

## **SECTION 3**

### **AGING MANAGEMENT REVIEWS**

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### 3.0 Aging Management Review

The Omaha Public Power District (OPPD) is the first license renewal applicant to fully utilize the Generic Aging Lessons Learned (GALL) process. The purpose of GALL is to provide the staff with a summary of staff-approved aging management programs (AMPs) for the aging of structures and components that are subject to an aging management review (AMR). If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's license renewal application (LRA) will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report is a compilation of existing programs and activities used by commercial nuclear power plants to manage the aging of structures and components within the scope of license renewal and which are subject to an AMR. The GALL Report summarizes the aging management evaluations, programs, and activities credited for managing aging for most of the structures and components used throughout the industry. The report also serves as a reference for both applicants and staff reviewers to quickly identify those AMPs and activities that the staff has determined will provide adequate aging management during the period of extended operation.

The GALL Report identifies (1) systems, structures, and components, (2) component materials, (3) the environments to which the components are exposed, (4) the aging effects associated with the materials and environments, (5) the AMPs that are credited with managing the aging effects, and (6) recommendations for further applicant evaluations of aging effects and their management for certain component types.

In order to determine whether the GALL process would improve the efficiency of the license renewal review, the staff conducted a demonstration project to exercise the GALL process and to determine the format and content of a safety evaluation based on this process. The results of the demonstration project confirmed that the GALL process will improve the efficiency and effectiveness of the LRA review while maintaining the staff's safety focus. The Standard Review Plan for License Renewal (SRP-LR) was prepared based on both the GALL model and the lessons learned from the demonstration project.

During its review of the FCS LRA, the staff performed an aging management review (AMR) inspection from January 6-10, 2003, and from January 20-23, 2003. The purpose of the inspection was to examine activities that support the LRA, and consisted of a selected examination of procedures, representative records, and interviews with the applicant regarding proposed aging management activities. The inspection team also reviewed the proposed implementation of 19 of the 24 AMPs credited in the LRA for managing aging. On the basis of the inspection team's review of the proposed implementation of the 19 AMPs, the staff finds that the applicant will adequately implement the AMPs credited for managing aging during the extended period of operation. The inspection team concluded that the existing aging management activities are being conducted as described in the LRA and that new aging management activities appear to be acceptable for managing plant aging.

Concurrent with the AMR inspection, the staff performed a separate audit of specific issues raised by staff reviewers. On the basis of the information gathered during the audit, the staff finds that the applicant has adequately addressed the specific issues raised by the staff reviewers. The audit issues can be found in the staff's audit report dated April 9, 2003, and are addressed in this SER.

In its letter dated March 14, 2003, the applicant provided revisions to many tables in license renewal application (LRA) Sections 2 and 3. The staff will review the revised information to determine whether the revisions change the staff's conclusions as documented in this safety evaluation report (SER). This is Open Item 3.0-1.

As a result of the staff's review of the FCS application for license renewal, including the additional information and clarifications submitted subsequently, the staff identified two license conditions. The first license condition requires the applicant to include the USAR Supplement in the next USAR update required by 10 CFR 50.71(e) following issuance of the renewed license. The second license condition requires that the future inspection activities identified in the USAR Supplement be completed prior to the period of extended operation.

### 3.0.1 The GALL Format for the LRA

The Fort Calhoun Station, Unit 1 (FCS) LRA closely follows the standard LRA format, as agreed to between the Nuclear Energy Institute (NEI) and the staff (see letters dated August 9, 1999, and September 22, 1999). This format has been used by previous applicants and will continue to be used by future applicants. However, there are several important changes within the format reflect the GALL process. First, the tables in LRA Section 2 that identify the structures and components that are subject to an AMR now include a third column that links plant-specific structures and components in the Section 2 tables to generic GALL component groups discussed in Section 3 (this is described in more detail below). Second, the tables in LRA Section 3 are different from the Section 3 tables used in previous LRAs. There are no system- or structure-specific tables in Section 3 of the FCS LRA. The individual components within a system or structure have been included in a series of system/structural group tables. For example, FCS has 20 auxiliary systems at FCS. Each system has several components. In previous LRAs, each system had a separate table that listed the components within the system. In the FCS LRA, there are no system tables. Instead, all the components in the 20 auxiliary systems are included in any one of three auxiliary system tables. LRA Table 3.3-1 consists of auxiliary system components evaluated in the GALL Report, LRA Table 3.3-2 consists of FCS auxiliary systems components not evaluated in the GALL Report, and LRA Table 3.3-3 consists of FCS auxiliary systems components that were not evaluated in the GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP. Similarly, the LRA tables for the other system groups (3.1 - reactor systems, 3.2 - engineered safety features systems, 3.4 - steam and power conversion systems, 3.5 - containment, structures, and component supports, and 3.6 - electrical and instrumentation and control (I&C) systems) have 3.x-1 LRA tables for components evaluated in the GALL Report, 3.x-2 LRA tables for components not evaluated in the GALL Report, and 3.x-3 LRA tables for components that were not evaluated in the GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP.

The 3.x-1 LRA tables have six columns. Column 1 identifies the system group, table number, and row number. For example, 3.1.1.01 identifies Table 3.1-1, row 1. This information is repeated in the last column of the Section 2 tables, and allows the staff reviewer to link each plant-specific structure and component identified in the Section 2 tables to the generic structure and component types identified in the Section 3 tables. Column 2 of the 3.x-1 LRA tables lists the generic structure and component types evaluated in GALL. Column 3 identifies the applicable aging effects experienced by the structure or component. Column 4 identifies the AMP that the GALL Report credits for managing the aging effect identified in Column 3.

Column 5 indicates whether the GALL Report recommends further evaluation of the management of the aging effect(s). Column 6 provides plant-specific information regarding management of the aging effect(s). Columns 2 through 5 of the 3.x-1 LRA tables are taken directly from the associated tables in the SRP-LR and GALL Report. Column 6 tells the staff reviewer whether or not the FCS AMP is consistent with GALL, and provides information on the material and environment associated with the component group. This column also provides additional information if the aging management differs from what is assumed in GALL, and provides information on any additional evaluations that GALL recommends.

The 3.x-2 LRA tables contain structures and components that were not evaluated in GALL. Because these structures and components were not evaluated in GALL, the staff had to perform a full review, just like those done for past applications.

The 3.x-2 LRA tables also have six columns, but the columns are different from those in the 3.x-1 LRA tables. The 3.x-2 LRA tables look very much like the Section 3 tables in previous applications. The first column identifies the system group, table number, and row number in the table. For example, 3.3.2.01 identifies LRA Table 3.3-2, row 1. Column 2 of LRA Table 3.x-2 identifies the type of structure or component being evaluated. Column 3 identifies the structure or component material, while Column 4 identifies the environment that the structure or component is exposed to. Column 5 identifies the applicable aging effect, and Column 6 identifies the AMP that is credited for managing the aging effect.

Because these components were not evaluated in GALL, the staff determined the adequacy of the aging management evaluation and programs in the same manner as for previous applications.

The 3.x-3 LRA tables contain structures and components that were not evaluated in GALL, but the applicant has determined that the materials, environments, and aging effects are bounded by the GALL evaluation and that the GALL AMPs can be applied to these structures and components.

The 3.x-3 LRA tables have eight columns. Columns 1 and 2 are the same as in the other tables. Column 3 identifies the structure or component material. Column 4 identifies the environment to which the structure or component is exposed. Column 5 identifies the applicable aging effect. Column 6 identifies the FCS AMP. Column 7 identifies the applicable GALL AMR evaluation that the applicant credits for managing the aging effect, and Column 8 provides a justification for applying the GALL AMR evaluation to the structure or component.

For structures and components in the 3.x-3 LRA tables, the staff performed a traditional evaluation of the aging management results, and determined whether the GALL evaluation is applicable to the structure or component.

### 3.0.2 The Staff's Review Process

The staff's review of the FCS LRA was performed in three phases. In Phase 1, the staff reviewed the applicant's AMP descriptions to compare those AMPs for which the applicant claimed consistency with those reviewed and approved in the GALL Report. For those AMPs for which the applicant claimed consistency with the GALL AMPs, the staff conducted an inspection to confirm that the applicant's AMPs were consistent with the GALL AMPs.



Several FCS AMPs were described by the applicant as being consistent with GALL, but with some deviation from GALL. By letter dated October 11, 2002, the staff issued request for additional information (RAI) B.1-1, requesting the applicant to define the AMP deviations contained in the LRA. By letter dated December 19, 2002, the applicant addressed this RAI by defining the following three types of AMP deviations

- (1) Exceptions to GALL are defined as specified GALL requirements that the applicant does not intend to meet or implement
- (2) Clarifications to GALL are defined as GALL requirements that the applicant intends to meet, but that may deviate from the exact wording or criteria specified in the GALL Report as documented in the LRA
- (3) Enhancements to GALL are defined as revisions or additions to plant procedures or program activities that will be implemented prior to the period of extended operation. Enhancements to an AMP may expand the scope of the AMP, but will not reduce its scope, thus ensuring that the AMP still meets the consistency requirements provided in the GALL Report.

For each AMP that had one or more of these deviations, the staff reviewed each deviation to determine (1) whether the deviation is acceptable, and (2) whether the AMP, as modified, would adequately manage the aging effect(s) for which it is credited.

For those AMPs that are not evaluated in GALL, the staff evaluated the AMP against the 10 program elements defined in Branch Technical Position (BTP) RLSB-1 in Section A-1 of SRP-LR Appendix A and used in previous LRA evaluations.

The staff also reviewed the updated safety analysis report (USAR) Supplement for each AMP to determine whether it provided an adequate description of the program or activity, as required by Section 54.21(d) of Chapter 10 of the *Code of Federal Regulations* (10 CFR 54.21(d)).

The AMRs and associated AMPs in the GALL Report fall into two broad categories: those AMRs and associated AMPs that GALL concludes are adequate to manage the aging of the components referenced in GALL, and those AMRs and associated AMPs for which GALL concludes that aging management is adequate, but further evaluation must be done for certain aspects of the aging management process. In Phase 2, the staff compared the applicant's AMR results and associated AMPs to the AMR results and associated AMPs in GALL to determine whether the applicant's AMRs and associated AMPs were consistent with those reviewed and approved in the GALL Report. For those AMR results and associated AMPs for which the applicant claimed to be consistent with GALL, and for which GALL did not recommend further evaluation, the staff conducted an inspection to confirm that the applicant's AMRs and associated AMPs were consistent with the GALL AMRs and associated AMPs. For those AMRs and associated AMPs for which GALL recommended further evaluation, in addition to its confirmatory inspection, the staff reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL Report. Finally, for AMRs and associated AMPs that were not consistent with GALL, the staff's review determined whether the AMRs and associated AMPs were adequate to manage the aging effects for which they were credited.

Once it had determined that the applicant's AMRs and associated AMPs were adequate to manage aging, the staff performed Phase 3 of its review by reviewing plant-specific structures and components to determine whether the applicant demonstrated that the effects of aging will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation, as required by 10 CFR 54.21(a)(3). Specifically, this review involved a component-by-component review to determine whether the applicant properly applied the GALL program to the aging management of components within the scope of license renewal and subject to an AMR (i.e., the staff evaluated whether the applicant had properly identified the aging effects, and the AMPs credited for managing the aging effects, for each FCS structure and component within the scope of license renewal and subject to an AMR). For structures and components evaluated in GALL, the staff reviewed the adequacy of aging management against the GALL criteria. For structures and components not evaluated in GALL, the staff reviewed the adequacy of aging management against the 10 criteria in Appendix A of the SRP-LR. Some FCS structures and components were not evaluated in GALL, but the applicant determined that the GALL AMR results could be applied to these structures and components and provided justification to support this determination. In these cases, the staff reviewed the adequacy of aging management against the GALL criteria to determine whether the GALL AMPs were adequate to manage the aging effects for which they were credited.

As part of the staff's review, an AMR inspection was performed from January 6-10 and from January 20-23 to examine activities that support the LRA. The inspection consisted of a select examination of procedures and representative records and interviews with personnel regarding the proposed aging management activities to support license renewal. The inspection concluded that the existing aging management activities are being conducted as described in the LRA and proposed aging management activities appear acceptable to manage plant aging.

Concurrent with this inspection, the staff performed a separate audit of specific issues raised by staff reviewers. The audit findings were issued on April 9, 2003.

### 3.0.3 Aging Management Programs

Table 3.0.3-1 presents the common AMPs, the associated GALL program, the system groups that credit the program for management of component aging, and the section of the safety evaluation report (SER) that contains the staff's review of the program.

Table 3.0.3-1

Common Aging Management Programs

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)

Bolting Integrity (B.1.1)	XI.M3, XI.M18	3.1 - Reactor Systems 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.1
Chemistry (B.1.2)	XI.M2, XI.M21	3.1 - Reactor Systems 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.2
Containment ISI (B.1.3)	X.S1, XI.S1, XI.S2	3.5 - Structures 4.5 - Concrete and Containment Tendon Pre-Stress TLAA	3.0.3.3
Flow-Accelerated Corrosion (B.1.5)	XI.M17	3.1 - Reactor Systems 3.4 - Steam and Power Conversion	3.0.3.4
Inservice Inspection (B.1.6)	XI.M1, XI.S3	3.1 - Reactor Systems 3.5 - Structures	3.0.3.5
Boric Acid Corrosion Prevention (B.2.1)	XI.M10	3.1 - Reactor Systems 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures 3.6 - Electrical	3.0.3.6
Cooling Water Corrosion (B.2.2)	XI.M20, XI.M21	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.7
Fatigue Monitoring (B.2.4)	X.M1	3.1 - Reactor Systems 4.3 - Metal Fatigue TLAA	3.0.3.8
Fire Protection (B.2.5)	XI.M26, XI.M27	3.3 - Auxiliary 3.5 - Structures	3.0.3.9

Periodic Surveillance and Preventive Maintenance (B.2.7)	Plant-Specific	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.10
Structures Monitoring (B.2.10)	XI.S5, XI.S7	3.3 - Auxiliary 3.5 - Structures	3.0.3.11
General Corrosion of External Surfaces (B.3.3)	Plant-Specific	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.12
One-Time Inspection (B.3.5)	XI.M32	3.1 - Reactor Systems 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.13
Selective Leaching (B.3.6)	XI.M33	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.14

Table 3.0.3-2 presents the system-specific AMPs, the associated GALL program, the system groups that credit the program for management of component aging, and the SER section that contains the staff's review of the program.

Table 3.0.3-2

System-Specific Management Programs

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)
Containment Leak Rate (B.1.4)	XI.S1, XI.S4	3.5 - Structures	3.5.2.3.1
Reactor Vessel Integrity (B.1.7)	XI.M31	3.1 - Reactor Systems	3.1.2.3.1

Diesel Fuel Monitoring and Storage (B.2.3)	XI.M30	3.3 - Auxiliary Systems	3.3.2.3.1
Overhead Load Handling Systems Inspection (B.2.6)	XI.M23	3.3 - Auxiliary Systems	3.5.2.3.2
Reactor Vessel Internals Inspection (B.2.8)	XI.M13, XI.M16	3.1 - Reactor Systems	3.1.2.3.2
Steam Generator (B.2.9)	XI.M19	3.1 - Reactor Systems	3.1.2.3.3
Alloy 600 (B.3.1)	XI.M11	3.1 - Reactor Systems	3.1.2.3.4
Buried Surfaces External Corrosion (B.3.2)	XI.M34	3.3 - Auxiliary Systems	3.3.2.3.2
Non-EQ Cable Aging Management (B.3.4)	Plant-Specific	3.6 - Electrical and I&C Systems	3.6.2.3.1
Thermal Embrittlement of Cast Austenitic Stainless Steel (B.3.7)	XI.M12	3.1 - Reactor Systems	3.1.2.3.5

### 3.0.3.1 Bolting Integrity Program

#### 3.0.3.1.1 Summary of Technical Information in the Application

The applicant's bolting integrity program is discussed in LRA Section B.1.1, "Bolting Integrity Program." The applicant states that the program is consistent with GALL programs XI.M3, "Reactor Head Closure Studs," and XI.M18, "Bolting Integrity," with the exception that the applicant did not identify stress corrosion cracking (SCC) as an aging effect requiring management for high-strength carbon steel bolting in plant indoor air. The applicant also states that it will utilize American Society of Mechanical Engineers (ASME) Section XI, Subsection IWF, visual VT-3 inspection requirements rather than volumetric inspections for the inspection of supports.

This AMP is credited with managing aging in bolts in the reactor, ESF, auxiliary, and steam and power conversion systems.

The applicant performed inspections of bolted components under the FCS inservice inspection (ISI) program, the boric acid corrosion (BAC) prevention program, and the structures monitoring program (SMP). The SMP inspects structural bolts. Visual inspections conducted under the

BAC prevention program included the inspection of bolted components in borated systems. Any indication of boric acid residue or damage is reported and evaluated to determine if a component can remain in service per established procedures. Documentation of operating experience is included as part of the BAC prevention program. On occasion, visual observations have identified BAC damage. These deficiencies were documented in accordance with the FCS corrective action program (CAP) and resulted in repair or replacement, if required. Review of the plant-specific operating experience indicates that the inspections have been effective in managing the aging effects of bolted components.

On the basis of the above discussion, the applicant concluded that the bolting integrity program provides reasonable assurance that the bolting aging effects will be adequately managed.

#### 3.0.3.1.2 Staff Evaluation

In LRA Section B.1.1, "Bolting Integrity Program," the applicant described its AMP to manage aging in bolting. The LRA stated that this AMP is consistent with GALL AMPs XI.M3, "Reactor Head Closure Studs," and XI.M18, "Bolting Integrity," with the exception that the applicant did not identify SCC as an aging effect requiring management for high-strength carbon steel bolting in plant indoor air. The applicant also stated that it will utilize ASME Section XI, Subsection IWF, visual VT-3 inspection requirements, rather than volumetric inspections, for the inspection of supports. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and its justification to determine whether the AMP, with the deviation, remains adequate to manage the aging effects for which it is credited, and reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program.

In RAI B.1.1-1, issued by letter dated October 11, 2002, the staff requested that the applicant address its statement in Section B.1.1 of the LRA, that the bolting integrity program is consistent with the GALL Report, with the exception that FCS has not identified SCC as a creditable aging effect requiring management for high-strength carbon steel bolting in plant indoor air. The staff indicated that its understanding is that this exception means that this program will follow all the requirements in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," dated July 2001, with the exception of high-strength carbon steel bolting for steel structures, pipe supports, heating, ventilation, and air conditioning (HVAC) supports, electrical supports, and equipment supports. The staff requested that the applicant verify that the staff's understanding of the program is correct. The applicant's response by letter dated December 19, 2002, stated that the NRC staff's understanding of the program is correct. However, the applicant, in its response, did not discuss the exclusion of the aging effect of SCC regarding high-strength carbon steel bolting in plant indoor air or why an ASME Section XI, Subsection IWF, visual VT-3 inspection, rather than volumetric inspections, is adequate to inspect supports.

By letter dated February 20, 2003, the staff, in potential open item (POI)-7(a), requested that the applicant provide the basis for the exclusion of SCC as a plausible aging effect for high-strength carbon steel bolting in plant indoor air, as well as the basis for why a VT-3 inspection is sufficient to inspect supports. By letter dated March 14, 2003, the applicant clarified that the basis for excluding SCC as a plausible aging effect for high-strength carbon steel bolting in plant indoor air can be found in the response to RAI 3.2.1-2, submitted to the staff by letter dated December 12, 2002. In the response to RAI 3.2.1-2, the applicant states that stainless

steels, high-strength aluminum alloys, and brasses are the most susceptible alloys to SCC. Ordinary steels are not as susceptible. Secondly, SCC requires exposure to specific chemical solutions for the mechanism to occur. Stainless steels require chloride-laden solutions. Aluminum alloys require sodium chloride solutions. Brasses require ammonia solutions. Ordinary steels require exposure to caustic or mixed acid solutions. Thirdly, elevated temperature is usually a factor when SCC occurs. Thus, for the carbon steel bolting in question, SCC is not an issue because (1) the material is not readily susceptible to SCC, (2) a caustic or mixed acid solution environment is not present, and (3) elevated temperatures are not present. With regard to VT-3 inspections, in its response to POI-7(a), the applicant stated that support bolting does not perform a pressure-retention function like flange bolting, pump casing bolting, etc., and therefore the applicant concluded that a VT-3 inspection was adequate.

The staff has reviewed the applicant's response to POI-7(a) and RAI 3.2.1-2 and agrees that the conditions and environments needed for SCC to occur in high-strength carbon steel bolting in plant indoor air are not present at FCS. In addition, the staff agrees that the function of the support bolting does not warrant a volumetric inspection, and that a VT-3 inspection is sufficient. POI-7(a) is resolved.

The staff reviewed the applicant's operating experience with regard to the management of bolted components, as provided in LRA Section B.1.1. LRA Section B.1.1 states that inspections of bolted components have been conducted under the FCS ISI program, BAC prevention program, and the SMP. On occasion, visual observations have identified BAC damage. These deficiencies were documented in the FCS CAP and resulted in repair or replacement, if required. The applicant concludes, and the staff agrees, that the plant-specific operating experience indicates that visual inspections have proved effective in managing the aging effects of bolted components.

LRA Section A.2.2 provides the applicant's USAR Supplement describing the bolting integrity program. The staff reviewed the USAR Supplement and finds it to be an adequate description of the bolting integrity program.

#### 3.0.3.1.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the bolting integrity program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.2 Chemistry Program

#### 3.0.3.2.1 Summary of Technical Information in the Application

The applicant's water chemistry program is discussed in LRA Section B.1.2, "Chemistry Program." The applicant states that the program is consistent with GALL program XI.M2, "Water Chemistry," and includes the chemistry-related portions of the program in GALL XI.M21, "Closed-Cycle Cooling Water System." This extends its applicability to the systems containing closed-cycle cooling water.

This AMP is credited with managing aging effects caused by primary and secondary water chemistries, and by the water chemistry in the component cooling water (CCW) system. It is based on the Electric Power Research Institute (EPRI) water chemistry guidelines. These guidelines are referenced in the following EPRI reports, Topical Report (TR)-105714 for primary water chemistry, TR-102134 for secondary water chemistry, and TR-107396 for closed-cycle cooling water chemistry.

The chemistry program will manage the aging effects on components which either are not evaluated in GALL, or, although not specifically evaluated, are relying on the AMPs in GALL. These components are listed in Tables 3.1-2 through 3.5-2 and Tables 3.1-3 through 3.5-3 of the LRA. They are included in reactor systems, engineering safety features, auxiliary systems, steam and power conversion systems, and containment, structures and component supports. The components are made of carbon steel, stainless steel, cast austenitic stainless steel (CASS), low-alloy steel, cast iron, and nickel-based and copper alloys. When exposed to the environments of primary, secondary, or closed-cycle cooling water, the resulting aging effect is loss of material caused by crevice corrosion, pitting, and cracking. The chemistry program manages these aging effects by specifying water chemistries which minimize corrosive damage.

On the basis of the above discussion, the applicant concluded that the chemistry program provides reasonable assurance that the aging effects caused by plant water chemistry will be adequately managed.

