reviewer should then confirm that the LRA AMR line-item is consistent with the GALL line-item to which it is compared.

If the applicant identifies an exception to the cited GALL AMP, the LRA should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the AMP, the reviewer identifies a difference from the GALL AMP, this difference should be reviewed and dispositioned as if it were an exception identified by the applicant in its LRA. The disposition of all LRA-defined exceptions and staff-identified differences should be documented.

The LRA should identify any enhancements that are needed to permit an existing aging management program to be declared consistent with the GALL AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, if implemented, would allow the existing plant aging management program to be consistent with the GALL AMP and also that the applicant has a commitment in the FSAR supplement to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.5.2.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic acceptance criteria defined in 3.5.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

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 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 to manage the aging effects for inaccessible areas if the environment is aggressive.

3.5.2.2.1.2 Cracks and Distortion due to Increased Stress Levels from 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 General, Pitting and Crevice Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate

Loss of material due to general, pitting and crevice 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 Stress Corrosion Cracking

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. Moreover, stress corrosion cracking is a concern for dissimilar metal welds. The GALL report recommends further evaluation of the inspection methods implemented to detect these aging effects.

3.5.2.2.1.8 Scaling, Cracking, and Spalling due to Freeze-Thaw; and Expansion and Cracking due to Reaction with Aggregate

Scaling, cracking, and spalling due to freeze-thaw could occur in PWR and BWR concrete containments; and expansion and cracking due to reaction with aggregate could occur in concrete elements of PWR and BWR concrete and steel containments. Further evaluation is not necessary if stated conditions in NUREG-1801 are satisfied for inaccessible areas.

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 and 3 structures; (2) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack for Groups 1 and 3 structures; (3) expansion and cracking due to reaction with aggregates for Groups 1 and 3 structures; (4) cracking, spalling, loss of bond, and loss of material due to general, pitting and crevice corrosion of embedded steel for Groups 1 and 3 structures; (5) cracks and distortion due to increase in component stress level from settlement for Groups 1and 3 structures; (6) reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1 and 3 structures; (7) loss of material due to general, pitting and crevice corrosion of structural steel components for Groups 1 and 3 structures; (8) loss of strength and modulus of concrete structures due to elevated temperatures for Groups 1; and (9) cracking due to SCC and loss of material due to crevice corrosion of stainless steel liner for tanks in Group 3 structure. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

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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).

Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas for Groups 1 and 3 structures; and expansion and cracking due to reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1 and 3 structures. 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.

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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 and 3 structures.

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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 and B2 supports; (2) loss of material due to environmental corrosion, for Groups B2 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements for mechanical equipment in Group B2 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

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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 AMR Results Not Consistent with or Not Addressed in 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. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Examples of the type of information required are provided in Table 3.5-2 of this standard review plan.

3.5.3 Review Procedures

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

3.5.3.1 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The applicant may reference the GALL report in its license renewal application, as appropriate, and demonstrate that the aging management reviews and programs at its facility are consistent with those reviewed and approved in the GALL report. The reviewer should not conduct a re-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 acceptable the applicant's reference to GALL in its license renewal application. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms 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.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the structures and component supports that are contained in GALL as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL report. If the applicant commits to an enhancement to make its aging management program consistent with a GALL AMP, then the reviewer is to confirm that this enhancement when implemented will indeed make the LRA AMP consistent with the GALL AMP. If an aging management program in the LRA identifies an exception to the GALL AMP to which it is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL AMP, with which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL pertinent to the structures and component supports are summarized in Table 3.5-1 of this standard review plan. In this table, the ID column provides a row identifier useful in matching the information presented in the corresponding table in the GALL report Vol. 1. The Related Item column identifies the item number in the GALL report Vol. 2, Chapters II through VIII, presenting detailed information summarized by this row.

3.5.3.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic review procedures defined in 3.5.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

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 to manage the aging effects for inaccessible areas if the below-grade environment is aggressive. Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. The GALL recommends that examination of representative samples of below-grade concrete, when excavated for any reason, be performed, if the below-grade environment is aggressive. 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 Cracks and distortion due to increased stress levels from 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) cracks and distortion due to increases in component stress level from 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 confirms 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 General, Pitting and Crevice Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate

The GALL report identifies programs to manage loss of material due to general, pitting and crevice 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 confirm 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 Stress Corrosion Cracking

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, especially for dissimilar metal welds. The reviewer should evaluate the applicant's proposed programs to confirm that adequate inspection methods will be implemented to ensure that cracks are detected.