#### 3.0.3.2.2 Staff Evaluation

In LRA Section B.1.2, "Chemistry Program," the applicant described its AMP to manage aging effects by controlling primary and secondary water chemistries and by the CCW system. The LRA stated that this AMP is consistent with the chemistry program in Section XI.M2 of the GALL Report with an enhancement resulting from the inclusion of the chemistry-related portions of the GALL closed-cycle cooling water system program. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancement and its justification to determine whether the AMP, with the enhancement, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

The inclusion of the information discussed above causes changes in some attributes of the GALL chemistry program. Therefore, the staff reviewed this AMP against only those attributes of the applicant's program which deviate from the attributes of the GALL chemistry program, using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR.



[Preventive Actions] In addition to controlling water chemistry to minimize exposure of the affected components to aggressive chemistry environments, the preventive action attribute of the water chemistry program in the LRA also addresses maintaining proper corrosion inhibitor concentrations in the closed-cycle cooling water systems. The staff finds that this additional requirement in the applicant's chemistry program extends its preventive function to the closed-cycle cooling water systems, and therefore, finds it acceptable.

[Monitoring and Trending] The monitoring and trending attribute in the water chemistry program in GALL is modified by specifying the need for sampling water chemistry on a continuous, daily, weekly, or as needed basis, as indicated by plant operating conditions. The staff finds this modification acceptable because it will improve aging management by closely maintaining controlled water chemistry.

[Acceptance Criteria] The acceptance criteria in the GALL water chemistry program are extended by requiring the water in the closed-cooling water systems to maintain concentrations of corrosion inhibitors within the specified limits of EPRI TR-107396. The staff finds this modification acceptable because it will ensure that the corrosion damage to the components in these systems will be minimized.

[Operating Experience] The plant operating experience has indicated that over the operating history of the plant, several incidents have occurred which could be attributed to improper water chemistry. These included steam generator (SG) tube leaks, condenser tube leaks, some resin intrusion into the primary storage tank, and major pipe breaks due to flow-accelerated corrosion (FAC). This last incident is discussed in the FAC AMP. However, in all cases, proper corrective actions were implemented to prevent reoccurrence. In addition, the chemistry management of aging effects was continuously upgraded based on plant personnel and industry experience.

Such operating experience has provided feedback to revisions of the EPRI water chemistry guideline document. The staff concluded that the EPRI guideline document, which was developed based on operating experience, has been effective over time with widespread use.

#### 3.0.3.2.3 Conclusions

On the basis of its review and inspection of the applicant's AMP, including the proposed enhancements to the AMP, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP, and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the chemistry program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.3 Containment Inservice Inspection Program

The applicant described its containment ISI program in Section B.1.3 of the LRA. The applicant credits this program with managing the aging of containment structures and components that are within the scope of license renewal. The staff reviewed the containment ISI program to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.3.1 Summary of Technical Information in the Application

The LRA states that the FCS containment ISI program is consistent with GALL programs X.S1, "Concrete Containment Tendon Prestress," XI.S1, "ASME Section XI, Subsection IWE," and XI.S2, "ASME Section XI, Subsection IWL." The 10-year containment (IWE and IWL) ISI program plan for FCS, incorporating the examination requirements of Subsection IWE and Subsection IWL of the Code, has been developed and implemented.

As part of the operating experience, the applicant states that inspections of the containment liner have been conducted in accordance with the containment leak rate testing program and the maintenance rule implementation program. Inspections of the tendons and tendon anchorages have been conducted in accordance with technical specifications, the USAR, and plant procedures. Furthermore, the applicant states that the ASME Code, Section XI, Subsection IWL, ISI program incorporates all of the inspection criteria and guidelines of the previous tendon inspection program and is implemented using existing plant procedures. No significant age-related degradation has been identified in the inspections performed.

Based on the implementation of the ISI programs, the applicant concluded that the containment ISI program provides reasonable assurance that the aging effects will be managed such that the components subject to an AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

#### 3.0.3.3.2 Staff Evaluation

LRA Section B.1.3 describes the applicant's containment ISI program. The LRA states that this AMP is consistent with GALL programs X.S1, "Concrete Containment Tendon Prestress," XI.S1, "ASME Section XI, Subsection IWE," and XI.S2, "ASME Section XI, Subsection IWL," with no deviations. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

In addition to the review of Section B.1.3 of the LRA, the staff reviewed the relevant portions of Section 3.5, "Aging Management of Containment, Structures, and Component Supports," of the LRA to correlate the results of the AMR of the containment components with the ISI program described in Section B.1.3 of the LRA.

The applicant's containment ISI program is consistent with the provisions of GALL programs XI.S1 and XI.S2. Moreover, for the prestressing tendons of the FCS containment, the applicant's prestressing tendon monitoring program is consistent with GALL program X.S1. In general, the staff considers the use of these GALL programs appropriate and acceptable. Plant-specific implementation is discussed below.

To assess the present condition of the containment liner plate, the staff asked the applicant, in RAI B.1.3-1, to provide a summary of the significant degradations (i.e., metal thinning in excess of 10 percent of the nominal thickness of the metal) discovered during the last inspection of the liner, and a summary of corrective actions taken. By letter dated December 19, 2002, the applicant provided the following response:

Inspections of the liner performed in May 2001 identified approximately 6 locations of corrosion and loss of material at the base of the liner, between the floor expansion seal and the curb at elevation 994' 6". The total area of corrosion was less than 6 square inches. Inspection identified small areas within the corroded areas with a maximum thickness loss of approximately 15%. The minimum thickness measured with [ultrasonic testing] UT was 0.216" compared to a nominal thickness of 0.25". The inspection identified some areas of seal separation from the liner and shrinkage below the curb, which allowed moisture to collect. Repairs were made to recoat the degraded areas of the liner and restore degraded areas of the moisture barrier during the 2002 refueling outage. This included removal of the top portion of the moisture barrier to inspect inaccessible sections of the liner. Only minor surface corrosion was found on the liner extending only 0.125" to 0.25" below the top of the existing joint sealer. FCS plans to reperform the liner inspection during the 2003 refueling outage.

Since the applicant is monitoring the liner condition as part of its ISI program, and maintaining the moisture barrier through periodic inspections, the staff believes that significant liner degradation will be monitored and corrective actions will be taken so that the integrity of the containment, as required by the CLB, will be maintained during the period of extended operation.

For inspection of concrete components of the FCS containment, the applicant is committing to use GALL program XI.S2, "ASME Section XI, Subsection IWL," during the period of extended operation. The GALL program recognizes the absence of explicit acceptance criteria for concrete components (in Element 6, Acceptance Criteria), and recommends the use of Chapter 5 of American Concrete Institute (ACI) 349.3R. By letter dated February 20, 2003, the staff issued POI-7(b), requesting the applicant to provide information regarding the acceptance criteria to be used for examination of the containment concrete at FCS. By letter dated March 14, 2003, the applicant stated that the FCS containment ISI program meets the requirements of ASME Section XI, Subsection IWL, and is consistent with the criteria specified in GALL program XI.S2, "ASME Section XI, Subsection IWL." In Appendix B of the March 14, 2003, letter, the applicant provided a copy of the vendor procedure used for the ASME XI, Subsection IWL, inspection performed in 2001. The staff reviewed the information provided in response to POI-7(b) and finds it acceptable because the vendor's process for examination of concrete surfaces of the FCS containment clearly delineates the responsibility, qualifications, quality control, and examination standards to be used for the examination. POI-7(b) is resolved.

In the 1990s, NRC staff inspections had noted a large amount of grease leakage from the tendons, specifically in the ring-girder areas of the FCS containment. In RAI B.1.3-2, the staff asked the applicant to provide an assessment of such leakage on tendon performance (i.e., absence of corrosion protection and potential degradation of tendon wires) during the period of extended operation, and the effectiveness of the actions taken to alleviate future grease leakage. By letter dated December 19, 2002, the applicant provided the following response:

Grease leakage noted on the outer containment walls during the 1990's resulted from seal leakage from helical tendon upper grease cans. The leakage characterized as a "large amount" ranges from a few cups to one gallon from a typical volume of more than 50 gallons. This upper seal can leakage has no effect on the long term corrosion of the tendon wires or end attachment, as demonstrated by inspection of the tendon ends when the leaks were repaired. The grease fill procedure was modified to leave additional "head

space” for thermal expansion to decrease the number of minor grease leaks on the containment upper helical can seals.

IN 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments,” identified examples of tendon degradation due to loss of grease. Our saw tooth construction and unique helical tendon design combine to make many of the aspects of the subject information notice not applicable to FCS. No damage to tendon wires due to lack of grease, corrosion, or other aging effects have been identified during tendon inspections performed at FCS. To investigate the anti-corrosion effectiveness of thin films of grease, OPPD committed to the NRC in 1992 to test a dome tendon that had lost a significant amount of grease. The results of surveillance testing of the dome tendon showed enough grease adheres to the tendon wires to protect them from corrosion even when large grease voids occur. The type of grease was not changed.

The staff believes that the example of wire breakage at the Calvert Cliffs Nuclear Power Plant (described in information notice (IN) 99-10) is applicable to FCS containment tendon wires, and the potential for corrosion induced wire breakage is a plausible aging effect. However, the applicant is aware of the problem, and since the tendon wires will be monitored during the IWL examinations, the staff finds the applicant’s process for addressing this issue acceptable.

The staff reviewed the applicant’s operating experience as provided in LRA Section B.1.3 which states that inspections have been conducted of the containment liner, tendons, and tendon anchorages and no age-related degradation of these components were found. The applicant concludes, and the staff agrees, that the plant-specific operating experience indicates that inspections have proved effective in managing the aging effects associated with components within the scope of the containment ISI program.

The applicant provided a summary description of the containment ISI program in Section A.2.6 of the LRA. The staff finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

### 3.0.3.3.3 Conclusion

On the basis of its review and inspection of the applicant’s program, and the applicant’s responses to the staff’s RAIs, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the containment ISI program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.4 Flow-Accelerated Corrosion Program

#### 3.0.3.4.1 Summary of Technical Information in the Application

The applicant’s FAC program is discussed in LRA Section B.1.5, “Flow-Accelerated Corrosion Program.” The applicant states that the program is consistent with GALL program XI.M17, “Flow-Accelerated Corrosion.”

This AMP is credited with managing aging effects in components which, although not specifically evaluated, are relying on the aging management of the FAC program in GALL. These components are listed in Tables 3.1-3 and 3.4-3 of the LRA. They are included in reactor and steam and power conversion systems. The components susceptible to FAC are made of carbon and low-alloy steel and are affected by FAC when exposed to the environments of deoxygenated water or saturated steam. The resulting aging effects are caused by loss of material.

The applicant's program for controlling FAC relies on the implementation of the EPRI guidelines contained in NSAC-202L-R2, "Recommendation for an Effective Flow-Accelerated Corrosion Program." The program includes procedures and administrative controls to ensure structural integrity of all carbon or low-alloy lines containing high-energy fluids. The applicant ascertains that all aging effects caused by FAC are properly managed by using predictive codes and inspection procedures which include wall thickness measurements. The applicant uses two codes: CHECWORKS, developed by EPRI, and FACManager which supplements the CHECWORKS code predictions. Using these two codes and performing measurements, the applicant can make timely predictions of loss of material by FAC so that the damaged components can be repaired or replaced before their failure.

On the basis of the above discussion, the applicant concluded that the FAC program provides reasonable assurance that the aging effects due to FAC will be adequately managed.

#### 3.0.3.4.2 Staff Evaluation

In LRA Section B.1.5, "Flow-Accelerated Corrosion Program," the applicant described its AMP to manage aging effects caused by FAC. The LRA stated that this AMP is consistent with GALL AMP XI.M17, "Flow-Accelerated Corrosion Program," with no deviations. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff reviewed the applicant's description of the program in the LRA and evaluated the applicant's responses to the staff's RAI B.1.5-1, issued by letter dated October 11, 2002. This RAI requested the applicant to identify the methods used for predicting component degradation by FAC, as discussed in NSAC-202L-R2. By letter dated December 19, 2002, the applicant stated that it had performed a susceptibility analysis to identify components susceptible to degradation by FAC. Components that are suitable for modeling are modeled using CHECWORKS. In addition, all inspection methods are stored in a Microsoft Access-based program called FACManager, which was purchased from a vendor with considerable FAC expertise. FACManager calculates wear using the same equations as CHECWORKS, but calculates wear by a straight line wear over time formula, which is the average wear rate over the components' life (or the time between inspections if the point-to-point method is used). For non-modeled components, FACManager is used to predict component degradation rates. For modeled components, both FACManager and CHECWORKS results are used in determining the component degradation rates.

On the basis of the staff's review, including the applicant's response to RAI B.1.5-1, the staff finds that the applicant's program is consistent with the GALL program. Therefore, the staff determined that there is no need for the staff to review the attributes in the applicant's FAC program, with the exception of plant-specific operating experience. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

[Operating Experience] The plant operating experience, described in the LRA, has indicated that on some occasions pipe wall thickness has been found to be below the established screening criteria, and visual inspections have identified through-wall erosion. These deficiencies were documented and the damaged components were repaired or replaced. A major rupture of an extraction steam pipe line occurred in 1997. As a result of that occurrence, the FAC program was upgraded. The current program follows the EPRI guidelines. The staff finds this approach acceptable because, by following current procedures, the applicant ensures that the FAC program will properly manage aging effects due to FAC.

The applicant provided its USAR Supplement for the FAC program in Section A.2.12 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

#### 3.0.3.4.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the FAC program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.5 Inservice Inspection Program

##### 3.0.3.5.1 Summary of Technical Information in the Application

The applicant's ISI program is discussed in LRA Section B.1.6, "Inservice Inspection Program." The applicant states that the program is consistent with GALL programs XI.M1, "ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD," and XI.S3, "ASME Section XI, Subsections IWF." The applicant also states that the scope of the FCS ISI program includes those plant-specific components identified in Tables 3.1-2 and 3.2-3 of the LRA for which the ISI program is identified as an AMP.

As part of the operating experience, the applicant states that the FCS ISI program has been effective in managing the aging effects of components. No significant age-related degradation has been identified in the inspections performed.

On the basis of the above discussion, the applicant concluded that the ISI program provides reasonable assurance that the aging effects will be adequately managed such that the ASME Class 1, 2, and 3 components and their integral supports, subject to an AMR, will continue to perform their intended functions consistent with the CLB for the period of extended operation.

##### 3.0.3.5.2 Staff Evaluation

The applicant states that the program is consistent with GALL program XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and XI.S3, "ASME Section XI, Subsections IWF," with no deviations. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff concludes that the applicant's program is consistent with the GALL program. There is no need, therefore, for the staff to review the attributes in the applicant's ISI program, with the exception of plant-specific operating experience. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

[Operating Experience] The plant operating experience, described in the LRA, has indicated that there was no significant age-related degradation identified through inservice inspection of components performed during the past inspection intervals. The FCS ISI program has been effective in managing the aging effects of those components and their integral supports identified in Tables 3.1-2 and 3.2-3 of the LRA for which the ISI program is identified as an AMP. The staff, therefore, has determined that the applicant's ISI program will adequately manage the aging effects in the components identified in the tables during the period of extended operation.

#### 3.0.3.5.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the ISI program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.6 Boric Acid Corrosion Prevention Program

##### 3.0.3.6.1 Summary of Information in the Application

The applicant's BAC prevention program is discussed in LRA Section B.2.1, "Boric Acid Corrosion Prevention Program." The applicant states that the program is consistent with GALL program XI.M10, "Boric Acid Corrosion." However, the applicant has enhanced this program by increasing its scope.

The AMP is credited with managing the aging effects in the systems carrying water containing boric acid. The program will manage the aging effects in the components which either are not evaluated in GALL, or, although not specifically evaluated, are relying on the AMPs in GALL. These components are listed in Tables 3.1-2, 3.1-3, and 3.3-3 of the LRA. They are included in the reactor and auxiliary systems. The components are made of carbon steel, low-alloy steel, cast iron, cadmium plated steel, galvanized steel, and copper alloys. When exposed to leakage of boric acid, the resulting aging effect is loss of material.

The program relies on implementation of the recommendations of NRC Generic Letter (GL)

88-05 to monitor the condition of the reactor coolant pressure boundary for boric acid leaks. Periodic visual inspections of adjacent structures, components, and supports for evidence of leakage and corrosion are the elements of the program.

On the basis of the above discussion, the applicant concluded that the BAC prevention program provides reasonable assurance that the aging effects due to boric acid leakage will be adequately managed.

#### 3.0.3.6.2 Staff Evaluation

In LRA Section B.2.1, "Boric Acid Corrosion Prevention Program," the applicant described its AMP to manage aging effects due to boric acid leakage. The LRA stated that this AMP is consistent with GALL AMP XI.M10, "Boric Acid Corrosion," with an enhancement. The enhancement increases the scope of inspections and provides specific guidance to the inspectors. The staff confirmed the applicant's claim of consistency during the AMR inspection.

The inclusion of the information discussed above causes changes in some attributes of the GALL BAC prevention program. Therefore, the staff reviewed this AMP against only those attributes of the applicant's program which deviate from the attributes of the GALL's BAC program, defined in BTP RLSB-1, found in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

[Scope of Program] The applicant added to the scope of the GALL BAC program, specific guidance for inspection of the components, structures, and electrical components where boric acid may have leaked. It also added the need for inspecting the fuel pool cooling and waste disposal systems. The staff finds this acceptable because these additional inspections will make the program more comprehensive, and improve the management of aging effects in the components potentially exposed to boric acid leaks.

[Parameters Monitored or Inspected] The applicant's BAC prevention program specifies the parameters monitored and inspected, with an enhancement to include the spent fuel pool cooling and waste disposal systems to the scope of the program. The staff finds this acceptable because this will broaden the program and enhance the program for managing the existing aging effects.

[Monitoring and Trending] The monitoring and trending attribute in the applicant's program will be enhanced by implementing specific guidance to require maintenance personnel to report boric acid leakage to the BAC prevention program engineer. These procedures will improve the way the plant systems containing boric acid are monitored and trended, and will contribute to better management of the aging effects caused by boric acid corrosion. Therefore, the staff finds this enhancement acceptable.

[Operating Experience] The plant operating experience included severe boric acid corrosion of pump studs, which prompted the applicant to introduce significant improvement in its BAC prevention program. The staff agrees with the applicant that the current program routinely identifies and corrects borated water leakage in the RCS and other systems carrying borated water, and adequately manages aging effects caused by boric acid corrosion.



The applicant provided its USAR Supplement for the BAC prevention program in Section A.2.3 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

The staff is currently reviewing the issues associated with NRC Bulletin 2002-01. This bulletin was issued as a result of a control rod drive mechanism nozzle cracking event at Davis Besse, which resulted in severe degradation of the reactor vessel head due to exposure to concentrated boric acid. To date, all licensees (except Davis Besse) have responded to the bulletin, providing information about their boric acid corrosion control programs. Any future regulatory actions that may be required as a result of those reviews will be addressed by the staff in a separate regulatory action. This is considered a current operating issue and will be handled as such. The staff will resolve this issue in accordance with 10 CFR 54.30 outside of the license renewal process.

#### 3.0.3.6.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the BAC prevention program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.7 Cooling Water Corrosion Program

##### 3.0.3.7.1 Summary of Technical Information in the Application

The applicant's cooling water corrosion program is discussed in LRA Section B.2.2, "Cooling Water Corrosion Program." The applicant states that the program is consistent with GALL program XI.M20, "Open-Cycle Cooling Water System," modified by moving the reference to external coatings to Section B.3.3, "General Corrosion of External Surfaces Program," in the LRA. The cooling water corrosion program is also consistent with the non-chemistry related portions of GALL program XI.M21, "Closed-Cycle Cooling Water System," modified by removing from the license renewal commitments reference to (1) fluid flow, which is an active function, and (2) testing the systems performing active functions.

Both of these GALL programs were enhanced by inspecting various components in open-cycle and closed-cycle water systems based on the evaluation of their susceptibility. These inspection activities will be commensurate with the GALL program. The modifications introduced to the GALL programs are reflected in the applicant's cooling water corrosion program attributes, some of which deviate from the attributes of the programs in GALL.

This AMP is credited with managing aging effects in the open-cycle and closed-cycle cooling water systems.

The cooling water corrosion program will manage the aging effects in the components which are either not evaluated in GALL, or, although not specifically evaluated, are relying on the AMP in GALL. These components are listed in Tables 3.2-2, 3.3-2, and 3.3-3 of the LRA. They are included in the sections of the LRA addressing the ESF and auxiliary systems. These components are made from Alloy 600, brass, bronze, copper and copper alloy, nickel-based alloy, carbon and stainless steel, and cast iron. They are exposed to the environments of corrosion-inhibited treated water, oxygenated or deoxygenated treated water, raw water, and lubricating oil.

The resulting aging effects are caused by the loss of material, crevice and pitting corrosion, cracking, galvanic corrosion, biofouling, and microbiologically influenced corrosion (MIC). The applicant's cooling water corrosion program is based on the EPRI guidelines in TR-107396.

On the basis of the above discussion, the applicant concluded that the cooling water corrosion program provides reasonable assurance that the aging effects due to corrosion will be adequately managed.

#### 3.0.3.7.2 Staff Evaluation

In LRA Section B.2.2, "Cooling Water Corrosion Program," the applicant described its AMP to manage aging effects due to corrosion. The LRA stated that this AMP is consistent with GALL program XI.M20, "Open-Cycle Cooling Water System," modified by moving the reference to external coatings to Section B.3.3, "General Corrosion of External Surfaces Program," in the LRA. The cooling water corrosion program is also consistent with the non-chemistry related portions of GALL program XI.M21, "Closed-Cycle Cooling Water System," modified by removing from the license renewal commitments reference to (1) fluid flow, which is an active function, and (2) testing the systems performing active functions. The staff confirmed the applicant's claim of consistency during the AMR inspection. The chemistry-related portions of XI.M21 are addressed in the FCS chemistry program (LRA Section B.1.2) which is evaluated by the staff in Section 3.0.3.2 of this SER.

The deviations of the program caused changes in some attributes of the GALL open-cycle and closed-cycle cooling water system programs. Therefore, the staff reviewed this AMP against only those attributes of the applicant's programs which deviate from the attributes of the GALL's open- and closed-cycle cooling water system programs, as defined in BTP RLSB-1, found in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

[Scope of Program] The scope of the applicant's cooling water corrosion program consists of the scope of GALL program, augmented by additional inspections of various raw water cooling system components based on a susceptibility evaluation. The staff finds this acceptable because including these additional inspections makes the program more comprehensive and ensures better management of the aging effects.

[Preventive or Mitigative Actions] The preventive actions attribute in the applicant's program is modified by removing the chemistry-related portions in the GALL's closed-cycle cooling water

program. The preventive actions specified in the removed portions address the need for maintaining corrosion inhibitor concentrations within specified limits, and monitoring and controlling cooling water chemistry. The staff finds this modification acceptable because these preventive actions are addressed in the applicant's chemistry program.

[Parameters Monitored or Inspected] The parameters monitored or inspected attribute in the applicant's program is modified by removing the need for monitoring and inspecting external coatings in the GALL's open-cycle cooling water system and relaxing the requirements for the frequency of monitoring in the closed-cycle cooling water system. The staff finds this acceptable because external coatings are addressed in the applicant's general corrosion of external surfaces program, and the need for specific monitoring frequency is not required by the EPRI guidelines on which the program is based.

[Detection of Aging Effects] The detection of aging effects attribute in the applicant's program is modified by removing the need for detecting aging effects caused by defective external protective coatings in the open-cycle cooling water system and by the addition, to both the open- and closed-cycle cooling water systems of more component inspections based on a susceptibility evaluation. The detection of aging effects caused by defective external protective coatings is addressed in the applicant's general corrosion of external surfaces program, and additional inspections will improve detection of the aging effects. Therefore, the staff finds the deviation from the GALL program to be acceptable.

[Monitoring and Trending] The monitoring and trending attribute is required to demonstrate system capability to remove heat from the cooling water. In the applicant's program, this consists of modifying the GALL attribute to add inspections of various components in the open-cycle and closed-cycle cooling water systems, based on evaluations of their susceptibility. Also, the applicant moved the monitoring of the conditions of the surface coatings to its general corrosion of external surfaces program. The staff finds the modification of the monitoring and trending attribute of the applicant's program to be acceptable because it includes additional inspections, and the monitoring and trending functions removed from the GALL programs are addressed in other programs.

[Operating Experience] The plant operating experience has identified the need for some component repair and replacement due to corrosion and cracking in the component cooling water and raw water environments. Appropriate long-term corrective actions were implemented based on these experiences. As a result, the staff agrees that the current cooling water corrosion program provides reasonable assurance that the aging effects will be properly managed.

The applicant provided its USAR Supplement for the cooling water corrosion program in Section A.2.8 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

### 3.0.3.7.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the clarifications, exceptions, and enhancements

to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the cooling water corrosion program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.8 Fatigue Monitoring Program

The applicant described its fatigue monitoring program (FMP) in Section B.2.4 of the LRA. This program monitors the number of transients that were assumed in the fatigue design. The applicant credits this program with managing the aging of RCS and some Code Class 2 and 3 structures and components that are within the scope of license renewal and subject to an AMR. The staff reviewed the FMP to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.8.1 Summary of Technical Information in the Application

The LRA states that the FMP is consistent with GALL program X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," except that the program will also be used for some Class 2 and 3 components that are subject to fatigue as an aging effect requiring management (AERM). The LRA states that the current program will be enhanced to include the pressurizer surge line bounding locations and some Class 2 and 3 components. In addition, the applicant indicates that site-specific calculations will be performed to address environmental fatigue concerns identified in NUREG/CR-6260. Under operating experience, the LRA states that there have been no failures related to thermal fatigue; however, two enhancements to the program resulted from site corrective actions. The first related to cycle counting requirements for the chemical and volume control system (CVCS). The second related to thermal fatigue of small-bore piping. The LRA also describes actions (re-analyses and/or replacement) that will be taken for components that are expected to exceed their fatigue limits before the period of extended operation (e.g., the pressurizer surge line and the primary sampling system).

#### 3.0.3.8.2 Staff Evaluation

LRA Section B.2.4 describes the applicant's AMP to manage fatigue of RCS components. The LRA states that this AMP is consistent with GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the program enhancements and the applicant's justifications for the enhancements to determine whether the AMP is adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program.

The applicant indicated the scope of the FMP includes those plant-specific components identified in Table 3.1-2 of the LRA for which the FMP is identified as an AMP. However, Table

3.1-2 only lists the FMP as an AMP for the reactor vessel internals flow skirt. In RAI B.2.4-1, the staff requested that the applicant clarify the scope of the components covered by the FMP. In its December 12, 2002, response to RAI B.2.4-1, the applicant indicated that the statement should have referred to the components identified in Section 4.3 of the LRA. Section 4.3 of the LRA addresses metal fatigue of reactor coolant pressure boundary components. The staff considers the applicant's clarification acceptable.

The applicant indicated that the scope of the program was enhanced to include the pressurizer surge line bounding locations. The scope of the program specified in GALL program X.M1 includes metal components of the reactor coolant pressure boundary. The staff finds that inclusion of the pressurizer surge line locations is consistent with the GALL. The applicant also indicated that the scope of the program was enhanced to include additional Class 2 and 3 components. These components include portions of the primary sampling system. As discussed in Section 4.3 of this SER, the staff finds the inclusion of these Class 2 and 3 components in the FMP acceptable.

The applicant discussed the operating experience at FCS that led to enhancements to the FMP. The LRA indicates that an assessment of the operation of the CVCS was performed to ensure that the appropriate transients were monitored by the FMP. In RAI B.2.4-2, the staff requested that the applicant describe the enhancements to the FMP that resulted from this assessment. The applicant's December 19, 2002, response indicated that additional cycle counting requirements for CVCS transients, as discussed in Section 4.3.1 of the LRA, were incorporated in the monitoring procedure. The staff finds the applicant's clarification acceptable. The staff discussion of the CVCS transients is contained in Section 4.3 of this SER.

The applicant indicated that the program would be enhanced to include site-specific calculations to address environmental fatigue concerns identified in NUREG/CR-6260. The program specified in GALL X.M1 requires that the program include an evaluation of the impact of the reactor coolant environment on the components identified in NUREG/CR-6260. Therefore, the applicant's program is consistent with the GALL Report. Section 4.3 of this SER contains additional discussion of the NUREG/CR-6260 components.

The applicant provided its USAR Supplement for the FMP program in Section A.2.10 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

### 3.0.3.8.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the FMP will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the

associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.9 Fire Protection Program

The applicant described its fire protection program (FPP) in Section B.2.5 of the LRA. The applicant credits this program with managing the aging of fire protection system components that are within the scope of license renewal and subject to an AMR. The staff reviewed the FPP to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.9.1 Summary of Technical Information in the Application

The LRA states that the FPP is consistent with GALL programs XI.M26, "Fire Protection," and XI.M27, "Fire Water System," with the following exception. In the flow tests of portions of the sprinkler system that are not routinely subjected to flow, the applicant proposed to perform the flow tests at a slightly lower pressure than the normal system operating pressure. The LRA also lists several enhancements that will be made to the current plant program.

For operating experience, the LRA states that the routine visual inspections of fire barriers have proven effective in identifying material degradation and damage, and that inspections have adequately managed the fire barrier walls, ceilings, doors, and floors. The LRA states that through-wall leakage of seamed fire protection system piping has been identified at FCS, and routine walkdowns and piping inspections have been implemented to identify early stages of pressure boundary degradation. Further, yard fire hydrants, fire dampers, sprinklers, and nozzles, as well as halon system piping and tanks, have been adequately managed.

On the basis of the information above, the applicant has concluded that the FPP provides reasonable assurance that the aging effects will be managed such that the structures and components subject to an AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

#### 3.0.3.9.2 Staff Evaluation

In LRA Section B.2.5, "Fire Protection Program," the applicant described its AMP to manage the aging of structures and components in the fire protection system. The LRA states that this AMP is consistent with GALL programs XI.M26, "Fire Protection," and XI.M27, "Fire Water System," with one exception. The exception is that, in the flow tests of portions of the sprinkler system that are not routinely subjected to flow, the applicant proposed to perform the flow tests at a slightly lower pressure than the normal system operating pressure. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and its justification to determine whether the AMP, with the deviation, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program.

GALL program XI.M26 includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of

fire barrier protection seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire-rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The AMP also includes periodic inspection and testing of the halon/carbon dioxide fire suppression system.

GALL program XI.M27 applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, stand pipes, water storage tanks, and above-ground and underground piping and components that are tested in accordance with the applicable National Fire Protection Association (NFPA) codes and standards. Such testing assures the minimum functionality of the systems. Also, these systems are normally maintained at required operating pressure and monitored such that loss of system pressure is immediately detected and corrective actions initiated. In addition to NFPA codes and standards, which do not currently contain programs to manage aging, those portions of the fire protection sprinkler system, which are not routinely subjected to flow, are to be subjected to full flow tests at the maximum design flow and pressure before the period of extended operation (and at not more than 5-year intervals thereafter). In addition, a sample of sprinkler heads is to be inspected by using the guidance of NFPA-25, Section 2.3.3.1. This NFPA section states that "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." It also contains guidance to perform this sampling every 10 years after the initial field service testing. Finally, portions of fire protection suppression piping located above ground and exposed to water are disassembled and visually inspected internally once every refueling outage. The purpose of full-flow testing and internal visual inspections is to ensure that corrosion, MIC, or biofouling aging effects are managed such that the system function is maintained.

During the staff's audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff verified that the scope of the FPP includes the components identified in GALL programs XI.M26 and XI.M27.

The clarification to GALL is related to program XI.M27, Element 2, "*Preventative Action.*" The GALL specifies that portions of the fire protection sprinkler system, which are not routinely subjected to flow, are to be subjected to full flow tests at the maximum design flow and pressure. The FCS USAR, Table 9.11-3, directs flow testing to be performed using a clean water source. The applicant stated that the demineralized water booster pumps or Blair City water are used for flow testing at pressures slightly lower than the normal system operating pressure. This is not consistent with GALL; however, the applicant stated that both the pressure and resulting flow are sufficient to effectively entrain any sediment and adequately flush and flow test the sprinkler system piping. The staff finds it appropriate to use a clean water source to flush the fire protection sprinkler system, and finds it acceptable for the applicant to flush/flow test the system at a slightly lower pressure in order to use the clean water source. Therefore, the staff finds the proposed deviation to be acceptable.

Chapter 3 of the LRA identifies those components for which the FPP is identified as an AMP. The staff verified that the components in Chapter 3 of the LRA to which the program applies are consistent with the intent of GALL programs X1.M.26 and X1.M.27. The staff finds this acceptable.

The enhancements to the applicant's program that are identified in the LRA were also reviewed, and the applicant was requested to provide additional information relating to the staff's concerns. In RAI B.2.5-1, Item 1, the staff asked the applicant to confirm that the guidance which will be added to the diesel fuel pump maintenance procedure will ensure that the diesel-driven fire pump is under observation during performance tests (e.g., flow and discharge tests, sequential starting capability tests, and controller function tests) for detecting any degradation of the fuel supply line. In its December 19, 2002, response, the applicant stated that the procedure enhancements would ensure that the diesel fire pump is under direct observation during performance testing. The staff finds the applicant's response reasonable and acceptable and the RAI issue is considered to be resolved.

In RAI B.2.5-1, Item 2, the staff asked the applicant to confirm that (1) the guidance which will be added to halon and fire damper inspection procedures will include periodic visual inspection and function tests at least once every six months to examine signs of degradation of the halon/carbon dioxide fire suppression system, (2) the suppression agent charge pressure will be monitored in the test, (3) the material conditions that may affect the performance of the system, such as corrosion, mechanical damage, or damaged dampers, are observed during these tests, and (4) the inspection will be performed at least once every month to verify that the extinguishing agent supply valves are open, and the system is in automatic mode. By letter dated December 19, 2002, the applicant provided the following response:

The enhancement identified in the license renewal application for Fire Protection Program (B.2.5) was to add specific guidance to the halon and fire damper inspection procedures to inspect halon system components and fire dampers for corrosion, mechanical, and physical damage. This enhancement will be implemented prior to the period of extended operation.

Halon and fire damper inspection procedures include periodic visual inspections and functional tests every 18-months to examine signs of degradation of the halon fire suppression system. Although the suppression agent charge pressure is checked on a semi-annual basis and inspections are performed on a monthly basis that verify that the extinguishing agent supply valves are open and that the system is in automatic mode, these activities are not required for license renewal. Per interim staff guidance, these activities are not aging management related since the valve line-up inspection, charging pressure inspection, and automatic mode of operation verification are operational activities pertaining to system or component configurations or properties that may change.

The staff finds the applicant's response acceptable because it conforms to the staff position described in Interim Staff Guidance (ISG)-04, "Aging Management of Fire Protection Systems for License Renewal." (Letter from D. Matthews to A. Nelson and D. Lochbaum, dated December 3, 2002, ML023440137.)

During the staff's audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff reviewed the applicant's inspection frequency for the halon fire suppression system. GALL program XI.M26 prescribes a 6-month frequency for the functional tests of the halon system. The staff noted that the following were not inspected on a six-month frequency.

- Visual and functional tests of the control room walk-in cabinet, cable spread room, and switchgear room are conducted on an 18-month frequency.
- The fire protection system halon system air-flow test, which verifies that each halon nozzle and associated piping is unobstructed, is conducted on a three-year frequency.
- Fire dampers are inspected on an 18-month frequency.



Operating experience has shown that these inspection frequencies are adequate to ensure the system maintains its function. The staff finds that these frequencies are acceptable based on the applicant's operating experience.

In RAI B.2.5-1, Item 3, the staff asked the applicant to confirm that (1) the specific guidance which will be added related to the fire door inspections will ensure that hollow metal fire doors are visually inspected at least once bi-monthly for holes in the skin of the door, (2) fire door clearances are also checked at least once bi-monthly as part of an inspection program, and (3) function tests of fire doors are performed daily, weekly, or monthly (which may be plant-specific) to verify the operability of automatic hold-open, release, closing mechanisms, and latches. By letter dated December 19, 2002, the applicant provided the following response.

The enhancement identified in the license renewal application for Fire Protection Program (B.2.5) was to add specific guidance to the fire door inspection procedures to inspect for wear and missing parts. This enhancement will be implemented prior to the period of extended operation.

Inspections of fire doors for holes, clearances, and proper operation of opening, latching, and closure mechanisms within the specified frequencies are currently included in the FCS Fire Protection Program with the exception of the frequency of inspection for fire door clearances. A revision to the inspection frequency for fire door clearances is currently in process to meet the bimonthly requirement.

The staff finds the applicant's response acceptable because it is consistent with GALL.

The staff has proposed a revision to GALL program XI.M27 related to inspections for wall thinning of piping due to corrosion. The revised staff position states that each time the system is opened, oxygen is introduced into the system, thus accelerating the potential for general corrosion. Therefore, the staff has recommended that a non-intrusive means of measuring wall thickness, such as ultrasonic inspection, be used to detect this aging effect. The staff recommends that, in addition to a baseline ultrasonic inspection of the fire protection piping that is performed before exceeding the current licensing term, the applicant should perform ultrasonic inspections at 10-year intervals thereafter. In RAI B.2.5-2, the staff asked the applicant whether the inspection criteria for the FPP conforms with the staff position outlined above. By letter dated December 12, 2002, the applicant responded that enhancements will be made to the FPP prior to the period of extended operation to implement the interim staff guidance. The staff finds this acceptable, and the RAI issue is considered to be resolved.

The program description for XI.M27 states that underground piping is to be managed by the program. However, the program does not address aging management of underground piping. To evaluate whether the applicant's FPP will adequately manage aging of underground piping in the fire water system, the staff asked the applicant (RAI B.2.5-3) to describe the environmental and material conditions that exist on the interior surface of below-grade fire protection piping, to demonstrate how the above-ground piping conditions can be extrapolated to determine the below-ground piping conditions, and to describe how the FPP will manage aging of underground piping. RAI B.2.5-3 also asked the applicant to demonstrate how underground piping will be adequately managed during the period of extended operation to assure maintenance of the component intended function if a meaningful extrapolation cannot be made. By letter dated December 19, 2002, the applicant provided the following response:

Portions of the Fire Protection System piping that are underground are made of asbestos-cement or cast iron with a cement lining. For these materials, an aging management evaluation determined that aging management is not required because the interior of these pipes is not exposed to an aggressive

environment (pH < 5.5, sulfates > 1500 ppm, and chlorides > 500 ppm). Under normal conditions, the system is filled with potable water whose pH, sulfate, and chloride content is within these limits. If untreated raw water is injected into the system, the system is flushed and refilled with potable water. The cement lining was installed in accordance with American Water Works Association (AWWA) Standard C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. The minimum lining thickness for the size of pipe at FCS is 1/16" and meets the requirements of ASTM C150. The lining was applied to the pipe at the time of manufacture. The cement lining of cast iron piping provides it with an added feature to prevent the loss of material of the base metal due to corrosion. The cement lining also prevents internal buildup of turbules that would contribute to degradation of the pipe flow characteristics. In addition to the inspection activities, the testing features of the Fire Protection Program provide assurance that the entire system can perform its intended function. A visual as-found inspection performed on a section of the FP piping during modification/maintenance work in May of 2000 identified that the internal surfaces of the underground piping were clean with a little oxidation on the piping wall.

The staff finds the applicant's response to be reasonable and acceptable.

In RAI B.2.5-4, the staff informed the applicant about its concern that the applicant's FPP may not adequately manage aging of coatings in steel structures, since neither XI.M26 nor XI.M27 address coatings. On this basis, the staff asked the applicant to identify any steel structures within the scope of license renewal and subject to an AMR which depend on coatings to protect the steel structures from age-related degradation, and to describe the AMP and activities that manage the aging effects for the coatings. In its December 19, 2002, response, the applicant stated that no steel structures within the scope of license renewal that are subject to an AMR depend on coatings to protect the steel structure from age-related degradation. The staff finds the applicant's response acceptable to resolve the concern.

In RAI B.2.5-5, Item 2, the staff asked the applicant to clarify the schedule for testing and replacement of sprinkler heads. NFPA-25, 1999 Edition, Section 2.3.3.1, "Sprinklers," states, "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." NFPA-25 also contains guidance to perform this sampling every 10 years after the initial field service testing. The 50-year service life of sprinkler heads does not necessarily equal the 50<sup>th</sup> year of operation in terms of licensing. The service life is defined from the time the sprinkler system is installed and functional. In most cases, sprinkler systems are in place several years before the operating license is issued. However, sprinkler systems in some plants may have been installed after the plant was placed in operation. The staff interpretation, in accordance with NFPA-25, is that sprinkler head testing should be performed at year 50 after installation, not at year 50 of plant operation, with subsequent sprinkler head testing every 10 years thereafter. This is reflected in GALL program XI.M27. In its December 19, 2002, response to RAI B.2.5-5, the applicant clarified that the testing schedule would be based on the sprinkler inservice date, and the inservice date of 1972 would be used to determine the schedule. The staff finds the applicant's response acceptable because it conforms to the staff position.

The staff reviewed the summary description of the FPP in Appendix A of the LRA. The staff finds that the information in the USAR Supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

### 3.0.3.9.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the clarification to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review and the applicant's commitments discussed above, the staff concludes that the applicant has demonstrated that the FPP will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.10 Periodic Surveillance and Preventive Maintenance Program

#### 3.0.3.10.1 Summary of Technical Information in the Application

The applicant's periodic surveillance and preventive maintenance program (PS/PMP) is discussed in LRA Section B.2.7, "Periodic Surveillance and Preventive Maintenance Program." This AMP is not consistent with a GALL AMP. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

The PS/PMP, credited for license renewal, is a select subset of activities performed under the FCS surveillance test and preventive maintenance programs. The purpose of the surveillance test program is to complete all surveillance requirements set forth in the FCS technical specifications, FPP, and off-site dose calculation manual (ODCM). The purpose of the preventive maintenance program is to prevent or minimize equipment breakdown and to maintain equipment in a satisfactory condition for normal and/or emergency use. The program is accomplished by performing periodic inspections and tests that are relied on to manage aging of system components and structures that are not evaluated as part of other AMPs.

The applicant states that the purpose of the PS/PMP is to prevent or minimize equipment breakdown and to maintain equipment in a satisfactory condition for normal and/or emergency use. The activities performed under the PS/PMP can be described in the following general categories, component inspections for degradation (i.e., valve internals, ventilation dampers, intake structure screens, manhole covers, etc.), lube oil analysis, and visual observations (i.e., operations logs, spent fuel pool level monitoring, etc.). In addition, the preventive maintenance tasks of performing replacement of components identified as "periodically replaced" during the scoping, screening, and AMR process are incorporated into this program.

#### 3.0.3.10.2 Staff Evaluation

In LRA Section B.2.7, "Periodic Surveillance and Preventive Maintenance Program," the applicant described its AMP to manage the effects of aging of system components and structures that are not evaluated as part of other AMPs. This AMP is not consistent with a

GALL AMP. Therefore, the staff reviewed this AMP against the 10 program elements defined in BTP RLSB-1, found in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The FCS PS/PMP provides for periodic inspection and testing of components in the following systems and structures:

- auxiliary building
- auxiliary building HVAC
- auxiliary feedwater
- chemical and volume control
- component cooling
- containment
- containment ventilation
- control room HVAC and toxic gas monitoring
- diesel generator lube oil
- duct banks
- emergency diesel generators
- fire protection
- fuel handling equipment/heavy load cranes
- intake structure
- liquid waste disposal
- containment penetration and system interface components for non-critical quality element (CQE) systems
- control area chilled water
- reactor coolant
- safety injection and containment spray
- ventilating air

The staff found that the scope of the PS/PMP is acceptable because it is comprehensive in that it includes the systems, structures, and major components that may be affected by equipment breakdown.

[Preventive or Mitigative Actions] The applicant states that the PS/PMP includes periodic refurbishment or replacement of components, which could be considered to be preventive or mitigative actions. The staff finds the applicant's approach acceptable because routine replacement or timely refurbishment of components will prevent or minimize equipment breakdown and will maintain equipment in a condition that will enable it to perform its intended function during the period of extended operation.

[Parameters Inspected or Monitored] The applicant states that inspection and testing activities performed under the program monitoring parameters include surface condition, loss of material, presence of corrosion products, signs of cracking, and presence of water in oil samples. The staff finds that the parameters inspected or monitored provide symptomatic evidence of potential degradation for timely replacement of components to prevent equipment failure and, therefore, are acceptable.

[Detection of Aging Effects] The applicant states that the PS/PMP testing activities provide for periodic component inspections and testing to detect the following aging effects and mechanisms:

- change in material properties
- loss of material - general corrosion
- cracking
- loss of material - pitting corrosion
- fouling
- loss of material - pitting/ crevice/general corrosion
- loss of material - wear
- loss of material - crevice corrosion
- separation
- loss of material - fretting

The LRA states that the extent and schedule of the inspections and testing assures detection of component degradation prior to the loss of component intended functions. It also states that established techniques, such as visual inspections and dye penetrant testing, are used. The staff finds that the techniques used by the applicant to detect aging effects are consistent with accepted engineering practice and, therefore, satisfy this program element.

[Monitoring and Trending] The applicant states that the PS/PMP testing activities provide for monitoring and trending of age-related degradation. Inspection intervals are established to provide for timely detection of component degradation. Inspection intervals are dependent on the component material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations.

The LRA states that the PS/PMP includes provisions for monitoring and trending with the stated intent of identifying potential failures or degradation and making adjustments to ensure components remain capable of performing their functions. The PS/PMP review and update guidelines are provided that include adjustment of the PS/PMP tasks and frequencies based on the as-found results of previous performance of the PS/PMP. In particular, responsible system engineers are required to periodically review the results of preventive maintenance and recommend changes based on these reviews. The PS/PMP includes guidance to assist the system engineers in achieving efficient and effective trending.

The staff finds that the overall monitoring and trending techniques proposed by the applicant are considered acceptable because inspections, replacements, and sampling activities will effectively manage the applicable aging effects.

[Acceptance Criteria] The applicant states that the PS/PMP acceptance criteria are defined in the specific inspection and testing procedures. The LRA further states that FCS confirms component integrity by verifying the absence of the aging effect or by comparing applicable parameters to limits based on the applicable intended function(s) as established by the plant design basis. This is acceptable to the staff in the absence of code-specified acceptance criteria.

[Operating Experience] The applicant states that the PS/PMP activities have been in place at FCS since the plant began operation. These activities have demonstrated a history of detecting

damaged or degraded components and, thereby, requiring repair or replacement in accordance with the site corrective action process.

With few exceptions, age-related degradation adverse to component intended functions have been discovered, and corrective actions have been taken prior to loss of intended function. The staff finds that the applicant's operating experience supports the conclusion that the program will adequately manage the aging effects in the specified systems, structures, and components.