3.5.3.2.1.8 Scaling, Cracking, and Spalling due to Freeze-Thaw; and Expansion and Cracking due to Reaction with Aggregate

The GALL report recommends further evaluation only if the stated conditions are not satisfied for inaccessible concrete. This includes scaling, cracking, and spalling due to freeze-thaw; and expansion and cracking due to reaction with aggregate for concrete elements of PWR and BWR containments. The reviewer should confirm that the applicant has satisfied the conditions for inaccessible concrete as identified in the GALL report. Otherwise, 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 these aging effects in inaccessible areas are adequately managed.

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 and 3 structures; (2) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack for Groups 1 and 3 structures; (3) expansion and cracking due to reaction with aggregates for Groups 1 and 3 structures; (4) cracking, spalling, loss of bond, and loss of material due to general, pitting and crevice corrosion of embedded steel for Groups 1 and 3 structures; (5) cracks and distortion due to increase in component stress level from settlement for Groups 1 and 3 structures; (6) reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1 and 3 structures; (7) loss of material due to general, pitting and crevice corrosion of structural steel components for Groups 1 and 3 structures; (8) loss of strength and modulus of concrete structures due to elevated temperatures for Group 1; and (9) cracking due to SCC and loss of material due to crevice corrosion of stainless steel liner for tanks in Groups 3 structures. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

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The aging management program consists of a structures monitoring program to confirm that the CLB is maintained through periodic testing and inspection of critical plant structures, systems, and components. The reviewer confirms 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.)

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 following degradations are managed: loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1 and 3 structures; and expansion and cracking due to reaction with aggregates for Groups 1 and 3 structures. 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.

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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 an aggressive environment. The following degradations are managed: 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 for Groups 1 and 3 structures. Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. The GALL recommends that examination of representative samples of below-grade concrete, when excavated for any reason, be performed, if the below-grade environment is aggressive. 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.

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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 and B2 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 in Mechanical equipment, for Group B2 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

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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 confirms 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 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in the license renewal application, has identified applicable aging effects, listed the appropriate combination of materials and environments, and aging management programs that will adequately manage the aging effects. The aging management program credited could be an AMP that is described and evaluated in the GALL report or a plant-specific program. 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 confirms 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 confirms that the applicant has provided information equivalent to that in Table 3.5-2 in the FSAR supplement for SRP-LR Subsection 3.5.3.3, "AMR Results Not Consistent with 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 confirm that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments, 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

If the reviewer has confirmed that the applicant has provided information sufficient to satisfy the provisions of this review plan section, an evaluation finding similar to the following text should be included in the staff's safety evaluation report:

> On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects and the AMPs credited with managing these aging effects for the structures and component supports systems, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB during the period of extended operation. The staff also reviewed the applicable FSAR supplement program descriptions and concludes that the FSAR supplement provides an adequate program description of the AMPs credited for managing aging effects, as required by 10 CFR 54.21(d).

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. Draft NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, Revision 1, September 2005.

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
Common Components of All Types of PWR and BWR Containment						
1	BWR/PWR	Penetration sleeves, penetration bellows, dissimilar metal welds, and downcomers	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)	C-13
2	BWR/PWR	Penetration sleeves, bellows, dissimilar metal welds, and downcomers.	Cracking due to cyclic loading, or cracking 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)	C-14, C-15
3	BWR/PWR	Penetration sleeves, penetration bellows, and dissimilar metal welds	Loss of material due to general, pitting and crevice corrosion	Containment ISI and Containment leak rate test	No	C-12
4	BWR/PWR	Personnel airlock, equipment hatch and CRD hatch	Loss of material due to general, pitting and crevice corrosion	Containment ISI and Containment leak rate test	No	C-16
5	BWR/PWR	Personnel airlock, equipment hatch and CRD 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	C-17
6	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	C-18

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment						
7	BWR/PWR	Concrete elements: foundation, walls, dome.	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	Containment ISI and for inaccessible concrete, an examination of representative samples of below-grade concrete, when excavated for any reason, be performed, if the below-grade environment is aggressive	Yes, if the environment is aggressive (see Subsection 3.5.2.2.1.1)	C-03, C-05
8	BWR/PWR	Concrete elements: foundation, walls, dome.	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide.	Containment ISI	No, if concrete was constructed as stated for inaccessible areas.	C-02
9	BWR/PWR	Concrete elements: All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)	C-06