The applicant provided its USAR Supplement for the PS/PMP in Section A.2.18 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

### 3.0.3.10.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that the program adequately addresses the ten program elements defined in BTP RLSB-1, found in Appendix A.1 of the SRP-LR, and the program will adequately manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the PS/PMP will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.11 Structures Monitoring Program

The applicant described its SMP in Section B.2.10 of the LRA. The applicant credits this program with managing the aging of the containment, other Class 1 structures, and auxiliary system components that are within the scope of license renewal. The staff reviewed the SMP to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.0.3.11.1 Summary of Technical Information in the Application

The LRA states that the SMP is consistent with GALL programs XI.S5, "Masonry Wall Program," XI.S6, "Structures Monitoring Program," and XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," with the following two clarifications:

- FCS does not have the support components made from lubrite that are identified in The GALL Report, Chapter III, Item A4.2-b.
- FCS is not committed to RG 1.127.

In addition to the clarifications listed above, the following enhancements will be made to the SMP prior to the period of extended operation:

- Specific guidance will be added to inspect masonry walls for cracking and condition of steel bracing.
- Specific guidance will be added for inspection of component supports, new fuel storage rack, and the plant-specific components identified in LRA Table 3.5.
- Specific guidance will be added for the performance of periodic sampling and evaluation of ground water.
- Specific guidance will be added to inspect structural components when exposed by excavation.

The LRA also states that additional guidance will be added to the acceptance criteria and detection of aging effects to ensure that the SMP is consistent with industry codes, standards, and guidelines.

The applicant performed inspections in the auxiliary building, containment, intake structure, and turbine building in 1996-1997 and 1999-2000. No significant deterioration was identified, with the exception of some corrosion of support anchors, which was documented under the applicant's CAP.

#### 3.0.3.11.2 Staff Evaluation

LRA Section B.2.10 described the SMP, which is credited with managing the aging of several structural components. The LRA states that this AMP is consistent with GALL programs XI.S5, "Masonry Wall Program," XI.S6, "Structures Monitoring Program," and XI.S7, RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," with two clarifications. The first clarification is that FCS does not have the support components made from lubrite that are identified in the GALL Report, Volume 2, Chapter III, Item A4.2-b. The second clarification is that FCS is not committed to RG 1.127. In addition, the staff also determined whether the applicant properly applied the SMP to its facility. Furthermore, the staff reviewed the applicant's claim that the SMP, with these clarifications and enhancements, is adequate to manage the aging effects for which it is credited.

With regard to the first clarification to GALL, the applicant states that FCS does not have the support components made from lubrite that are identified in GALL Chapter III, Item A4.2-b (reactor coolant pump supports); however, FCS does have support components made of lubrite for other ASME components (e.g., SG supports), as identified in GALL Chapter III.B. The applicant stated that these components are inspected under the ISI program. The staff's evaluation of the ISI program is covered in Section 3.0.3.5 of this SER. For the second clarification, the applicant states that while FCS is not committed to RG 1.127, the applicable attributes from RG 1.127 have been incorporated into the SMP. The staff finds that the applicant's explanation and treatment of these two deviations to be adequate.

The applicant provided its USAR Supplement for the SMP in Section A.2.23 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

#### 3.0.3.11.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent

with GALL. In addition, the staff has reviewed the clarifications and enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, including the applicant's commitments discussed above, the staff concludes that the applicant has demonstrated that the SMP will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.12 General Corrosion of External Surfaces Program

#### 3.0.3.12.1 Summary of Technical Information in the Application

The applicant's general corrosion of external surfaces program is discussed in LRA Section B.3.3, "General Corrosion of External Surfaces Program." This AMP is not consistent with a GALL AMP. Therefore, the staff reviewed this AMP against the 10 program elements defined in BTP RLSB-1, found in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

This AMP is credited for the aging management of the effects of loss of material and cracking for applicable components, including piping, valves, supports, tanks, and bolting which are made of cadmium-plated steel, carbon steel, cast iron, copper alloy, galvanized steel, low-alloy steel, and neoprene. These components are exposed to an ambient air environment in the ESF, auxiliary, and steam and power conversion systems.

The activities credited in this program were selected based on their effectiveness as indicated by a review of site corrective action documents. In addition, the activities are elements of established FCS programs that have been ongoing for years and have been enhanced based on site and industry experience.

On the basis of the above discussion, the applicant concluded that the general corrosion of external surfaces program provides reasonable assurance that components subject to an AMR will be adequately managed.

#### 3.0.3.12.2 Staff Evaluation

In LRA Section B.3.3, "General Corrosion of External Surfaces Program," the applicant described its AMP to manage the effects of loss of material and cracking for various components due to corrosion. This AMP is not consistent with a GALL AMP. Therefore, the staff reviewed this AMP against the 10 program elements defined in BTP RLSB-1, found in Appendix A of the SRP-LR. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] As indicated in the LRA, the program consists of several FCS activities that manage the aging effects of loss of material and cracking for components in auxiliary boiler fuel



oil, auxiliary building HVAC, auxiliary feedwater (AFW), chemical and volume control, CCW, containment ventilation, control room HVAC, diesel generator lube oil, starting air, feedwater, fire protection fuel oil, gaseous waste disposal, instrument air, main steam (MS) and turbine steam extraction, containment penetration systems and system interface components for non-CQE systems, nitrogen gas, primary sampling, raw water, and ventilating air. The staff finds that relevant systems and structures are included in the scope of the program, and therefore, the scope is acceptable.

[Preventive or Mitigative Actions] The applicant did not identify any preventive actions taken as part of this program. The staff recognizes that while this program may not prevent the occurrence of the aging effects stated, the program description should clearly describe the manner in which this program will be used to manage aging effects.

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-1, that the applicant describe what this program accomplishes. In its response dated December 19, 2002, the applicant responded that this program is a condition monitoring program which identifies evidence of corrosion on external surfaces, or significant degradation of coatings, sealants, and caulking through visual inspections, and initiates corrective action prior to any loss of intended function. The staff notes that aging management of bolts is performed by several programs: bolting for mechanical systems is managed by this program and the bolting integrity program, structural bolting is managed by the structures monitoring program, and bolting degradation due to exposure to boric acid is identified by the boric acid corrosion prevention program

Based on the applicant's response to the RAI, the staff concurs with the applicant that preventive actions are not needed because this is a condition monitoring program.

[Parameters Monitored or Inspected] The applicant stated that the surface conditions of components are monitored through visual observation and inspection to detect signs of external corrosion and to detect conditions that can result in external corrosion, such as fluid leakage.

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-2, that the applicant describe the parameters, besides fluid leakage, that detect degradation of surface conditions on components within the scope of this program, and to justify why these parameters need not be included in this program to manage the aging of components within the program scope. In its response dated December 19, 2002, the applicant responded that fluid leakage was identified only as an example of a condition which could lead to component degradation if not corrected. Fluid leakage is an indicator of a degraded condition which, in addition, could lead to corrosion on surrounding components if allowed to continue. The applicant responded further by stating that this program includes monitoring of components and their external coatings for evidence of cracking, checking, blistering, rusting, pinholes, abrasions, delamination, and significant substrate defects (e.g., corrosion pits). The monitoring of these indications ensures that component degradation is identified and corrected prior to any loss of pressure boundary.

Based on the applicant's response to the RAI, the staff finds that the program monitors conditions that relate to the aging effects of concern.

[Detection of Aging Effects] The applicant indicated that the aging effects of loss of material and cracking are detected by visual observation and inspection of external surfaces. In

addition, evidence for leaking fluids also provides indirect monitoring of certain components that are not routinely accessible.

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-3, that the applicant describe the methods, besides the observance of fluid leakage, that will be used to detect loss of material and cracking in locations that may be inaccessible, such as the bottom of a tank, and provide a justification for why these methods are not material to demonstrate adequate aging management for components within the scope of the program. In its response dated December 12, 2002, the applicant stated that this program relies on visual observations and inspections, and is only applicable to those components accessible to this type of inspection. Aging management activities on components inaccessible to visual inspections, such as ultrasonic testing of buried emergency diesel fuel oil tank, are incorporated into other plant programs.

The staff finds the applicant's response to be reasonable and adequate because this program inspects for the aging effects of accessible components, in conjunction with other programs which inspect components not readily accessible.

[Monitoring and Trending] As described in Section B.3.3 of the LRA, various plant personnel perform periodic material condition inspections and observations outside containment. These inspections are performed in accordance with approved plant procedures and include documentation of the evidence of fluid leaks, significant coating damage, or significant corrosion. The inspections and observations are performed at intervals based on previous inspections and industry experience. For example, operator rounds occur several times a day and system engineer walk downs are performed at least quarterly. In addition, inspections inside containment are performed at each refueling outage and are part of the inspections described in the OPPD response to GL 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment."

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-4, additional information on the extent of the documentation process, including whether inspections are documented and the results trended, or whether only significant findings are documented using a corrective action process. In its response dated December 12, 2002, the applicant responded that deficiencies identified during operator and system engineer walk downs are documented under the maintenance work order or corrective action process. Deficiencies identified during the containment coating inspection procedure would result in the initiation of a corrective action item if the deficiencies are significant as documented in this procedure. In addition, system engineers monitor and report ongoing and significant system deficiencies for their respective systems in their system report cards.

Based on the staff's review of the LRA, the applicant's response to the staff's RAI, and the findings of the AMR inspection, the staff finds that the activities associated with this program are appropriate because these activities and their frequency ensure that the aging effects of components within the scope of this program will be detected and corrected before compromising the components' intended functions.

[Acceptance Criteria] The applicant stated that plant procedures provide criteria for determining the acceptability of as-found conditions and for initiating the appropriate corrective action. These procedures incorporate appropriate provisions of NRC and industry guidance to avoid unacceptable degradation of the component intended functions by inspecting for the existence of leakage, presence of corrosion products, coating defects, and elastomer cracking.

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-5, that the applicant discuss the NRC or industry guidance and operating experience used to establish the acceptance criteria. In its response dated December 19, 2002, the applicant responded that guidance from RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," is incorporated in the containment coatings inspection discussed in Section 5.2.5 of the FCS USAR. In addition, the system engineer and operator walk downs initiate maintenance work orders or corrective action documents based on engineering judgement and operating experience. Initiation of a corrective action document is based on procedural guidance to identify damage or degradation that adversely affects the functional capability of a structure, system, or component. The applicant further responded that the procedural guidance is being enhanced as part of the implementation of this new program.

Based on the staff's review of the LRA, the applicant's response to the staff's RAI, and the findings in the AMR Inspection, the staff finds that the acceptance criteria and guidance associated with this program are appropriate because they incorporate adequate guidance to ensure that the aging effects of components within the scope of this program will be detected and corrected in a timely manner.

[Operating Experience] The applicant stated that the inspection activities of this program are a subset of a larger number of inspection activities and results in redundant inspections. The inspection activities credited in this program were selected based on their effectiveness, as indicated by a review of site corrective action documents. The applicant has completed a review of its records and concluded that the activities in this program are effective in detecting loss of material due to corrosion. These findings are consistent with the findings of recent internal and external assessments, such as audits and NRC inspections.

By letter dated October 11, 2002, the staff requested, in RAI B.3.3-6, that the applicant clarify whether this program will adequately manage the aging effects of inaccessible components within the scope of this program that are not routinely accessible and which rely on the indirect monitoring of fluid leakage. In its response dated December 19, 2002, the applicant responded that the scope of systems listed in Section B.3.3 excludes components that are not routinely accessible. Aging management of inaccessible components is incorporated into other plant programs. For example, ultrasonic testing of buried components and level monitoring and leakage detection are incorporated in the buried surfaces external corrosion program and the diesel fuel monitoring and storage program. Inspections and monitoring of these components has not identified any degradation. The staff notes that the applicant's statement with regard to the inaccessible fire protection diesel fuel oil tank is in question. In Section 3.3.2.3.1 of this SER, the staff evaluates the applicant's commitment to a one-time inspection of the fire protection diesel fuel oil tank to confirm that the tank is not in a degraded condition.

During the staff's AMR inspection, the applicant committed to revise the general corrosion of external surfaces program to include the spent fuel pool cooling system. This is Confirmatory Item 3.0.3.12.2-1.

Based on the staff's review of the LRA, the applicant's response to the staff's RAI, the applicant's commitment to enhance the procedural guidance to perform a one-time inspection of the fire protection diesel fuel oil tank, and the findings in the staff's AMR inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff finds that the activities in this program have effectively managed the aging effects of components within the scope of this program and will continue to do so in the period of extended operation.

The applicant provided its USAR Supplement for the general corrosion of external surfaces program in Section A.2.13 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information, as required by 10 CFR 54.21(d), and is acceptable.

### 3.0.3.12.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that the program adequately addresses the ten program elements defined in BTP RLSB-1, found in Appendix A.1 of the SRP-LR, and that the program will adequately manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, including the applicant's commitments discussed above, the staff concludes that the applicant has demonstrated that the general corrosion of external surfaces program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.13 One-Time Inspection Program

#### 3.0.3.13.1 Summary of Technical Information in the Application

The applicant's one-time inspection program is discussed in LRA Section B.3.5, "One Time Inspection Program." The applicant states that the program is consistent with GALL program XI.M32, "One-Time Inspections," as identified in the GALL Report.

This AMP is credited with managing the aging effects of components in the reactor, ESF, auxiliary, and steam and power conversion systems.

On the basis of the above discussion, the applicant concluded that the one-time inspection program provides reasonable assurance that the applicable aging effects will be adequately managed.

#### 3.0.3.13.2 Staff Evaluation

In LRA Section B.3.5, "One Time Inspection Program," the applicant described its AMP to manage aging in reactor, ESF, auxiliary, and steam and power conversion systems. The LRA stated that this AMP is consistent with GALL AMP XI.M32, "One-Time Inspections," with no deviations. For this AMP, GALL recommends that the program be reviewed by the staff on a

plant-specific basis. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

The program description in GALL AMP XI.M32 indicates that the one-time inspection program is to provide additional assurance that either aging is not occurring or evidence that aging is so insignificant that an AMP is not warranted. As an example, the description indicates that for Class 1 piping with a diameter less than nominal pipe size (NPS) 4 inch that does not receive volumetric examination during inservice inspection, the one-time inspection program confirms that crack initiation and growth due to SCC or cyclic loading is not occurring and, therefore, there is no need to manage age-related degradation for the period of extended operation. The "Detection of Aging Effects" portion of GALL AMP XI.M32 indicates that for small-bore piping less than NPS 4 inches, including pipe, fittings, and branch connections, a plant-specific destructive examination of replaced piping due to plant modification, or non destructive examination (NDE) that permits inspection of the inside surfaces of the piping, is to be conducted to ensure cracking has not occurred. Inspection of the inside surface can be performed using volumetric examination.

During its inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff reviewed FCS documents to confirm that FCS was implementing the one-time inspection program for small-bore piping in the RCS, in accordance with GALL AMP XI.M.32. Specifically, Attachment 3 to the FCS engineering analysis (EA-FC-00-088) provides a program description and a direct comparison of the ten elements in GALL AMP XI.M32 and the FCS activity to implement the one-time inspection program. The applicant has committed to develop this program prior to entering the license renewal term.

The basis for this program will be documented in the FCS one-time inspection program basis document. EA-FC-00-88 indicates that the one-time inspection program will include RCS small-bore piping that is susceptible to crack initiation and growth due to SCC or cyclic loading. Although the FCS EA specifies the criteria in GALL AMP XI.M32, cyclic loading is a general requirement. In order to designate locations that are most susceptible to failure from cyclic loading, the mechanism which could cause age-related degradation must be specified.

The staff is concerned that cyclic loading that is caused by thermal fatigue resulting from thermal stratification or turbulent penetration could lead to the loss of function in small-bore piping. The staff reviewed Attachment 6 to EA-FC-00-88, which identifies all components that are to be included in the one-time inspection program. This document indicates that reactor coolant stainless steel small-bore piping components in borated treated water will receive augmented inspection using volumetric examination or equivalent. This document does not address carbon steel small-bore piping in the RCS. By letter dated February 20, 2003, the staff issued POI-8(e) requesting that the applicant clarify whether the one-time inspection program will include RCS small-bore piping that is susceptible to crack initiation and growth due to SCC or thermal fatigue resulting from thermal stratification or turbulent penetration, and whether there is carbon steel small-bore piping with full penetration welds in the RCS system. If there is carbon steel small-bore piping with full penetration welds in the RCS, the applicant should include this piping in its one-time inspection program. By letter dated March 14, 2003, the applicant responded to POI-8(e), stating that since FCS is a pressurized-water reactor (PWR) with stainless steel loops, there is no carbon steel small-bore piping in the RCS. It is a borated water system, therefore, the use of carbon steel would be inappropriate.

In response to this POI, the applicant committed to the requirements in GALL Section XI.M32, relative to the inspection of small-bore RCS piping and to base inspections on those locations where small-bore piping is subject to thermal cycling stratification or turbulent penetration. On the basis of this commitment, and that there is no carbon steel small-bore piping in the RCS, POI-8(e) is resolved.

The applicant provided its USAR Supplement for the one-time inspection program in Section A.2.12 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable. The staff notes that the one-time inspection is intended to confirm that aging is not occurring or that the aging is so insignificant that an AMP is not warranted. The applicant proposes to use this AMP across a wide range of structures and components at FCS. The staff has identified the commitments associated with this AMP in Appendix A of this SER.

### 3.0.3.13.3 Conclusions

On the basis of its review, and inspection and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d). The staff notes that the one-time inspection is intended to confirm that aging is not occurring or that the aging is so insignificant that an AMP is not warranted. The applicant proposes to use this AMP across a wide range of structures and component at FCS. The staff has identified the application of this AMP in Appendix A of this SER.

Therefore, on the basis of its review, including the applicant's commitments discussed above, the staff concludes that the applicant has demonstrated that the one-time inspection program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.14 Selective Leaching Program

#### 3.0.3.14.1 Summary of Technical Information in the Application

The applicant's selective leaching program is discussed in LRA Section B.3.6, "Selective Leaching Program." The applicant states that the program is consistent with the GALL program XI.M33, "Selective Leaching of Materials," with the exception that the applicant will not perform an evaluation of selective leaching by means of hardness testing during the one-time inspection.

The AMP is credited with managing aging effects in the systems containing plant-specific components susceptible to the selective leaching mechanism. The aging effects are managed in the components which either are not evaluated in GALL, or, although not specifically evaluated, are relying on the AMP in GALL. These components are listed in Tables 3.2-2, 3.3-2, 3.3-3, 3.4-2, and 3.5-3 of the LRA and are included in ESF, auxiliary, and steam and power conversion systems, and containment structures and components. These components are made from cast iron, copper alloy, copper-zinc alloy and bronze. Selective leaching takes

place when these components are exposed to raw water, corrosion-inhibited treated water, or deoxygenated treated water, or are buried underground. The applicant's selective leaching program relies on inspection of the affected components.

On the basis of the above discussion, the applicant concluded that the selective leaching program provides reasonable assurance that the aging effects associated with selective leaching will be adequately managed.

#### 3.0.3.14.2 Staff Evaluation

In LRA Section B.3.6, "Selective Leaching Program," the applicant described its AMP to manage aging effects due to selective leaching. The LRA stated that this AMP is consistent with GALL AMP XI.M33, with the clarification that the applicant will not perform an evaluation of selective leaching by means of hardness testing during the one-time inspection. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the clarification and its justification to determine whether the AMP, with the clarification, remains adequate to manage the aging effects for which it is credited, and reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program.

The clarification of the program causes changes in some attributes of the GALL selective leaching program. Therefore, the staff reviewed this AMP against only those attributes of the applicant's program which deviate from the attributes of the GALL's selective leaching of materials program using the guidance in BTP RLSB-1, found in Appendix A of the SRP-LR.

[Scope of Program] The scope of the applicant's selective leaching program and the scope of the corresponding program in GALL do not address evaluating selective leaching in the buried copper-zinc pipes. However, in response to the staff's RAI B.3.6-2, issued by letter dated October 11, 2002, the applicant, by letter dated December 19, 2002, indicated that the selective leaching program will credit the inspections performed by the "Buried Surfaces External Corrosion Program" in Section B.3.2 of the LRA. The staff finds this acceptable because the buried surfaces external corrosion program scope includes the copper-zinc pipes. The staff's evaluation of the buried surfaces external corrosion program can be found in Section 3.3.2.3.2 of this SER.

[Parameters Monitored or Inspected] The applicant's selective leaching program deviates from the program in GALL by not requiring evaluation of selective leaching by means of hardness testing with a one-time inspection. By letter dated October 11, 2002, the staff issued RAI B.3.6-1, requesting the applicant to describe how the degradation due to leaching can be evaluated without hardness measurements, particularly for cases in which visual inspection cannot produce meaningful results. By letter dated December 19, 2002, the applicant justified this deviation by pointing out that there is no suitable equipment for performing these tests in the field. The staff finds this acceptable because the applicant is not able to perform this evaluation with its equipment.

The applicant provided its USAR Supplement for the selective leaching program in Section A.2.21 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

### 3.0.3.14.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the clarification to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the selective leaching program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.0.3.15 Evaluation Findings

The staff has reviewed the common AMPs in Appendix B of the LRA. On the basis of its review, including the applicant's commitments discussed above, the staff concludes that the applicant has demonstrated that these AMPs will effectively manage aging in the structures and components for which these AMPs are credited so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). In addition, the staff has reviewed the the USAR Supplements for these AMPs and concludes that the USAR Supplements provide an acceptable description of the programs and activities for managing the effects of aging of the components for which the AMPs are credited, as required by 10 CFR 54.21(d).

### 3.0.4 FCS Quality Assurance Program Attributes Integral to Aging Management Programs

The staff has reviewed LRA Appendix B, Section 2.0, "Aging Management Activities," in accordance with the requirements of 10 CFR 54.21(a)(3) and 10 CFR 54.21(d). The staff has evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three quality assurance program attributes, namely corrective actions, confirmation process, and administrative controls. These three attributes of the quality assurance program are addressed for all of the applicant's AMPs.

An applicant for license renewal is required to demonstrate that the effects of aging on structures and components that are subject to an AMR will be adequately managed to ensure that their intended functions will be maintained in a manner that is consistent with the CLB of the facility throughout the period of extended operation. To manage these effects, applicants have developed new, or revised existing, AMPs and applied those programs to the SSCs of interest. For each of these AMPs, the existing 10 CFR Part 50, Appendix B, quality assurance program may be used to address the attributes of corrective actions, confirmation process, and administrative controls.



#### 3.0.4.1 Summary of Technical Information in Application

Chapter 3.0, "Aging Management Review Results," of the LRA provides an AMR summary for each unique structure, component, or commodity group at FCS determined to require aging management during the period of extended operation. This summary includes identification of the AERMs and AMPs utilized to manage these aging effects.

Appendix B, Section 2.0, "Aging Management Activities," of the LRA provides the aging management activity description for each activity credited for managing aging effects. These activities are based upon the AMR results provided in Sections 3.1 through 3.6 of the LRA. The applicant stated that it uses the existing FCS quality assurance program, consistent with the summary table in Appendix A.2 of NUREG-1800, "Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants," published July 2001 (SRP-LR) to address the elements of corrective action, confirmation process, and administrative controls for all of its AMPs. The FCS quality assurance program implements the requirements of 10 CFR 50 Appendix B. The applicant further states that these programs, credited for license renewal, encompass both the safety-related and non-safety-related SSCs within the scope of license renewal.

Three AMPs identified in Appendix B, Section 2.0 of the LRA, as new or enhanced programs, provide descriptions of the specific attributes of corrective action, confirmation process, and administrative controls. These programs include B.2.7, "Periodic Surveillance and Preventive Maintenance (PM) Program," B.3.3, "General Corrosion of External Surfaces Program," and B.3.4, "Non-EQ Cable Aging Management Program."

With respect to the three quality assurance attributes, the applicant's program descriptions describe these as follows.

1. Corrective Action-Identified deviations are evaluated within the FCS corrective action process which includes provisions for root cause determinations and corrective actions to prevent recurrence as dictated by the significance of the deviation. The FCS corrective action process is in accordance with 10 CFR 50, Appendix B.
2. Confirmation Process-The FCS corrective action process is in accordance with the 10 CFR 50 Appendix B and includes reviews to assure that proposed actions are adequate, tracking and reporting of open corrective actions, root cause determinations, and reviews of corrective action effectiveness.
3. Administrative Controls-All credited aging management activities are subject to the FCS administrative controls process which is in accordance with 10 CFR 50, Appendix B, and requires formal reviews and approvals.

#### 3.0.4.2 Staff Evaluation

The staff has evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three quality assurance program attributes, namely corrective actions, confirmation process, and administrative controls. These three attributes of the quality assurance program are used in all of the applicant's AMPs.

During the audit of the FCS scoping and screening methodology conducted July 8-12, 2002, the staff reviewed the applicant's programs described in Appendix A, "Updated USAR Supplement," and Appendix B, "Aging Management Activities," to assure that the aging management activities were consistent with the staff's guidance described in Section A.2, "Quality Assurance for Aging Management Programs" and BTP IQMB-1, regarding quality assurance of the SRP-LR. During the review, the applicant stated that the attributes of corrective action, confirmation process, and administrative control were developed for, and are integral to, the site quality assurance programs. The audit team confirmed that the applicant credited this process for both the safety-related and non-safety-related structures, systems, and components (SSCs) within the scope of license renewal.

Based on the staff's evaluation, the description and applicability of the AMPs and their associated attributes to all safety-related and non-safety-related structures and components (SCs) provided in Appendix A and Appendix B of the LRA are consistent with the staff's position regarding quality assurance for aging management. However, the staff noted that the applicant had not sufficiently described the use of the quality assurance program and its associated attributes (corrective action, confirmation process, and administrative control) in the application. In a letter dated October 11, 2002, the staff requested that the applicant clarify its description in Appendix A, "Updated USAR Supplement," and Appendix B, "Aging Management Activities" of the LRA to include aspects of the quality assurance program that are credited for the three AMP attributes identified above (RAI 2.1-2).

In a letter dated December 19, 2002, the applicant provided a response to the staff's RAI. In that response, the applicant described how the quality assurance program referenced in Appendix A and Appendix B of the LRA is used and described the associated attributes of corrective action, confirmation process, and administrative control relative to the AMPs. Specifically, the applicant stated that the FCS quality assurance plan implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Section A.2 of the SRP-LR. The FCS quality assurance plan includes the elements of corrective action, confirmation process, and administrative controls and is applicable to the safety-related and non-safety-related structures, systems, and components that are within the scope of license renewal.

The applicant further stated that corrective action is initiated upon identification of conditions adverse to quality through the FCS condition report system. This includes review for significance, cause determination, corrective actions, prevention of recurrence, and trending. The FCS quality assurance plan provides for control over activities affecting the quality of SSCs consistent with their importance to safety. Confirmation is achieved through review of proposed corrective actions for significant conditions adverse to quality by the FCS plant review committee. Activities affecting safety are described by written procedures of a type appropriate to the circumstances, and are accomplished in accordance with these instructions and procedures. These procedures include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

Based on the information provided in the LRA, as supplemented by the applicant's response to the staff's RAI, the staff has determined that for all AMPs credited for license renewal, the corrective actions, confirmation process, and administrative controls are adequately addressed in the applicant's approved quality assurance program and satisfy the requirements of 10 CFR 54.21(a)(3). Therefore, RAI 2.1-2 is resolved.

With regard to the summary descriptions of the corrective actions, confirmation process, and administrative controls program attributes, the staff finds that the applicant has provided an acceptable summary description of these generic program attributes in the USAR Supplement, as required by 10 CFR 54.21(d).

### 3.0.4.3 Conclusion

The staff finds that the quality assurance attributes satisfy 10 CFR 54.21(a)(3). The staff finds that the applicant's response to the staff's RAI provides a sufficient description of the quality assurance program attributes and activities for managing the effects of aging. With regard to the USAR Supplement, the applicant has provided an acceptable USAR Supplement describing the three program elements of corrective actions, confirmation process, and administrative controls. On this basis, the staff concludes that the applicant has provided an adequate description of the program attributes to satisfy 10 CFR 54.21(d).

## 3.1 Reactor Systems

This section addresses the aging management of the components of the reactor systems group. The systems that make up the reactor systems group are described in the following SER sections:

- Reactor Vessel Internals (2.3.1.1)
- Reactor Coolant System (2.3.1.2)
- Reactor Vessel (2.3.1.3)

As discussed in Section 3.0.1 of this SER, the components in each of these reactor systems are included in one of three LRA tables. LRA Table 3.1-1 consists of reactor system components that are evaluated in the GALL Report, LRA Table 3.1-2 consists of reactor system components that are not evaluated in the GALL Report, and LRA Table 3.1-3 consists of reactor system components that were not evaluated in the GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP.

### 3.1.1 Summary of Technical Information in the Application

In LRA Section 3.1, the applicant described its AMRs for the reactor systems group at FCS.

The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.1.1-1, 2.3.1.2-1, and 2.3.1.3-1.

The applicant's AMRs include an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify AERMs. These reviews concluded that the aging effects requiring management based on FCS operating experience were consistent with aging effects identified in GALL.

The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that AERMs based on industry operating experience were consistent with aging effects identified in GALL.

The applicant's ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

### 3.1.2 Staff Evaluation

In Section 3.1 of the LRA, the applicant describes its AMR for the reactor systems at FCS. The staff reviewed LRA Section 3.1 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the reactor system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of reactor system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the USAR Supplement to ensure that it provided an adequate description of the programs credited with managing aging for the reactor system components.

Table 3.1-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.1 that are addressed in the GALL Report.

Table 3.1-1

Staff Evaluation Table for FCS Reactor System Components in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.1 below)
Steam generator shell assembly	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry	Inservice Inspection (B.1.6), Chemistry (B.1.2), and Steam Generator (B.2.9) Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.2 below)
BWR isolation condenser	Loss of material due to general, pitting and crevice corrosion	Inservice inspection; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR

Pressure vessel ferritic materials that have a neutron fluence greater than $10^{17}$ n/cm <sup>2</sup> (E>1 MeV)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	TLAA	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.3 below)
Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Reactor Vessel Integrity Program (B.1.7)	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.3 below)
Westinghouse and B&W baffle/former bolts	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant-specific	Not applicable since FCS is a CE plant	Not applicable since FCS is a CE plant
Small-bore reactor coolant system and connected systems piping	Crack initiation and growth due to SCC, intergranular SCC, and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	Inservice Inspection (B.1.6), Chemistry (B.1.2), and One-Time Inspection (B.3.5) Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.4 below)
Jet pump sensing line, and reactor vessel flange leak detection line	Crack initiation and growth due to SCC, intergranular stress corrosion cracking (IGSCC), or cyclic loading	Plant-specific	Inservice Inspection (B.1.6), Chemistry (B.1.2), and One-Time Inspection (B.3.5) Programs	GALL recommends further evaluation of the reactor vessel flange leak detection line (See Section 3.1.2.2.4 below)
BWR - Isolation condenser	Crack initiation and growth due to stress corrosion cracking (SCC) or cyclic loading;	Inservice inspection; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
Vessel shell	Crack growth due to cyclic loading	TLAA	TLAA	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.5 below)
Reactor internals	Changes in dimension due to void swelling	Plant-specific	Reactor Vessel Internals Inspection Program (B.2.8)	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.6 below)
PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads and nozzles for the steam generator instruments and drains	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant-specific	Alloy 600 Program (B.3.1)	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.7 below)
Cast austenitic stainless steel (CASS) reactor coolant system piping	Crack initiation and growth due to SCC	Plant-specific	Chemistry (B.1.2), Inservice Inspection (B.1.6), and Thermal Embrittlement of Cast Austenitic Stainless Steel (B.3.7) Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.7 below)

Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Ni-alloys	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry	Alloy 600 (B.3.1), Chemistry (B.1.2), and Inservice Inspection (B.1.6) Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.7 below)
Westinghouse and B&W baffle former bolts	Crack initiation and growth due to SCC and IASCC	Plant-specific	Not applicable since FCS is a CE plant	Not applicable since FCS is a CE plant (See Section 3.1.2.2.8 below)
Westinghouse and B&W baffle former bolts	Loss of preload due to stress relaxation	Plant-specific	Not applicable since FCS is a CE plant	Not applicable since FCS is a CE plant (See Section 3.1.2.2.9 below)
Steam generator feedwater impingement plate and support	Loss of section thickness due to erosion	Plant-specific	Not applicable to FCS	Not applicable to FCS (See Section 3.1.2.2.10 below)
(Alloy 600) Steam generator tubes, repair sleeves, and plugs	Crack initiation and growth due to PWSCC, outside diameter stress corrosion cracking (ODSCC), and/or intergranular attack (IGA) or loss of material due to wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry	Steam Generator (B.2.9), and Chemistry (B.1.2), Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.11 below)
Tube support lattice bars made of carbon steel	Loss of section thickness due to FAC	Plant-specific	Steam Generator Program (B.2.9)	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.12 below)
Carbon steel tube support plate	Ligament cracking due to corrosion	Plant-specific	Steam Generator (B.2.9), and Chemistry (B.1.2), Programs	Consistent with GALL. GALL recommends further evaluation (See Section 3.1.2.2.13 below)
Steam generator feedwater inlet ring and supports	Loss of material due to flow-accelerated corrosion	Combustion Engineering (CE) steam generator feedwater ring inspection	Since this aging effect is applicable to System 80 plants, It is not applicable to FCS	Since this aging effect is applicable to System 80 plants, It is not applicable to FCS (See Section 3.1.2.2.14 below)
Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	The reactor head closure stud program is incorporated into the Bolting Integrity Program (B.1.1)	Consistent with GALL (See Section 3.1.2.1 below)
CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	Inservice Inspection Program (B.1.6)	Consistent with GALL (See Section 3.1.2.1 below)

CASS piping	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program (B.3.7)	Consistent with GALL (See Section 3.1.2.1 below)
BWR/PWR piping and fittings; steam generator components	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	Flow Accelerated Corrosion Program (B.1.5)	Consistent with GALL (See Section 3.1.2.1 below)
Reactor coolant pressure boundary (RCPB) valve closure bolting, manway and holding bolting, and closure bolting in high pressure and high temperature systems	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	Bolting Integrity Program (B1.1)	Consistent with GALL (See Section 3.1.2.1 below)
BWR - Feedwater and control rod drive (CRD) return line nozzles	Crack initiation and growth due to cyclic loading	Feedwater nozzle; CRD return line nozzle	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Vessel shell attachment welds	Crack initiation and growth due to SCC, IGSCC	BWR vessel ID attachment welds; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Nozzle safe ends, recirculation pump casing, connected systems piping and fittings, body and bonnet of valves	Crack initiation and growth due to SCC, IGSCC	BWR stress corrosion cracking; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Penetrations	Crack initiation and growth due to SCC, IGSCC, cyclic loading	BWR penetrations; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Core shroud and core plate, support structure, top guide, core spray lines and spargers, jet pump assemblies, control rod drive housing, nuclear instrumentation guide tubes	Crack initiation and growth due to SCC, IGSCC, IASCC	BWR vessel internals; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Core shroud and core plate access hole cover (welded and mechanical covers)	Crack initiation and growth due to SCC, IGSCC, IASCC	ASME Section XI inservice inspection; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
BWR - Jet pump assembly castings; orificed fuel support	Loss of fracture toughness due to thermal aging and neutron embrittlement	Thermal aging and neutron irradiation embrittlement	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR

BWR - Unclad top head and nozzles	Loss of material due to general, pitting, and crevice corrosion	Inservice inspection; water chemistry	Not applicable since FCS is a PWR	Not applicable since FCS is a PWR
CRD nozzle	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry	Chemistry (B.1.2) and Alloy 600 (B.3.1) Programs	Consistent with GALL (See Section 3.1.2.1 below)
Reactor vessel nozzles safe ends and CRD housing; reactor coolant system components (except CASS and bolting)	Crack initiation and growth due to cyclic loading, and/or SCC and PWSCC	Inservice inspection; water chemistry	Inservice Inspection (B.1.6) and Chemistry (B.1.2) Programs	Consistent with GALL (See Section 3.1.2.1.1 for CRD housings and Section 3.1.2.1 below)
Reactor vessel internals CASS components	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement, and void swelling	Thermal aging and neutron irradiation embrittlement	Reactor Vessel Internals Inspection Program (B.2.8)	Consistent with GALL (See Section 3.1.2.1 below)
External surfaces of carbon steel components in reactor coolant system pressure boundary	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Corrosion Prevention Program (B.2.1)	Consistent with GALL (See Section 3.1.2.1 below)
Steam generator secondary manways and handholds (CS)	Loss of material due to erosion	Inservice inspection	Not applicable to FCS	Not applicable to FCS because GALL indicates this item is applicable to B&W steam generators
Reactor internals, reactor vessel closure studs, and core support pads	Loss of material due to wear	Inservice Inspection	Inservice Inspection Program (B.1.6)	Consistent with GALL (See Section 3.1.2.1 below)
Pressurizer integral support	Crack initiation and growth due to cyclic loading	Inservice Inspection	Not applicable to FCS	Not applicable to FCS (See Section 3.1.2.1.2 below)
Upper and lower internal assembly (Westinghouse)	Loss of preload due to stress relaxation	Inservice Inspection; loose part and/or neutron noise monitoring	Not applicable since FCS is a CE plant	Not applicable since FCS is a CE plant
Reactor vessel internals in fuel zone region (except Westinghouse and Babcock & Wilcox [B&W] baffle bolts)	Loss of fracture toughness due to neutron irradiation embrittlement, and void swelling	PWR vessel internals; water chemistry	Chemistry (B.1.2) and Reactor Vessel Internals Inspection (B.2.8)	Consistent with GALL (See Section 3.1.2.1 below)
Steam generator upper and lower heads; tubesheets; primary nozzles and safe ends	Crack initiation and growth due to SCC, PWSCC, IASCC	Inservice inspection; water chemistry	Inservice Inspection (B.1.6) and Chemistry (B.1.2) Programs	Consistent with GALL (See Section 3.1.2.1 below)



Vessel internals (except Westinghouse and B&W baffle former bolts)	Crack initiation and growth due to SCC and IASCC	PWR vessel internals; water chemistry	Chemistry (B.1.2) and Reactor Vessel Internals Inspection (B.2.8)	Consistent with GALL (See Section 3.1.2.1 below)
Reactor internals (B&W screws and bolts)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	Not applicable since FCS is a CE plant	Not applicable since FCS is a CE plant
Reactor vessel closure studs and stud assembly	Loss of material due to wear	Reactor head closure studs	The reactor head closure stud program is incorporated into the Bolting Integrity Program (B.1.1)	Consistent with GALL (See Section 3.1.2.1 below)
Reactor internals (Westinghouse upper and lower internal assemblies; CE bolts and tie rods)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	Inservice Inspection Program (B.1.6)	Since it does not credit loose part monitoring, it is not consistent with GALL (See Section 3.1.2.1.3 below)

The staff's review of the reactor systems group for the FCS LRA is contained within four sections of this SER. Section 3.1.2.1 is the staff review of components in the reactor systems that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.1.2.2 is the staff review of components in the reactor systems that the applicant indicates are consistent with GALL and GALL recommends further evaluation. Section 3.1.2.3 is the staff evaluation of aging management programs that are specific to the reactor systems. Section 3.1.2.4 contains an evaluation of the adequacy of aging management for components in each system in the reactor systems group and includes an evaluation of components in the reactor systems that the applicant indicates are not in GALL. This section is divided into three subsections, reactor vessel internals, reactor coolant system, and reactor vessel. These are the three systems that the applicant has identified as within the reactor system group.

### 3.1.2.1 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups during the AMR inspection to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The results of the staff's AMR inspection can be found in Inspection Report 50-285/03-07, dated March 20, 2003.

On the basis of its review of the inspection results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for reactor system components. Therefore, on this basis, the staff concludes that the applicant has demonstrated that the components for which the applicant claimed consistency with GALL will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.1.1 Cracking of Control Rod Drive Housings

Programs identified in the GALL Report are generic programs. When components experience unusual aging effects, the programs identified in the GALL Report may not be applicable. Control rod drive (CRD) housings (LRA Table 3.1-1, row 3.1.1.25), which are fabricated from stainless steel, are identified as being susceptible to SCC and primary water stress corrosion cracking (PWSCC) with aging management provided by the ISI (B.1.6) and chemistry (B.1.2) programs. Cracking has been reported on CRD housings at FCS (January 25, 2002, letter from OPPD) and Palisades (Nuclear Management Company letters to the NRC dated August 20, 2001, and March 14, 2002 ). The Palisades and FCS CRD housings have similar designs.

Because this operating experience was not considered in the development of the LRA, the staff requested the applicant to consider whether the proposed ISI and chemistry programs would be adequate for managing the aging effect of cracking of the control element drive mechanism (CEDM) housings at FCS. In response to RAI 3.1.1-4, the applicant indicated that in 1999 the applicant began a proactive approach to dealing with the CRD housing cracking phenomenon by establishing a CEDM Material Reliability Management Plan to monitor the CRDs on an outage-by-outage basis through the performance of eddy current testing of the CRDs. Details of the OPPD approach are contained in a letter from OPPD (R. L. Phelps) to NRC (Document Control Desk), dated January 25, 2002, "Fort Calhoun Station (FCS) Discussion of Control Element Drive Mechanism (CEDM) Housing Reliability" (LIC-02-0007), and in a letter from OPPD (R. L. Phelps) to NRC (Document Control Desk), dated October 15, 2001, "Fort Calhoun Station (FCS) CEDM Housing Reliability Management" (LIC-01-0095).

The applicant considers this to be a CLB issue, with the resolution to be incorporated into the appropriate AMPs. The applicant indicates that it will continue to be involved in industry/regulatory activities relative to this issue, and will apply recommended or mandated activities to the maintenance of the FCS CEDM housings as applicable. By letter dated February 20, 2003, the staff issued POI-8(f) requesting the applicant to include a description of the program to manage CEDM housings in the USAR Supplement. By letter dated March 14, 2003, the applicant committed to apply recommended or mandated activities resulting from the CRD Material Reliability Management Plan with regard to management of CEDM housings. The applicant's commitment to apply recommended or mandated activities resulting from the CRD Material Reliability Management Plan ensures that CEDM housings will receive adequate aging management during the license renewal term. The applicant committed to submit a revised AMP and associated USAR Supplement prior to the period of extended operation to ensure that the revised AMP and USAR Supplement are adequate to manage the aging of the CEDM housings. POI-8(f) is resolved.

The staff reviewed the USAR Supplement for the ISI program and finds that, based on the applicant's commitments described above, the USAR provides an adequate summary description of the AMP to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that, based on the applicant's commitments described above, the applicant has adequately evaluated the management of cracking in CRD housings. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.1.2 Crack Initiation and Growth Due to Cyclic Loading of Pressurizer Integral Support

In response to RAI 3.1.2-6, the applicant indicated that this aging effect is not applicable for the FCS pressurizer integral supports because the terminology does not correspond to that used for FCS. However, in the response to this RAI, the applicant indicated that the aging management of the support skirt should have been included, and now includes cracking for the low alloy steel welds between the two low-alloy steel sections of the support skirt and between the support skirt and the low alloy steel pressurizer. The FCS ISI program inspects these welds. FCS is, therefore, consistent with GALL Report line items IV.C2.5-v (the only difference being that the GALL Report includes materials of carbon steel or stainless steel while the FCS skirt is low-alloy steel). Since the aging effects and aging management program are consistent with GALL, the AMR is acceptable.

The staff also reviewed the USAR Supplement for this aging management program and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that, the applicant has adequately evaluated the management of crack initiation and growth due to cyclic loading of the pressurizer integral support. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.1.3 Loss of Preload Due to Stress Relaxation of CE Bolts and Tie Rods in Reactor Internals

The applicant indicates that its program is not consistent with GALL because it does not credit loose parts monitoring. The applicant's AMP for managing loss of preload due to stress relaxation of CE bolts and tie rods in reactor internals is the ISI program. The staff considers the ISI program adequate for loss of preload due to stress relaxation of CE bolts and tie rods because the program has been successful during the current term and should be successful during the license renewal period. The applicant discusses the adequacy of this program in response to RAI 3.1.3-1 and additional discussion of this issue is contained in SER Section 3.1.2.3.2, in which the staff evaluates the reactor vessel internals inspection (RVII) AMP. In its evaluation of this AMP, the staff reviewed CE reports on baffle former bolting and control element assembly (CEA) shroud bolts, and concluded that augmented examination of bolting in FCS reactor vessel internals is not necessary.

The staff reviewed the USAR Supplement for the ISI program and concludes that it provides an adequate summary description of the program and activities credited for managing loss of preload due to stress relaxation of CE bolts and tie rods in reactor internals to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that, the applicant has adequately evaluated the management of loss of preload due to stress relaxation of CE bolts and tie rods in reactor internals. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that

these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.1.4 Conclusions

On the basis of its review of the inspection results the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for reactor system components. Therefore, on this basis, the staff concludes that, for those components that are managed consistent with the GALL Report, the applicant has demonstrated that the effects of aging will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplement for the ISI program, including the applicant's commitments discussed above, and concludes that the supplements provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components, as required by 10 CFR 54.21(d).

#### 3.1.2.2 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The results of the staff's AMR inspection can be found in Inspection Report 50-285/03-07, dated March 20, 2003.

The GALL Report indicates that further evaluation should be performed for the aging effects described in the following sections:

##### 3.1.2.2.1 Cumulative Fatigue Damage

As stated in the SRP-LR, fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAA's are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

On the basis of the staff's review of LRA Section 4.3, the staff concludes that, pending satisfactory resolution of Confirmatory Items 4.3.2-1 and 4.3.2-2, the components in the reactor systems subject to fatigue will be adequately managed during the period of extended operation.

##### 3.1.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion

As stated in the SRP-LR, loss of material due to pitting and crevice corrosion could occur in the PWR steam generator shell assembly. The existing program relies on control of chemistry to mitigate corrosion and ISI to detect loss of material. The extent and schedule of the existing steam generator inspections are designed to ensure that flaws cannot attain a depth sufficient

to threaten the integrity of the welds. However, according to NRC Information Notice (IN) 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," dated January 26, 1990, if pitting and crevice corrosion of the shell exists, the program may not be sufficient to detect pitting and corrosion. The GALL Report recommends augmented inspection to manage this aging effect. The staff review verifies that the applicant has proposed a program that will manage loss of material due to pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material and ensure that the component intended function will be maintained during the period of extended operation.

In response to RAI 3.1.1-1, the applicant indicates that the pitting and crevice corrosion discussed in IN 90-04 is applicable to Westinghouse Model 44 and Model 51 vertical, recirculation, U-tube steam generators with feedwater ring design. FCS has Combustion Engineering steam generators. Based on an evaluation from CE, the applicant concluded that the shell-to-cone girth welds at FCS will not be susceptible to cracking similar to that identified in IN 90-04.