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
10	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)	C-07
11	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)	C-08
12	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)	C-11
13	BWR/PWR	Steel elements: liner plate, containment shell downcomers, drywell support skirt, ECCS suction header	Loss of material due to general, pitting and crevice 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)	C-09, C-19
14	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)	C-13, C-21

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
15	BWR/PWR	Steel elements: protected by coating	Loss of material due to general, pitting and crevice corrosion in accessible areas only	Protective coating monitoring and maintenance	No	C-12, C-19
16	BWR/PWR	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	No	C-10
17	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, if stated conditions are satisfied for inaccessible areas (see Subsection 3.5.2.2.1.8)	C-01, C-04
18	BWR	Steel elements: vent line bellows, vent headers, downcomers	Cracking due to cyclic loads or Cracking 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)	C-20, C-22
19	BWR	Steel elements: Suppression chamber liner	Cracking due to SCC	Containment ISI and Containment leak rate test	No	C-24
20	BWR	Steel elements: drywell head and downcomer pipes	Fretting and lock up due to wear	Containment ISI	No	C-23

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
Class I Structures						
21	BWR/PWR	All Groups except Group 2: accessible and inaccessible interior/exterior concrete, steel & lubrite components	All types of aging effects	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated (see Subsection 3.5.2.2.2.1)	T-01, T-03, T-04, T-06, T-11,
22	BWR/PWR	Groups 1 and 3: 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	Examination of representative samples of below-grade concrete, when excavated for any reason, be performed, if the below-grade environment is aggressive	Yes, if environment is aggressive (see Subsection 3.5.2.2.2.2)	T-05, T-07
23	BWR/PWR	Groups 1 and 3: inaccessible concrete components, such as exterior walls below grade and foundation	Aging of inaccessible concrete areas due to leaching of calcium hydroxide	None, if concrete was constructed as stated.	No, if concrete was constructed as stated for inaccessible areas.	T-02

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
24	BWR/PWR	Group 2; all accessible/ inaccessible concrete, metal, 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, *and/or Structures Monitoring*	No	T-15, T-16, T-17, T-18, T-19, T-20, T-21, T-22
25	BWR/PWR	Group 1; Fuel pool liners	Cracking due to SCC and loss of material due to pitting and crevice corrosion	Water Chemistry Program and Monitoring of spent fuel pool water level	No	T-14
26	BWR/PWR	Groups 1 and 2; all masonry block walls	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall */Structures Monitoring*	No	T-12
27	BWR/PWR	Groups 1 and 3; foundation	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program (see Subsection 3.5.2.2.1.2)	T-08

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
28	BWR/PWR	Groups 1-3 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)	T-09
29	BWR/PWR	Groups 1; 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)	T-10
30	BWR/PWR	Groups 3; Tank liners	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	Plant-specific	Yes, plant-specific (see subsection 3.5.2.2.1.7)	T-23
319	BWR/PWR	Group 2; Seals, gaskets, and moisture barriers	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring	No	TP-7
32	BWR/PWR	All groups except 2; Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports	Lock-up due to wear	ISI or Structures monitoring	No, if within the scope of the applicant's structures monitoring program or ISI	T-13

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
Component Supports						
33	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)	T-29, T-30, T-31, TP-6, TP-8
34	BWR/ PWR	All Groups: stainless steel support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc.	None	None	NA-no AE/M or AMP	TP-4, TP-5
35	BWR/PWR	Groups B1 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)	T-26
36	PWR	All Groups: support members: anchor bolts, welds	Loss of material due to boric acid corrosion	Boric acid corrosion	No	T-25, TP-3
37	BWR/PWR	Groups B1: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators; radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, other supports	Loss of material due to general and pitting corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI Structures Monitoring	No No, if within the applicant's structures monitoring program.	T-24, T-28, TP-1, TP-2

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

ID	Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
38	BWR/PWR	Group B1: high strength low-alloy bolts (for ASME Class 1 piping suoort)	Cracking due to SCC	Bolting integrity	No	T-27

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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, and 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 App. B program provides for corrective actions, 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.