The applicant proposed the ISI (B.1.6), chemistry (B.1.2), and steam generator (B.2.9) programs to manage loss of material due to pitting and crevice corrosion in the steam generator shell assembly. The ISI program is reviewed in SER Section 3.0.3.5. The chemistry program is reviewed in SER Section 3.0.3.2. The steam generator program is reviewed in SER Section 3.1.2.3.3. In addition, in response to RAI B.2.9-2, the applicant indicates that the secondary shell, secondary handholds, secondary head, secondary manway, and transition cone are visually inspected for loss of material (general, pitting, and crevice corrosion) to ensure pressure boundary integrity. This RAI response is discussed in greater detail in SER Section 3.1.2.3.3.2.2.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of loss of material due to pitting and crevice corrosion, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

As stated in the SRP-LR, certain aspects of neutron irradiation embrittlement are TLAAs, as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAAs separately using the guidance in Section 4.2 of the SRP-LR. The results of the staff's review can be found in Section 4.2 of this SER.

Loss of fracture toughness due to neutron irradiation embrittlement could occur in the reactor vessel. A reactor vessel materials surveillance program monitors neutron irradiation embrittlement of the reactor vessel. Reactor vessel surveillance programs are plant-specific,

depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Thus, the GALL Report recommends further evaluation of the reactor vessel materials surveillance program for the period of extended operation.

The applicant's reactor vessel material surveillance program is documented in the reactor vessel integrity program (RVIP) (B.1.7), and Section 4.2 of the program basis document for RVIP. The RVIP is reviewed in SER section 3.1.2.3.1. The surveillance capsule withdrawal schedule was submitted for staff review in a letter from OPPD dated November 8, 2001. The purpose of the submittal was to modify the surveillance capsule withdrawal schedule to reflect the renewal license period of 60 years. In a letter dated May 2, 2002, the staff indicated that the revised withdrawal schedule is acceptable for the renewal period of 60 years.

The staff reviewed the USAR Supplement for the RVIP AMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of fracture toughness due to neutron irradiation embrittlement for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.4 Crack Initiation and Growth Due to Thermal and Mechanical Loading or Stress Corrosion Cracking

As stated in the SRP-LR, crack initiation and growth due to thermal and mechanical loading or SCC (including intergranular stress corrosion cracking (IGSCC)) could occur in the small-bore reactor coolant system and connected system piping less than NPS of 4 inch. The existing program relies on the ASME Section XI ISI and on control of water chemistry to mitigate SCC. The GALL Report recommends that a plant-specific destructive examination or a non-destructive evaluation (NDE) that permits inspection of the inside surfaces of the piping be conducted to ensure that cracking has not occurred and the component intended function will be maintained during the period of extended operation. The AMPs should be augmented by verifying that service-induced weld cracking is not occurring in the small-bore piping less than NPS 4 inch, including pipe, fittings, and branch connections. A one-time inspection of a sample of locations is an acceptable method to ensure that the aging effect is not occurring and that the component's intended function will be maintained during the period of extended operation. GALL Chapter XI.M32, "One-Time Inspection," contains an acceptable verification method.

The GALL Report recommends that the inspection include a representative sample of the system population, and, where practical and prudent, focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. For small-bore piping, actual inspection locations should be based on physical accessibility, exposure levels, NDE techniques, and locations identified in IN 97-46, "Unisolable Crack in High-Pressure Injection Piping." Combinations of NDE, including visual,

ultrasonic, and surface techniques, are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR 50, Appendix B. For small-bore piping less than NPS 4 inch, including pipe, fittings, and branch connections, a plant-specific destructive examination or NDE that permits inspection of the inside surfaces of the piping should be conducted to ensure that cracking has not occurred. Followup of unacceptable inspection findings should include expansion of the inspection sample size and locations. The inspection and test techniques prescribed by the program should verify any aging effects because these techniques, used by qualified personnel, have been proven effective and consistent with staff expectations. The staff's review confirms that the program includes measures to verify that unacceptable degradation is not occurring, thereby validating the effectiveness of existing programs, or confirming that there is no need to manage aging-related degradation for the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the proposed inspection will be performed using techniques similar to ASME Code and American Society for Testing and Materials (ASTM) standards, including visual, ultrasonic, and surface techniques, to ensure that the component's intended function will be maintained during the period of extended operation.

The GALL Report recommends that a plant-specific AMP be evaluated for the management of crack initiation and growth due to thermal and mechanical loading or SCC (including IGSCC) in a boiling-water reactor (BWR) reactor vessel flange leak detection line and BWR jet pump sensing line. Since reactor vessel flange leak detection lines are also utilized in PWRs, this issue is applicable to PWRs. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP).

The applicant has proposed the ISI (B.1.6), chemistry (B.1.2), and one-time inspection (B.3.5) programs to manage cracking of the small-bore RCS and connected system piping. The ISI program is reviewed in SER Section 3.0.3.5. The chemistry program is reviewed in SER section 3.0.3.2. The one-time inspection program is reviewed in SER Section 3.0.3.13. The ISI program is consistent with XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," as identified in the GALL Report. ASME Code Section XI, Subsection IWB, requires surface and VT-2 visual examination. However, these examination methods will not be able to detect a crack initiating from the inside surface that is not through-wall. In order to detect a crack initiating from the inside surface that is not through-wall, a volumetric examination is required.

The FCS chemistry program is consistent with XI.M2, "Water Chemistry," as identified in the GALL Report. This program will mitigate damage caused by stress corrosion through periodic monitoring and control of known detrimental contaminants. The FCS one-time inspection program will be consistent with XI.M32, "One-Time Inspections," as identified in the GALL Report prior to the period of extended operation. This program specifies that the inside surface of piping be examined by either performing destructive examination or NDE. The NDE must permit inspection of the inside surface of the piping. NDE using volumetric examination methods can be performed from the outside and would be able to detect cracking initiating from the inside surface. During its inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff confirmed that the applicant's one-time inspection program will include volumetric examination and will inspect locations that are susceptible to SCC or

thermal cycling. The results of the staff's inspection and audit are documented in AMR Inspection Report 50-285/03-07, dated March 20, 2003, and audit report dated April 9, 2003. Additional discussion of the one-time inspection program is contained in Section 3.0.3.13 of this SER.

Leakage detection lines, or closure head vent lines, have been included within the scope of license renewal and are addressed in LRA Table 2.3.1.3-1 under the component type "Pipes & Fittings, CEDM Housings." The applicable components are linked to AMR results Items 3.1.1.01, 3.1.1.06, and 3.1.1.24. Item A2.1.4 in Section IV of the GALL Report indicates vessel flange leak detection lines require further plant-specific evaluation. Since this line functions as a pressure boundary for the vessel flange, by letter dated February 20, 2003, the staff issued POI-8(a), requesting the applicant to address the plant-specific review in item A2.1.4 in Section IV of The GALL Report. In addition, the staff asked the applicant to identify the materials used in the leakage detection line, the method of pressurizing the lines, and the inspection methods that are used to detect crack initiation and growth due to SCC that initiates on the inside surface. By letter dated March 14, 2003, the applicant addressed this POI by stating that AMR Item 3.1.1.06 is equivalent to GALL Report Item IV.A2.1.4. AMR Item 3.1.1.06 specifies in discussion item 3 that the lines are fabricated from stainless steel. Discussion item 2 specifies that the chemistry, ISI, and one-time inspection programs are to be used to manage the aging of these lines. The one-time inspection program will be used to verify that weld cracking is not occurring. This is consistent with the GALL Report (IV.C1.1.13, IV.C2.1.5, and IV.C2.2.8). The applicant is treating these lines in the same manner as other small-bore RCS lines.

Further, on the basis of its review of the information provided in the POI response, the staff finds that the applicant's response, including its commitment to use the one-time inspection program to confirm that weld cracking is not occurring, is adequate to ensure that the reactor vessel flange leakage detection lines will be adequately managed during the period of extended operation. POI-8(a) is resolved.

The staff reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking for small-bore piping and reactor vessel flange leak detection lines in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.5 Crack Growth Due to Cyclic Loading

As stated in the SRP-LR, crack growth due to cyclic loading could occur in the reactor vessel shell and RCS piping and fittings. Growth of intergranular separations (underclad cracks) in low-alloy or carbon steel heat-affected zones under austenitic stainless steel cladding is a TLAA to be evaluated for the period of extended operation for all the SA 508, Class 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for



evaluating the underclad flaw should be consistent with the current, well-established flaw evaluation procedure and criterion in the ASME Section XI Code. Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis," of the SRP-LR provides generic guidance for meeting the requirements of 10 CFR 54.21(c). The GALL Report recommends further evaluation of programs to manage crack growth due to cyclic loading in the reactor vessel shell and RCS piping and fittings. The GALL Report states that this aging effect is only applicable for the reactor vessel shell if it is made of SA 508, Class 2 forgings and is exposed to a neutron fluence greater than  $10^{17}$  n/cm<sup>2</sup>. The applicant indicates that this aging effect is not applicable to FCS.

In response to RAI 3.1.1-2, the applicant indicates that the only reactor vessel components fabricated of SA 508, Class 2 steel and clad with a stainless steel or a nickel-based alloy weld overlay, are the reactor vessel flange, closure head flange, and the primary coolant nozzles, nozzle extensions, and nozzle safe ends. A recent Westinghouse analysis performed for FCS indicates the flanges and nozzles will not experience a fluence greater than  $10^{17}$  n/cm<sup>2</sup> by the end of the period of extended operation. Based on its experience with neutron flux in regions outside the beltline, the staff agrees that the neutron fluence at the flange and nozzles will be less than  $10^{17}$  n/cm<sup>2</sup>. In addition, the applicant indicates that Westinghouse/CE indicated to the applicant that there have been no cases of underclad cracking of any clad CE reactor vessel subcomponents. Based on this information, the staff concludes that this aging effect does not need to be managed during the period of extended operation.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack growth due to cyclic loading for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.6 Changes in Dimension Due to Void Swelling (PWR)

As stated in the SRP-LR, changes in dimension due to void swelling could occur in reactor internal components. The GALL Report recommends further evaluation to ensure that this aging effect is adequately managed. The reactor vessel internals receive a visual inspection (VT-3) according to Category B-N-3 of Subsection IWB of ASME Section XI. However, this inspection is not sufficient to detect the effects of changes in dimension due to void swelling. Therefore, GALL recommends that a plant-specific AMP be evaluated. The applicant should provide a plant-specific AMP or participate in industry programs to investigate aging effects and determine an appropriate AMP. Otherwise, the applicant should provide the basis for concluding that void swelling is not an issue for the component. The staff verifies that the applicant has either proposed a program to manage changes in dimension due to void swelling in the pressure vessel internal components, or provided the basis for concluding that void swelling is not an issue.

The applicant has not indicated that void swelling is not an issue. The applicant has proposed to manage this aging effect by the RVII program (B.2.8). This program is reviewed in SER section 3.1.2.3.2. The RVII program references GALL programs XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)," and XI.M16, "PWR Vessel Internals," as identified in The GALL Report. These GALL sections identify

programs that are acceptable to the staff for managing void swelling. Since the applicant has proposed a program to manage this aging effect, the applicant has provided the additional information requested in the SRP-LR.

The staff reviewed the USAR Supplement for the RVII program and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of changes in dimension due to void swelling for reactor vessel internals components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.7 Crack Initiation and Growth Due to Stress Corrosion Cracking or Primary Water Stress Corrosion Cracking

As stated in the SRP-LR, crack initiation and growth due to SCC and PWSCC could occur in PWR core support pads (or core guide lugs), instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The GALL Report also recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP-LR). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

Crack initiation and growth due to SCC could occur in PWR CASS RCS piping and fittings and the pressurizer surge line nozzle. The GALL Report recommends further evaluation of piping that do not meet either the reactor water chemistry guidelines of TR-105714, "PWR Primary Water Chemistry Guidelines-Revision 3," November 1995, or material guidelines of NUREG-0313, Revision. 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping." Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP-LR). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

Crack initiation and growth due to PWSCC could occur in PWR pressurizer instrumentation penetrations and heater sheaths and sleeves made of nickel alloys. The existing program relies on the ASME Section XI ISI and on control of water chemistry to mitigate PWSCC. However, the existing program should be augmented to manage the effects of SCC on nickel-alloy components. The GALL Report recommends that the applicant provide a plant-specific AMP or participate in industry programs to determine an appropriate AMP for PWSCC of Alloy 600 and Inconel 82/182 welds. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP-LR). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

The applicant has proposed to manage crack initiation and growth due to SCC or PWSCC for core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads and nozzles for the steam generator instruments and drains using the Alloy 600 program (B.3.1). This program is evaluated in SER Section 3.1.2.3.4. The Alloy 600 program references GALL program XI.M11, "Nickel-Alloy Nozzles and Penetrations," as identified in The GALL Report. This GALL section identifies programs that are acceptable to the staff for managing crack initiation and growth due to SCC or PWSCC.

The applicant has proposed to manage crack initiation and growth due to SCC in CASS RCS piping using the chemistry (B.1.2), ISI (B.1.6), and thermal embrittlement of CASS (B.3.7) programs. The ISI program is reviewed in SER Section 3.0.3.5. The chemistry program is reviewed in SER Section 3.0.3.2. The thermal embrittlement of CASS program is reviewed in SER Section 3.1.2.3.5. The FCS chemistry program is consistent with GALL program XI.M32, "Water Chemistry," as identified in The GALL Report. This program will mitigate damage caused by stress corrosion through periodic monitoring and control of known detrimental contaminants. GALL program XI.M2 indicates that the primary water chemistry program is based on the EPRI guidelines in TR-105714. Since the proposed program is consistent with EPRI guidelines in TR-105714, the applicant has proposed an acceptable program to manage this aging effect and the applicant has provided the additional information requested in the SRP-LR.

The applicant has proposed to manage crack initiation and growth due to PWSCC in pressurizer instrumentation penetrations and heater sheaths and sleeves made of nickel-alloys by the Alloy 600 (B.3.1), chemistry (B.1.2), and ISI (B.1.6) programs. The ISI program is reviewed in SER Section 3.0.3.5. The chemistry program is reviewed in SER Section 3.0.3.2. The Alloy 600 program is reviewed in SER Section 3.1.2.3.4. The Alloy 600 program references GALL program XI.M11, "Nickel-Alloy Nozzles and Penetrations," as identified in The GALL Report. This GALL section identifies programs that are acceptable to the staff for managing crack initiation and growth due to SCC or PWSCC.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack initiation and growth due to SCC or PWSCC for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.8 Crack Initiation and Growth Due to Stress Corrosion Cracking or Irradiation-Assisted Stress Corrosion Cracking

As stated in the SRP-LR, crack initiation and growth could occur in baffle/former bolts due to SCC or irradiation-assisted stress corrosion cracking (IASCC) in Westinghouse and B&W reactors. FCS is a CE reactor and therefore this issue does not apply.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack initiation and growth due to SCC or IASCC for baffle/former bolts, as recommended in the GALL Report.

#### 3.1.2.2.9 Loss of Preload Due to Stress Relaxation

As stated in the SRP-LR, loss of preload due to stress relaxation could occur in baffle/former bolts in Westinghouse and B&W reactors. Loss of preload on baffle/former bolts is due to neutron irradiation and could occur in components that are susceptible to SCC or IASCC. Since baffle/former bolts in CE reactors are not susceptible to SCC or IASCC, they would not be susceptible to loss of preload due to stress relaxation. FCS is a CE reactor and therefore this issue does not apply.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of preload due to stress relaxation for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.10 Loss of Section Thickness due to Erosion

As stated in the SRP-LR, loss of section thickness due to erosion could occur in steam generator feedwater impingement plates and supports. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

The applicant indicates that this aging effect is not applicable because FCS does not utilize impingement plates and supports for supplying feedwater to the steam generators. By letter dated February 20, 2003, the staff issued POI-8(b), requesting the applicant to clarify whether FCS has steam generator feedwater impingement plates and supports. By letter dated March 14, 2003, the applicant directed the staff to LRA AMR Item 3.1.1.14. On the basis of the applicant's response to POI-8(b), the staff finds that feedwater is supplied to steam generators through the steam generator feedwater feed ring. The steam generator feedwater feed ring is susceptible to cumulative fatigue and loss of material. Based on plant operating experience, it is not susceptible to loss of section thickness due to erosion. Since FCS does not utilize impingement plates and associated supports, and the steam generator feedwater feed ring is not susceptible to loss of section thickness due to erosion, this aging effect is not applicable to FCS. POI-8(b) is resolved.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of section thickness due to erosion for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.11 Crack Initiation and Growth Due to PWSCC, ODSCC, or Intergranular Attack, or Loss of Material Due to Wastage and Pitting Corrosion, or Loss of Section Thickness Due to Fretting and Wear, or Denting Due to Corrosion at Carbon Steel Tube Support Plate Intersections

As stated in the SRP-LR, crack initiation and growth due to PWSCC, outside diameter stress corrosion cracking (ODSCC), or intergranular attack (IGA) or loss of material due to wastage and pitting corrosion or deformation due to corrosion could occur in Alloy 600 components of the steam generator (SG) tubes, repair sleeves, and plugs. The GALL Report recommends further evaluation of (1) crack initiation and growth due to PWSCC, ODSCC, or IGA or (2) loss of material due to wastage and pitting corrosion or (3) deformation due to corrosion in Alloy 600 components of the SG tubes, repair sleeves, and plugs. All PWR licensees have committed voluntarily to an SG degradation management program described in NEI 97-06, "Steam Generator Program Guidelines." The GALL Report recommends that an AMP based on the recommendations of staff-approved NEI 97-06 guidelines, or some other alternate regulatory basis for SG degradation management, be developed to ensure that this aging effect is adequately managed. At present, the staff does not plan to endorse NEI 97-06 or detailed industry guidelines referenced therein. The staff is working with the industry to revise plant technical specifications to incorporate the essential elements of the industry's NEI 97-06 initiative as necessary to ensure tube integrity is maintained. This would require implementation of programs to ensure that performance criteria for tube structural and leakage integrity are maintained, consistent with the plant design and licensing basis. NEI 97-06 provides guidance on programmatic details for accomplishing this objective. These guidelines apply to all degradation or damage mechanisms. However, these programmatic details would be outside the scope of the technical specifications. As part of the NRC Reactor Oversight Program, NRC would monitor the effectiveness of these programs in terms of whether the bottom line goals of these programs are being met, particularly whether the tube structural and leakage integrity performance criteria are being maintained. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects for the period of extended operation.

The applicant has proposed to manage (1) crack initiation and growth due to PWSCC, ODSCC, or intergranular attack, or (2) loss of material due to wastage and pitting corrosion, or (3) loss of section thickness due to fretting and wear, or (4) denting due to corrosion of carbon steel tube support plate intersections by the SG (B.2.9) and chemistry (B.1.2) programs. The chemistry program is reviewed in SER Section 3.0.3.2. The steam generator program (SGP) is reviewed in SER Section 3.1.2.3.3. These aging effects are discussed in greater detail in SER Section 3.1.2.3.3.2.4.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of (1) crack initiation and growth due to PWSCC, ODSCC, or intergranular attack, or (2) loss of material due to wastage and pitting corrosion, or (3) loss of section thickness due to fretting and wear, or (4) denting due to corrosion at carbon steel tube support plate intersections, as recommended in the GALL Report. On the basis of this finding, and the

finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.12 Loss of Section Thickness Due to Flow-Accelerated Corrosion

As stated in the SRP-LR, loss of section thickness due to FAC could occur in tube support lattice bars made of carbon steel. The GALL Report recommends further evaluation of loss of section thickness due to flow-accelerated corrosion of the tube support lattice bars made of carbon steel. The GALL Report recommends a plant-specific AMP be evaluated and, on the basis of the guidelines of NRC Generic Letter 97-06, an inspection program for SG internals be developed to ensure that this aging effect is adequately managed. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP-LR).

Loss of section thickness due to FAC in tube support lattice bars made of carbon steel is managed by the SGP (B.2.9). The applicant's SGP is reviewed in SER Section 3.1.2.3.3. This aging effect is discussed in greater detail in SER Section 3.1.2.3.3.2.5.

The staff reviewed the USAR Supplement for the SG program and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of section thickness due to FAC for components in the reactor systems, as recommended in the GALL Report. Further, on the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.13 Ligament Cracking Due to Corrosion

As stated in the SRP-LR, ligament cracking due to corrosion could occur in the carbon steel SG tube support plate. The GALL Report recommends further evaluation of ligament cracking due to corrosion in carbon steel components in the SG tube support plate. All PWR licensees have committed voluntarily to an SG degradation management program described in NEI 97-06. The GALL Report recommends that an AMP based on the recommendations of staff-approved NEI 97-06 guidelines, or some other alternate regulatory basis for SG degradation management, be developed to ensure that this aging effect is adequately managed. At present, the staff does not plan to endorse NEI 97-06 or detailed industry guidelines referenced therein. The staff is working with the industry to revise plant technical specifications to incorporate the essential elements of the industry's NEI 97-06 initiative as necessary to ensure tube integrity is maintained. This would require implementation of programs to ensure that performance criteria for tube structural and leakage integrity are maintained, consistent with the plant design and licensing basis. NEI 97-06 provides guidance on programmatic details for accomplishing this objective. These guidelines apply to all degradation or damage mechanisms. However, these programmatic details would be outside the scope of the technical specifications. As part of the

NRC Reactor Oversight Program, NRC would monitor the effectiveness of these programs in terms of whether the bottom line goals of these programs are being met particularly whether the tube structural and leakage integrity performance criteria are being maintained. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

Ligament cracking due to corrosion which could occur in the carbon steel steam generator tube support plate is managed by the SG (B.2.9) and chemistry (B.1.2) programs. The chemistry program is reviewed in SER Section 3.0.3.2. The SGP is reviewed in SER Section 3.1.2.3.3. The FCS chemistry program is consistent with GALL program XI.M2, "Water Chemistry," as identified in The GALL Report. This program will mitigate damage caused by stress corrosion through periodic monitoring and control of known detrimental contaminants. This aging effect is discussed in greater detail in SER Section 3.1.2.3.3.2.6.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the reactor system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of ligament cracking due to corrosion for components in the reactor systems, as recommended in the GALL Report. Further, on the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.2.14 Loss of Material Due to Flow-Accelerated Corrosion

As stated in the SRP-LR, loss of material due to FAC could occur in the feedwater inlet ring and supports. The GALL Report recommends that a plant-specific AMP be evaluated to manage loss of material due to FAC in these components. As noted in IN 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," IN 91-19, "Steam Generator Feedwater Distribution Piping Damage," and licensee event report (LER) 50-362/90-05-01, this form of degradation has been detected only in certain CE System 80 steam generators. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting loss of material due to FAC. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects. However, since this aging effect is applicable only to System 80 plants, it is not applicable to FCS.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to FAC for components in the reactor systems, as recommended in the GALL Report.

#### 3.1.2.2.15 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for components in the reactor systems. On the basis of its review, the staff

concludes that the applicant has provided sufficient information to demonstrate that the issues for which GALL recommends further evaluation have been adequately addressed, and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3). In addition, the staff concludes that the applicant's USAR Supplement provides an adequate description of the programs credited with managing these aging effects, as required by 10 CFR 54.21(d).

### 3.1.2.3 Aging Management Programs for Reactor Systems Components

In SER Sections 3.1.2.1 and 3.1.2.2, the staff determined that the applicant's AMRs and associated AMPs will adequately manage component aging in the reactor systems. The staff then reviewed specific components in the reactor systems to ensure that they were properly evaluated in the applicant's AMR.

To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3.1.1-1 through 2.3.1.3-1 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage component aging effects. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the USAR Supplements for the AMPs credited with managing aging in reactor system components to determine whether the program description adequately describes the program.

The applicant credits 12 AMPs to manage the aging effects associated with components in the reactor systems. Seven of the AMPs are credited for managing the aging of components in several system groups (common AMPs), while five AMPs are credited with managing aging only for reactor system components. The staff's evaluation of the common AMPs is provided in Section 3.0.3 of this SER. A list of the common AMPs follows.

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Flow-Accelerated Corrosion Program - SER Section 3.0.3.4
- Inservice Inspection Program - SER Section 3.0.3.5
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Fatigue Monitoring Program - SER Section 3.0.3.8
- One-Time Inspection - SER Section 3.0.3.13

The staff's evaluation of the five reactor system AMPs is provided below.

#### 3.1.2.3.1 Reactor Vessel Integrity Program

##### 3.1.2.3.1.1 Summary of Technical Information in the Application

The applicant's reactor vessel integrity program (RVIP) is documented in Section B.1.7 of the LRA. The applicant states that the RVIP is consistent with GALL program XI.31, "Reactor Vessel Surveillance," as identified in The GALL Report, with the enhancement that the revised,



optimized withdrawal and test schedule was submitted for review and approval per OPPD Letter LIC-01-0107 dated November 8, 2001. This AMP is credited for managing loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline shell and welds.

#### 3.1.2.3.1.2 Staff Evaluation

The staff reviewed the enhancement and its justification to determine whether the AMP, with the enhancement, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program. The staff further reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL Report, and confirmed that the AMP would adequately address these issues.

In LRA Section B.1.7, "Reactor Vessel Integrity Program," the applicant described its AMP to manage aging in the reactor vessel beltline shell and welds. The LRA stated that this AMP is consistent with GALL AMP XI.31, with an enhancement that the revised, optimized withdrawal and test schedule was submitted for review and approval per OPPD Letter LIC-01-0107 dated November 8, 2001. For this AMP, GALL recommends further evaluation. The proposed withdrawal schedule was reviewed and approved by the staff in a letter from S. Dembek (NRC) to R. T. Ridenoure (OPPD) dated May 2, 2002. In this letter, the staff found the revised withdrawal schedule acceptable for 60 years. In addition, the staff approved an integrated surveillance program for FCS as described in CEN-636, Revision 2, in a safety evaluation dated June 6, 2001. The use of the integrated surveillance program allows OPPD to utilize data originating from the surveillance programs at Mihama 1, Palisades, and Diablo Canyon Unit 1, to monitor neutron irradiation embrittlement to the FCS reactor vessel beltline. The weld materials in Mihama 1, Palisades, and Diablo Canyon Unit 1 surveillance capsules contain material that is representative of the weld materials in the FCS beltline. The staff review that was documented in letters dated June 6, 2001, and May 2, 2002, satisfies the SRP recommendation for further evaluation.

The applicant provided its USAR Supplement for the RVIP in Section A.2.19 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

#### 3.1.2.3.1.3 Conclusion

On the basis of its review of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the RVIP will effectively manage aging in the components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.3.2 Reactor Vessel Internals Inspection Program

#### 3.1.2.3.2.1 Summary of Technical Information in the Application

The applicant's reactor vessel internals inspection (RVII) program is discussed in LRA Section B.2.8, "Reactor Vessel Internals Inspection Program." The applicant states that the program is consistent with GALL programs XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)," and XI.M16, "PWR Vessel Internals," with the exception that no augmented inspection of bolting is scheduled and the chemistry-related portions of the program are addressed in the FCS chemistry program. The tensile stresses on the reactor vessel internals bolting are lower than the industry levels where cracking was observed as an aging effect. The applicant also states that fluence and stress analyses discussed in GALL programs XI.M13 and XI.M16 will be performed to identify critical locations. A fracture mechanics analysis for critical locations will be performed to determine flaw acceptance criteria and resolution required to detect flaws. Appropriate inspection techniques will be based on these analyses. This AMP is credited for managing change of dimension due to void swelling and crack initiation and growth due to SCC and IASCC in reactor vessel internals.

#### 3.1.2.3.2.2 Staff Evaluation

In LRA Section B.2.8, the applicant described its AMP to manage aging in reactor internals. The LRA stated that this AMP is consistent with GALL AMPs XI.M13 and XI.M16 with the exception that no augmented inspection of bolting is scheduled and the chemistry-related portions of the program are addressed in the FCS chemistry program. For these AMPs, GALL recommends further evaluation. GALL XI. M13 indicates that an applicant can implement either a supplemental examination of the affected component as a part of the 10-year ISI program during license renewal, or a component-specific evaluation to determine the component's susceptibility to loss of fracture toughness. GALL XI.M16 further indicates that an applicant's program should identify the most limiting component, develop appropriate inspection techniques, and implement the inspections during the license renewal term. These recommendations have been satisfied since the applicant indicates that fluence and stress analyses discussed in GALL programs XI.M13 and XI.M16 will be performed to identify critical locations. A fracture mechanics analysis for critical locations will be performed to determine flaw acceptance criteria and resolution required to detect flaws. Appropriate inspection techniques will be based on these analyses.

The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exceptions and their justification to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program. The staff further reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL Report and confirmed that the AMP would adequately address these issues.

For bolted components, GALL XI.M16 indicates that an augmented ISI is recommended to detect cracks between the bolt head and shank unless the applicant performs component-specific mechanical analyses to preclude cracking. In the "operating experiences" portion of the RVII program, the applicant provided an evaluation of the susceptibility of cracking in baffle

former bolts and CEA shroud bolts. The Combustion Engineering Owners Group (CEOG) provided an assessment of the cracking of the baffle former bolts reported in foreign PWRs, including the potential impact of the cracking on domestic CE plants. The results are in CEOG Report CE NPSD-1098 for CEOG Task 1011, "Evaluation of the Applicability of Baffle Bolt Cracking to Ft. Calhoun and Palisades Internals Bolts," Final Report, Revision 0, April 1998. The most likely mechanism for the cracking of cold-worked 316 stainless steel baffle former bolts in foreign plants is IASCC. There are only two CE-designed plants (FCS and Palisades) that use bolts to attach the core shroud panels (i.e., the baffle plates) to the former plates. The report indicates that these bolts in FCS are less susceptible to IASCC because (1) the material used in these bolts is annealed 316 stainless steel, which is not cold-worked (2) the bolt stress from preload, as a percentage of yield strength, is much less than the foreign PWRs that cracked, (3) the differential pressure across the core shroud panels does not result in tensile loads on the panel (i.e., the baffle bolts) during normal operation and (4) the core shroud panel design allows for some flexing of the former plate relative to the core barrel, thus reducing the load on the panel bolts. Since CE NPSD-1098 was issued, cracking has been discovered in Point Beach baffle bolts. However, as with the foreign PWR experience, cracked bolts were highly stressed during preload, tensile stresses were applied during operation because of the Westinghouse design, and the bolts were fabricated with cold-worked 316 stainless steel. Based on the difference in the design, materials, and preload between the Point Beach and the foreign PWR that experienced baffle former bolt cracking, the FCS baffle former bolts are less susceptible to cracking and augmented inspection is not necessary.

SCC was identified in Babcock and Wilcox (B&W) lower thermal shield and lower core barrel bolts that were fabricated with Alloy A-286. Most of the failed bolts were highly stressed to at or over the yield strength. Although there have been no failures of CEA shroud bolts in CE-designed reactor vessel internals, there is a concern that SCC may occur since these bolts are fabricated with Alloy A-286. CE provided an evaluation of the stress level for these bolts in CEN-282, "Investigation and Evaluation of A286 Bolt Applications in CE's NSSS," September 1984. This report indicates that the operating stress levels are just below 32 Ksi. The stress concentration factor for the CEA shroud bolts is 2.06, leading to a local stress of approximately 66 Ksi. Yield strength for A-286 is about 115 Ksi, so the stress is approximately 60 percent of yield. Most of the failed B&W bolts had working stresses of approximately 65 Ksi and a local stress of 134 Ksi which is above the yield strength of the material. There were no failed bolts with working stresses of 35 Ksi. The conclusion of the report indicates a low probability for cracking of the CEA shroud bolts. Based on the difference in the operating stresses on the CEA shroud bolts and the failed B&W bolts, and the fact that there have been no failures of CEA shroud bolts in CE-designed reactor vessel internals, the CEA shroud bolts are less susceptible to SCC and augmented inspection is not necessary.

The applicant provided its USAR Supplement for the RVII program in Section A.2.20 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

#### 3.1.2.3.2.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the exceptions and enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging

effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the RVII program will effectively manage aging in the components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.3.3 Steam Generator Program

#### 3.1.2.3.3.1 Summary of Technical Information in the Application

The applicant's steam generator program (SGP) is discussed in LRA Section B.2.9, "Steam Generator Program." The applicant states that the program is consistent with GALL program XI.M19, "Steam Generator Tube Integrity," with the clarifications that the applicant has included aging management activities to address plant-specific AMP requirements identified in Table 3.1.1 of the LRA, and the enhancement that the applicant has added plant-specific components beyond those discussed in GALL and identified in Table 3.1.2 of the LRA, for which the SGP is identified as an AMP. The applicant also identified an enhancement which states that an annunciator response procedure for the loose parts monitor in the SG will be written.

This AMP is credited with managing aging in the SG shell assembly; SG tubes, repair sleeves, and plugs; tube support lattice bars made of carbon steel; carbon steel tube support plates; SG lower head and primary side tube sheet; secondary side of the tubesheet, SG feedwater, steam and instrument nozzles, and feedwater nozzle safe ends; SG steam nozzle safe end; and SG feed ring.

The applicant stated that SG management of aging effects has evolved and improved over the years based on industry experience. The applicant has adopted industry practices throughout the years and continues to do so. Past NRC inspections of this program cited sample plans and inspection evaluation as a strength. Only one noteworthy situation occurred at FCS. In 1984, a tube with ODSCC in the U-bend region of the SG ruptured. Re-evaluation of the eddy current data from the previous inspection indicated that flaws were present and had been missed during the data analysis due to human error. This situation was corrected and long-term corrective actions were implemented to prevent recurrence. Currently, the applicant's practices are state-of-the-art. The overall experience illustrates that the SGP is effective in managing aging.

On the basis of the above discussion, the applicant concluded that the SGP provides reasonable assurance that the SG component aging effects will be adequately managed.

#### 3.1.2.3.3.2 Staff Evaluation

In LRA Section B.2.9, the applicant described its AMP to manage aging in SG components. The LRA stated that this AMP is consistent with GALL AMP XI.M19, with the exception that the applicant included aging management activities to address plant-specific AMP requirements identified in Table 3.1-1 of the LRA, and the applicant added plant-specific components, beyond

those discussed in GALL and identified in Table 3.1-2 of the LRA, for which the SGP is identified as an AMP. The applicant also identified an enhancement which states that an annunciator response procedure for the loose parts monitor in the SG will be written prior to the period of extended operation. For this AMP, GALL recommends further evaluation. Furthermore, the staff reviewed the clarifications and enhancements, and the applicant's justifications, to determine whether the AMP remains adequate to manage the aging effects for which it is credited. The staff reviewed the USAR Supplement to determine whether it provides an adequate description of the revised program. The staff further reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL Report to confirm whether the AMP would adequately address these issues.

#### 3.1.2.3.3.2.1 Annunciator Response Procedure Enhancement

The applicant's LRA indicates that an annunciator response procedure will be written for the loose parts monitor in the SG, which was identified as an enhancement to the SGP AMP. In RAI B.2.9-1, the staff stated that it was not clear why the SGP was being enhanced to write an annunciator response procedure for the loose parts monitor for the SG, since the LRA states that loose parts monitoring is not credited for aging management. In response to RAI B.2.9-1, the applicant states that it has committed to NEI 97-06, "Steam Generator Program Guidelines," which states, "Licensees should have alarm response procedures for the loose parts monitoring system." Therefore, the applicant credits the annunciator response procedure for NEI 97-06 compliance, not as an AMP. In addition, the applicant stated that they have an annunciator response procedure that complies with the guidance in NEI 97-06. The staff finds the response acceptable and considers this issue closed.

On the basis of the applicant's response to RAI B.2.9-1, the staff concludes that the enhancement to the SGP will adequately address the management of loose parts at FCS to satisfy 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.2.2 Loss of Material Due to Pitting and Crevice Corrosion

As stated in the SRP-LR, loss of material due to pitting and crevice corrosion could occur in the PWR SG shell assembly. The existing program relies on control of chemistry to mitigate corrosion, and ISI to detect loss of material. The extent and schedule of the existing SG inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC IN 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," dated January 26, 1990, if general corrosion pitting of the shell exists, the program may not be sufficient to detect pitting and corrosion. The GALL Report recommends augmented inspection to manage this aging effect. The staff review verifies that the applicant has proposed a program that will manage loss of material due to pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material and ensure that the component intended function will be maintained during the period of extended operation.

In response to RAI 3.1.1-1, the applicant indicated that the pitting and crevice corrosion discussed in IN 90-04 is applicable to Westinghouse Model 44 and Model 51 vertical, recirculating, U-tube SGs with feedwater ring design. FCS has CE SGs. Based on an evaluation from CE, the applicant concluded that the shell-to-cone girth welds at FCS will not be susceptible to cracking that is similar to that identified in IN 90-04.

In addition, in response to RAI B.2.9-2, the applicant indicates that the secondary shell, secondary handholds, secondary head, secondary manway, and transitional cone are visually inspected for loss of material (general, pitting, and crevice corrosion) to ensure pressure boundary integrity. Since these components are made from the same material in the same environment, at least one of these components is “representatively” visually inspected each refueling outage. Scope is expanded based on a discovery of an unexpected change in degradation, where change is based on review of past inspections. Site operating experience indicates relatively little degradation relative to the thickness of these pressure boundaries. Furthermore, site Class Cleanliness Standards (see below) allow only a small amount of degradation before a condition report is required. The CAP provides an acceptable means of review, evaluation, and corrective action. Therefore, the representative visual inspections are considered adequate aging management of these pressure boundaries.

The applicant stated that Class C Cleanliness Standards, required for the secondary side indicate that “Thin uniform rust or magnetite films are acceptable. Scattered areas of rust are permissible provided that the area of rust does not exceed 15 square inches in 1 square foot on corrosion resistant alloys.”

The applicant’s RAI response did not include sufficient detail for the staff to determine whether the proposed inspection will provide reasonable assurance that this aging effect will be adequately managed during the period of extended operation for the following reasons.

- (1) The applicant states that at least one of these components is “representatively” visually inspected each refueling outage. The applicant needed to explain what “representatively” means in this context and the basis for the appropriateness of this level of inspection (i.e., sample size).
- (2) To detect pitting and crevice corrosion, the visual inspection must be performed in accordance with specified requirements (e.g., ASME Code VT-1). The applicant needed to describe the method or technique (including codes and standards) used to perform the visual inspection.
- (3) The applicant needed to specify the acceptance requirements utilized to analyze the condition of the component once a condition report is initiated, thus ensuring that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation.

By letter dated February 20, 2003, the staff issued POI-7(d)(1), requesting the applicant to address these issues. By letter dated March 14, 2003, the applicant responded to POI-7(d)(1) by stating that “representatively” implies that the item inspected bounds items that are not inspected. The manways and handholds are visually inspected each time. Since these components are all low-alloy steel in a deoxygenated treated water environment, and there is no site or industry experience with significant degradation to these components, then the inspection of the internal surfaces of the manways and handholds are representative of the other non-inspected items. A detailed crawl-through of the SG secondary side occurs and allows observation of other internal surfaces as well.

There is no specific industry standard for acceptance criteria established for visual inspections of the secondary side pressure boundary surfaces. The condition of the secondary side SG

components is considered acceptable if the knowledgeable personnel responsible for the performance of the inspections determine that there is no evidence of damage or degradation sufficient to warrant further evaluation or performance of repair/replacement activities. Although inspections are not required to be performed in accordance with ASME VT-1 requirements, inspections are overseen by Quality Control personnel who are VT-1 qualified. OPPD continues to perform these secondary side pressure boundary inspections as presented in OPPD's response to GL 97-06, dated March 25, 1998. In the NRC closeout of that response, dated September 29, 1999, the staff found these inspection practices provided reasonable assurance that the SG internals are in compliance with the current licensing basis. NUREG/CR-6754 concluded that there are no near-term problems nor is there a need for any immediate change in the current SG internals inspections. Furthermore, these same components are inspected for loss of material at the weld locations by ultrasonic testing by the inservice inspection program. Since there is no site or industry experience with significant pressure boundary degradation, OPPD considers these inspections as adequate aging management for the period of extended operation.

The staff has reviewed the applicant's response to POI-7(d)(1) and finds it acceptable because (1) the response clarifies what a representative visual inspection entails and that the scope of the inspections is adequate to represent the population of components of concern, (2) the applicant clarified that there are no specific acceptance criteria used across the industry, for visual inspections of secondary side pressure boundary surfaces and has provided information on the current activities used by FCS to manage aging of these surfaces, including inspector qualifications, and has noted the staff's approval of these activities, and (3) these activities will be continued during the period of extended operation. On this basis, POI-7(d)(1) is resolved.

The staff finds that the applicant has adequately evaluated the management of loss of material due to pitting and crevice corrosion for components in the reactor systems, including the SG shell assembly, as recommended in the GALL Report. Further, on the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation to satisfy 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

#### 3.1.2.3.3.2.3 Loss of Section Thickness Due to Erosion

As stated in the SRP-LR, loss of section thickness due to erosion could occur in SG feedwater impingement plates and supports. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed.

The applicant indicates that the components are not applicable to FCS. This item is further discussed in Section 3.1.2.2.10 of this SER.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of section thickness due to erosion for components in the reactor systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.2.4 Crack Initiation and Growth Due to PWSCC, ODSCC, or Intergranular Attack, or Loss of Material Due to Wastage and Pitting Corrosion, or Loss of Section Thickness Due to Fretting and Wear, or Denting Due to Corrosion of Carbon Steel Tube Support Plate

As stated in the SRP-LR, crack initiation and growth due to PWSCC, ODSCC, or IGA or loss of material due to wastage and pitting corrosion, or deformation due to corrosion, could occur in Alloy 600 components of the SG tubes, repair sleeves and plugs.

All PWR licensees have committed voluntarily to an SG degradation management program described in NEI 97-06, "Steam Generator Program Guidelines." The GALL Report recommends that an AMP based on the recommendations of staff-approved NEI 97-06 guidelines, or some other alternate regulatory basis for SG degradation management, should be developed to ensure that this aging effect is adequately managed.

At present, the staff does not plan to endorse NEI 97-06 or detailed industry guidelines referenced therein. The staff is working with the industry to revise plant technical specifications to incorporate the essential elements of the industry's NEI 97-06 initiative as necessary to ensure tube integrity is maintained. This would require implementation of programs to ensure that performance criteria for tube structural and leakage integrity are maintained, consistent with the plant design and licensing basis. NEI 97-06 provides guidance on programmatic details for accomplishing this objective. These guidelines apply to all degradation or damage mechanisms. However, these programmatic details would be outside the scope of the technical specifications.

As part of the NRC Reactor Oversight Program, the NRC would monitor the effectiveness of these programs in terms of whether the bottom line goals of these programs are being met particularly whether the tube structural and leakage integrity performance criteria are in fact being maintained. The staff reviews the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects for the period of extended operation.

The applicant has proposed to manage by the SG (B.2.9) and the chemistry (B.1.2) programs (1) crack initiation and growth due to PWSCC, ODSCC, or IGA, or (2) loss of material due to wastage and pitting corrosion, (3) loss of section thickness due to fretting and wear, or (4) denting due to corrosion of carbon steel tube support plates in the SG tubes, repair sleeves, and plugs. The staff's review of the SGP (B.2.9) is discussed here. The staff's review of the chemistry program is discussed in Section 3.0.3.2. of this SER. In response to RAI B.2.9-1, the applicant indicated that the SGP is consistent with GALL program XI.19, "Steam Generator Tube Integrity Program," and with guidance contained in NEI 97-06.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of (1) crack initiation and growth due to PWSCC, ODSCC, or IGA, or (2) loss of material due to wastage and pitting corrosion, (3) loss of section thickness due to fretting and wear, or (4) denting due to corrosion of carbon steel tube support plate in the SG tubes, repair sleeves and plugs, as recommended in the GALL Report. On the basis of this finding, and the



finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.2.5 Loss of Section Thickness Due to Flow-Accelerated Corrosion

As stated in the SRP-LR, loss of section thickness due to FAC could occur in tube support lattice bars made of carbon steel. The GALL Report recommends that a plant-specific AMP be evaluated and, on the basis of the guidelines of NRC GL 97-06, an inspection program for SG internals be developed to ensure that this aging effect is adequately managed. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects for the period of extended operation.

Loss of section thickness due to FAC in tube support lattice bars made of carbon steel is managed by the SGP. In response to RAI B.2.9-2, the applicant indicated that tube supports (batwings, eggcrates, and vertical grids) are visually inspected for loss of material due to FAC, general, pitting, crevice, and galvanic corrosion. A portion of the batwings are inspected each refueling outage. In addition, in 1998, a remote video camera was used to video the peripheral eggcrate locations from three drop points, with nearly all eggcrate elevations inspected from each drop point. No degradation of the eggcrate tube supports was noted. Furthermore, eddy current testing (ECT) each refueling outage has not resulted in any indications of missing or severely damaged tube supports in the areas adjacent to the tubes. Because operation has continued for 29 years with insignificant degradation, and all these components are carbon steel in the same environment, visual examination (augmented by ECT) is adequate management of these tube supports for structural function.

The applicant's RAI response did not include sufficient detail for the staff to determine whether the proposed inspection will provide reasonable assurance that this aging effect will be adequately managed during the period of extended operation for the following reasons.

- (1) The applicant indicates that tube supports (batwings, eggcrates, and vertical grids) are visually inspected for loss of material due to FAC, general, pitting, crevice, and galvanic corrosion, and that a portion of the batwings are inspected each refueling outage. It is not clear to the staff exactly what components (batwings, eggcrates and/or vertical grids) are inspected each refueling outage, the inspection method used (i.e., visual and/or ECT) for each sample, the sample size, and the applicant's basis for the inspection population and sample size.
- (2) The applicant did not describe the method or technique (including codes and standards) used for the visual inspection.
- (3) The applicant did not specify the acceptance requirements utilized to analyze the condition of the component based on the inspection results.

By letter dated February 20, 2003, the staff issued POI-7(d)(2), requesting the applicant to address these issues.

By letter dated March 14, 2003, the applicant responded to POI-7(d)(2) by stating that the inspection includes visible tube support structures as seen on a detailed crawlthrough of the SG

secondary side. Visible tube support structures include visible portions of the vertical and diagonal supports protruding from the top of the tube bundle, the periphery of the # 8 tube support plates and small portions of the periphery of the # 7 eggcrate support. Also included are portions of the supports which are visible through the handholes. The results are documented in the inspection procedure and in photographs taken during the inspection with standard and macro-capable photographic equipment.

Further, the applicant explained that there are no specific industry codes and standards for the visual examination of these secondary side internals. Eddy-current testing of the tubes is performed per technical specifications and NEI 97-06 guidance documents.

In addition, the response stated that there is no specific industry standard for acceptance criteria established for visual inspections of the secondary side pressure boundary surfaces. The condition of the secondary side SG components is considered acceptable if the knowledgeable personnel responsible for the performance of the inspections determines that there is no evidence of damage or degradation sufficient to warrant further evaluation or performance of repair/replacement activities. The Combustion Engineering Owners Group (CEOG) Evaluation of Degraded Secondary Internals Operability Assessment, (performed as an industry response to GL 97-06), concluded that even those plants which had experienced degradation of tube supports could continue to operate safely because there was adequate margin against tube damage and the damage could be detected in the normal eddy current examinations. Therefore the detection level is not an issue. Furthermore, the CEOG evaluation concludes that this damage mechanism only occurs when there is fouling sufficient to redistribute the flow to the periphery of the bundle. No steam pressure loss has been noted at FCS which would be apparent if fouling were occurring at a level sufficient to redistribute the flow. These tube support inspections were presented in OPPD's response to GL 97-06, dated March 25, 1998. In the NRC closeout of that response, dated September 29, 1999, the staff found the inspection practices provided reasonable assurance that the SG internals are in compliance with the current licensing basis. Furthermore, since site operating experience has not found flow-accelerated corrosion in the supports, OPPD concludes that these inspections are adequate aging management.

The staff reviewed the applicant's response and finds it acceptable because it addresses the staff's issues with regard to the scope, techniques, and acceptance criteria associated with the management of the subject components with regard to loss of section thickness due to FAC. On the basis of the information provided in the POI response, the staff concludes that loss of section thickness due to FAC in tube support lattice bars made of carbon steel will be adequately managed by the SGP during the period of extended operation. POI-7(d)(2) is resolved.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of section thickness due to FAC for tube supports (batwings, eggcrates, and vertical grids), as recommended in the GALL Report. Further, on the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.3.3.2.6 Ligament Cracking Due to Corrosion

As stated in the SRP-LR, ligament cracking due to corrosion could occur in carbon steel components in the SG tube support plate. All PWR licensees have committed voluntarily to a SG degradation management program described in NEI 97-06. The GALL Report recommends that an AMP based on the recommendations of staff-approved NEI 97-06 guidelines, or some other alternate regulatory basis for SG degradation management, be developed to ensure that this aging effect is adequately managed.

At present, the staff does not plan to endorse NEI 97-06 or detailed industry guidelines referenced therein. The staff is working with the industry to revise plant technical specifications to incorporate the essential elements of the industry's NEI 97-06 initiative as necessary to ensure tube integrity is maintained. This would require implementation of programs to ensure that performance criteria for tube structural and leakage integrity are maintained, consistent with the plant design and licensing basis. NEI 97-06 provides guidance on programmatic details for accomplishing this objective. These guidelines apply to all degradation or damage mechanisms. However, these programmatic details would be outside the scope of the technical specifications.

As part of the NRC Reactor Oversight Program, the NRC would monitor the effectiveness of these programs in terms of whether the bottom line goals of these programs are being met particularly whether the tube structural and leakage integrity performance criteria are being maintained. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

Ligament cracking due to corrosion in the carbon steel SG tube support plates is managed by the SG (B.2.9) and the chemistry (B.1.2) programs. The staff's review of the SGP (B.2.9) is discussed here. The staff's review of the chemistry program is discussed in Section 3.0.3.2 of this SER. In response to RAI B.2.9-2, the applicant indicates that tube supports (batwing, eggcrates, and vertical grids) are visually inspected for loss of material (FAC, general, pitting, crevice, and galvanic corrosion). The applicant does not describe the inspections, sample size, and acceptance criteria implemented to detect the presence of ligament cracking. By letter dated February 20, 2003, the staff issued POI-7(d)(3) requesting the applicant to provide this information.

By letter dated March 14, 2003, the applicant responded to POI-7(d)(3) by stating that cracking was inadvertently left off the list when the revised RAI response was submitted. Information regarding inspection sample size were already provided. There is no industry acceptance criteria related to detecting the presence of ligament cracking on support plates. Although minor cracking has occurred in the upper most tube support plates, this cracking was the result of stresses being relieved after a rim cut modification to allow expansion of the plates. As stated in NUREG/CR-6754, the rim cut modification was a proactive measure to minimize the possibility of denting and delaying the onset of ligament cracking. The CEOG Evaluation of Degraded Secondary Internals Operability Assessment concluded that support plate cracking is not detrimental to the safe operation of the plant and there are no reported tube wear indications directly related to tube support degradation. Therefore, the level of detectability of cracks is not an industry issue. Furthermore, these tube support inspections were presented in OPPD's response to GL 97-06, dated March 25, 1998, and the staff found the inspection practices provided reasonable assurance that the SG internals are in compliance with the

current licensing basis. Therefore, the applicant concludes that management of aging is adequate for this aging mechanism.

The staff reviewed the applicant's response to POI-7(d)(3) and finds it acceptable because the applicant provides the requested information regarding scope, techniques, acceptance criteria, and experience associated with detecting ligament cracking due to corrosion in carbon steel components in the SG tube support plate. On the basis of this POI response, the staff finds that the SGP at FCS will adequately manage ligament cracking in the tube support plate during the period of extended operation. POI-7(d)(3) is resolved.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the ligament cracking due to corrosion for tube supports (batwings, eggcrates, and vertical grids), as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.2.7 Plant-Specific Components from Table 3.1-2 of the LRA

The applicant identified a number of plant-specific components in Table 3.1-2 of the LRA which identified the SGP as the program that manages aging of the components. The staff's evaluation of these components is documented below.

##### 3.1.2.3.3.2.7.1 Nozzles, Nozzle Safe Ends, and Feeding

In response to RAI B.2.9-2, the applicant described the inspection program related to nozzles, nozzle safe ends, and the feeding (i.e., SG feedwater, steam and instrument nozzles, steam and feedwater nozzle safe ends, and the SG feeding). The applicant indicated that the aging effect managed by this program for these components is loss of material due to general, pitting, and crevice corrosion. The feeding additionally has galvanic corrosion as an aging effect. Ultrasonic testing for wall thinning of the feeding in 2002 revealed little or no degradation. The external surface of the feeding is visually inspected each refueling outage for corrosion. Scope is expanded based on a discovery of an unexpected change in degradation, where change is based on review of past inspections. Since the feeding internal and external surfaces are in the same environment, the visual examination of the external surface is considered representative of the internal surface for these aging effects. The nozzles and nozzle safe ends are not inspected, but are bounded by the visual inspection of the carbon steel feeding, which is more susceptible to aging than the low-alloy steel or carbon steel nozzles and nozzle safe ends. Site Class Cleanliness Standards allow only a small amount of degradation before a condition report is required. The CAP provides an acceptable means of review, evaluation, and corrective action. Because the UT revealed little or no degradation in 29 years of operation, and site Class Cleanliness Standards would require corrective action long before the pressure boundary integrity of the nozzles and nozzle safe ends or flow distribution of the feeding are compromised, this visual inspection is adequate aging management.

The applicant's RAI response did not include sufficient detail for the staff to determine whether the proposed inspection will provide reasonable assurance that this aging effect will be

adequately managed during the period of extended operation. (1)The applicant states that the nozzles and nozzle safe ends are not inspected, but are bounded by the visual inspection of the carbon steel feedring, which is more susceptible to aging than the low alloy steel or carbon steel nozzles and nozzle safe ends. The applicant must provide the basis for the statement that the carbon steel feedring is more susceptible to aging than the carbon steel nozzles and nozzle safe ends. (2) The applicant states that the external surface of the feedring is visually inspected each refueling outage for corrosion, but does not indicate the extent of the feedring that is inspected, nor the basis for this extent. (3) The visual inspection must be performed in accordance with specified requirements (e.g., ASME Code VT-1). Describe the method or technique (including codes and standards) used to perform the visual inspection. (4) The applicant needed to specify the acceptance requirements utilized to analyze the condition of the component once a condition report is initiated, which ensures that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation. By letter dated February 20, 2003, the staff issued POI-7(d)(4), requesting the applicant to address these issues.

By letter dated March 14, 2003, the applicant responded to POI-7(d)(4) by stating that the nozzles, nozzle safe ends and feedring are all in the same environment of deoxygenated treated water >200°F. The carbon steel feedring is more susceptible to corroding than low-alloy steel nozzles and nozzle safe ends, and therefore is bounding. Furthermore, the material of the feedring is thinner than the thickness of the nozzles and nozzle safe ends.

The POI response also stated that the visible portions of the feedring inspected include almost the entire feedring, excluding the underside. The basis of this extent is accessibility. In addition, POI-7(d)(1) discusses ASME Code VT-1. There are no codes and standards for performing this visual inspection. Finally, once a condition report is written, the site corrective action program provides the means of review, evaluation, and corrective action. The results of evaluations determine the acceptance criteria and may be based on many variables.

The staff reviewed the applicant's response to POI-7(d)(4) and finds it acceptable because the response (1) provides the basis for using the carbon steel feedring as a bounding component for management of the nozzles and safe ends, (2) provides the extent of the feedring inspection and its basis, (3) clarifies the techniques, used for the inspections, and (4) clarifies the inspection acceptance criteria. On the basis of the information provided in the POI response, the staff finds that the SGP at FCS will adequately manage nozzles, nozzle safe ends, and the feedring during the period of extended operation. POI-7(d)(4) is resolved.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting and crevice corrosion, and galvanic corrosion for the nozzles, nozzle safe ends, and feedring. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.1.2.3.3.2.7.2 Secondary-Side Tubesheet

In response to RAI B.2.9-2, the applicant described the inspection program related to the secondary-side tubesheet as follows. The secondary side tubesheet is visually inspected and supplemented by tube ECT during each refueling outage for loss of material due to general, pitting, and crevice corrosion. A camera is placed on top of the tubesheet and transported along the periphery of the tube bundle and down the blowdown line. In addition, ECT of the tubes would indicate if the adjacent tubesheet was degrading. The CAP provides an acceptable means of review, evaluation, and corrective action. Because the tubesheet is over 22 inches thick and ECT can reflect tubesheet loss, this visual inspection (augmented by ECT) is adequate to maintain the pressure boundary function of the tubesheet.

The applicant's RAI response did not include sufficient detail for the staff to determine whether the proposed inspection will provide reasonable assurance that this aging effect will be adequately managed during the period of extended operation. The applicant did not specify the acceptance criteria (for the visual and ECT) and the basis for the acceptance criteria. By letter dated February 20, 2003, the staff issued POI-7(d)(5) requesting the applicant to address these issues.

By letter dated March 14, 2003, the applicant responded to POI-7(d)(5) by stating that there are no industry acceptance criteria for visual inspections of the tubesheet. Eddy-current testing of the tubes is performed per technical specifications and NEI 97-06 guidance documents. Based on the thickness of the tubesheet and that there is no site or industry experience related to loss of material, OPPD considers this inspection adequate management of the pressure boundary.

The staff reviewed the applicant's response to POI-7(d)(5) and finds it acceptable because it provides clarifying information with regard to the methods and acceptance criteria associated with the inspection of the SG tube sheet. On the basis of the information provided in the POI response, the staff concludes that the SGP will adequately manage the secondary side tubesheet during the period of extended operation. POI-7(d)(5) is resolved.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, and crevice corrosion for the secondary-side tubesheet. Further, on the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.2.7.3 Primary-Side Tubesheet and Primary Head

In response to RAI B.2.9-2, the applicant described the inspection program related to the primary-side tubesheet and primary head as follows. These components are visually inspected for cracking. Portions of the primary-side tubesheet and primary head are inspected using a remote camera each refueling outage. The tubesheet and primary head are thick, so the initiation of a crack, which could grow to be a pressure boundary threat, could easily be detected with the camera. Because the tubesheet and primary head are the same material in the same environment, and there is no operating history of cracks to these components at FCS, this visual inspection is adequate to maintain the pressure boundary function of the tubesheet and primary head.

The applicant's RAI response did not include sufficient detail for the staff to determine whether the proposed inspection will provide reasonable assurance that this aging effect will be adequately managed during the period of extended operation for the following three reasons.

- (1) The applicant did not specify the extent (other than "portions") of the tubesheet and head that are visually inspected, or the basis for this extent.
- (2) The applicant did not describe the method or technique (including codes and standards) used for the visual inspection.
- (3) The applicant did not specify the acceptance requirements, and the basis for these acceptance requirements, used to analyze the condition of the component based on the inspection results.

By letter dated February 20, 2003, the staff issued POI-7(d)(6), requesting the applicant to address these issues.

By letter dated March 14, 2003, the applicant responded to POI-7(d)(6) by stating that the entire primary side tubesheet and internal head are inspected. The methods and technique were described (i.e., visual inspection by remote camera). There are no codes and standards which address this visual inspection.

There are no industry acceptance criteria regarding visual examinations of the primary head and primary side tubesheet. Since industry experience has not indicated cracking to the primary head and primary side tubesheet, and because tight primary water quality standards result in minimal corrosion levels compared to the thickness of these components, OPPD considers the visual inspection of these components as adequate management of cracking.

Overall, considering that the staff found the inspection practices presented in OPPD's response to GL 97-06 provided reasonable assurance that the condition of the SG internals are in compliance with current licensing basis for FCS, and considering that these practices continue at FCS and are conservative with regard to results of the CEOG Evaluation of Degraded Secondary Internals Operability Assessment and site and industry operating experience, OPPD considers that the management of these "added-scope" components is adequate for the period of extended operation.

The staff reviewed the applicant's response to POI-7(d)(6) and finds it acceptable because it addresses the staff's concern regarding (1) the scope of the inspections, (2) the methods and techniques, including associated codes and standards, (3) and inspection acceptance criteria associated with the management of the primary-side tubesheet and primary head. On the basis of the applicant's response, the staff concludes that the SGP will adequately manage the primary-side tubesheet and primary head during the period of extended operation. POI-7(d)(6) is resolved.

The staff reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cracking of the primary-side tubesheet and primary head. Further, on the basis

of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.3.3 Conclusion

On the basis of its review of the information provided by the applicant to address the GALL recommendation, the staff finds that the SGP adequately addresses the additional issues as recommended by GALL. In addition, the staff has reviewed the clarifications and enhancements to the program and finds that the applicant's program, with the clarifications and enhancements, provides for adequate management of aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the SGP will effectively manage aging in the components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.4 Alloy 600 Program

The applicant discusses its program for managing age-related degradation of the FCS Alloy 600 nozzles and their associated Alloy 82/182 weld materials in LRA Section B.3.1, "Alloy 600 Program."

##### 3.1.2.3.4.1 Summary of Technical Information in the Application

The applicant stated that the FCS Alloy 600 program will be consistent with the requirements of GALL program XI.M11, "Nickel-Alloy Nozzles and Penetrations," as identified in The GALL Report prior to the period of extended operation with the following exceptions:

- XI.M11 – Exception to the program description that affects the Scope of Program and Preventative Action program attributes for the AMP. The chemistry-related portions of the program are addressed in the FCS chemistry program.
- XI.M11-4 – Exception to the Detection of Aging Effects program attribute for the AMP. The Alloy 600 Program will not rely on an enhanced leakage detection system for detection of leaks caused by PWSCC as suggested by XI.M11 in The GALL Report. Bounding evaluations exist that demonstrate that PWSCC cracks can be detected via boric acid leakage prior to the structural integrity of the pressure boundary being compromised, and prior to unacceptable material loss of carbon steel vessels due to BAC.

The program includes participation in industry programs to determine an appropriate AMP for PWSCC of Alloy 600 and Inconel 82/182 welds. The scope of the Alloy 600 program includes the specific components identified in LRA Table 3.1-2 for which the Alloy 600 program is identified as an AMP.



#### 3.1.2.3.4.2 Staff Evaluation

The current CLB for the applicant's Alloy 600 program, as it pertains to inspection of the ASME Class 1 nickel-based alloy components other than the vessel head penetration (VHP) nozzles, may be found in the following regulation and ASME requirements:

- 10 CFR 50.55a
- applicable requirements found in ASME Section XI, Subsections IWA and IWB, as invoked by 10 CFR 50.55a

The current CLB for the applicant's Alloy 600 program, as it pertains to inspection of the ASME Class 1 FCS VHP nozzles, may be found in the following regulation, Order, and generic communications:

- 10 CFR 50.55a
- NRC Order EA-03-009, dated February 11, 2003.
- NRC Generic Letter (GL) 97-01, dated April 1, 1997
- NRC Bulletin 2001-01, dated August 3, 2001
- NRC Bulletin 2002-01, dated March 18, 2002
- NRC Bulletin 2002-02, dated August 9, 2002

The issuance of NRC Bulletin 2001-01 is significant because it documents the first reported occurrence of circumferential cracking in the VHP nozzles of a PWR in the United States (i.e., at Oconee Unit 3), and the safety significance related to this orientation of cracking. The NRC's issuance of Bulletins 2002-01 and 2002-02 is significant because the bulletins document how the borated reactor coolant leakage from a VHP nozzle at Davis Besse was significant enough to create a large cavity in the reactor vessel head due to corrosion of the low-alloy steel used to fabricate the reactor vessel head. Each of these bulletins raised issues regarding the ability of current ASME Section XI inspection requirements for PWR VHP nozzles and reactor vessel heads to ensure the structural integrity of the nozzles and heads during plant operation.

By Order EA-03-009, dated February 11, 2003,<sup>1</sup> the staff issued a generic order to modify the operating licenses of all operating PWRs in the United States and to require specific inspections of the VHP nozzles and reactor vessel head of each plant. In the correspondence letter for the Order, the staff stated its need to "establish a clear regulatory framework" for the evaluation and inspection of PWR VHP nozzles until the time when an acceptable augmented regulatory basis for inspection of the VHP nozzles could be incorporated into a revision of 10 CFR 50.55a, "Codes and Standards." The augmented inspection requirements of Order EA-03-009 supplement the applicable inspection method requirements for VHP nozzles found in the Subsections IWA and IWB of Section XI to the ASME Boiler and Pressure Vessel Code and

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1 Letter EA-03-009 from S. J. Collins to Holders of Operating Licenses for Pressurized Water Reactors, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," February 11, 2003. The correspondence letter, along with the augmented requirements in the attached Order, may be accessed on the World Wide Web at the following Web address:

<http://www.nrc.gov/reactors/operating/ops-experience/vessel-head-degradation/vessel-head-degradation-files/order-rpv-inspections.pdf>

will remain in place until acceptable augmented inspection requirements for the nozzles are incorporated into a revision of 10 CFR 50.55a. Order EA-03-009 and the augmented inspection requirements contained in the Order may be accessed at the World Wide Web address given in Footnote 1 or at NRC public reading rooms.

The applicant considers the Alloy 600 program to be consistent with the program attributes of GALL program XI.M11, with the exceptions listed in Section 3.1.2.3.4.1 above. In the first of these exceptions, the applicant stated that the chemistry-related portions of the program are addressed in the FCS chemistry program. This was an exception to the Scope and Preventative Actions program attributes for the Alloy 600 program. This exception implies that the applicant considers that implementation of the chemistry program, as related to controlling the ingress of ionic impurities and dissolved oxygen into the RCS coolant, can prevent or mitigate degradation in the FCS Alloy 600 components and their associated Alloy 182/82 weld materials. The staff has two issues with this exception. The first issue is that the applicant's chemistry program (LRA Section B.1.2) does not provide any indication that the AMP, as implemented consistent with GALL program XI.M2, "Water Chemistry," contains the chemistry-related portions of the Alloy 600 Program. Since this has been identified as an exception to the Scope program attribute for the Alloy 600 program, the staff issued POI-7(e) by letter dated February 20, 2003, requesting the applicant to amend the description of the chemistry program, as provided in Section B.1.2 of Appendix B to the FCS LRA, to state that the scope of the program includes the chemistry-related portions of the FCS Alloy 600 program. By letter dated March 14, 2003, the applicant responded to POI-7(e) by revising the first sentence of LRA Section B.1.2 to read "The FCS Chemistry Program is consistent with XI.M2, 'Water Chemistry', and contains the chemistry related portions of AMP B.3.1, 'Alloy 600 Program.' OPPD is, therefore, consistent with the GALL Report relative to Alloy 600 program chemistry criteria." The staff has reviewed the applicant's response to POI-7(e) and concludes that the applicant's response to POI-7(e) is acceptable because the response corrects and clarifies that FCS AMP B.1.2, "Chemistry Program," contains the water chemistry criteria for the FCS Class 1 nickel-based alloy components. POI-7(e) is resolved.

The second issue with this exception is technical. Although EPRI Report TR-105714, Revision 3, provides guidelines for mitigating PWSCC in nickel-based alloy components, industry experience<sup>2</sup> indicates PWSCC can occur in the Alloy 182/82 welds associated with welded Class 1 Alloy 600 components, even when the ingress of ionic impurities and dissolved oxygen in the reactor coolant has been controlled to concentrations recommended in acceptable industry chemistry guidelines (e.g., EPRI PWR Water Chemistry Guidelines of EPRI Report TR-105714, Revision 3). The staff therefore cannot agree that implementation of the water chemistry program will be capable of preventing the occurrence of PWSCC in the FCS Class 1 Alloy 600 components and their associated Alloy 182/82 weld materials even if the ingress of impurities is controlled to acceptable concentrations. The staff's evaluation of how this issue will impact the applicant's program attributes and implementation of Alloy 600 program is discussed below.

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2 Such events are summarized in NRC Bulletins 2001-01, 2002-01, and 2002-02 for PWSCC occurring in the VHP nozzles in PWRs, and in INs 2000-17 and 2000-17, Supplement 1, for PWSCC occurring in the reactor vessel hot-leg nozzle safe-end weld of the V.C. Summer nuclear plant.

The applicant's second exception to the Alloy 600 program deals with the Detection of Aging Effects program attribute for the AMP. In this exception, the applicant stated that it would not rely on an enhanced leakage detection system for detection of leaks caused by PWSCC, as suggested by GALL program XI.M11. According to the applicant, there are some bounding evaluations in the industry that support the conclusion that PWSCC-induced cracks can be detected via boric acid leakage prior to the structural integrity of the reactor coolant pressure boundary (RCPB) being compromised, and prior to unacceptable material loss of carbon steel vessels due to BAC. The staff does not accept this conclusion because there have been significant age-related degradation events such as those described below that invalidate it.

- The VHP nozzle cracking and leakage events at Oconee Units 1, 2, and 3; Arkansas Nuclear One Unit 1; and Davis Besse (collectively summarized in NRC Bulletins 2001-01, 2002-01, and 2002-02) demonstrate that the RCPB integrity can be violated prior to the performance of a visual examination of the reactor vessel head and in spite of the implementation of adequate RCS coolant chemistry programs.
- The Davis Besse boric acid wastage event of March 2002 (summarized in NRC Bulletins 2002-01 and 2002-02) demonstrates that severe boric acid wastage of PWR reactor vessel heads can occur in spite of the implementation of plant-specific boric acid wastage programs.

The FCS application was submitted prior to issuance of NRC Bulletins 2002-01 and 2002-02. However, the information in the applicant's LRA and the applicant's responses to NRC GL 97-01, and NRC Bulletins 2001-01, 2002-01, and 2002-02 indicates that the applicant is an active participant in the NEI program for monitoring and controlling PWSCC in VHP nozzles. The current program, as described and updated in the applicant's responses to Bulletins 2001-01, 2002-01, and 2002-02, indicate that the applicant has responded to the issues and action requests raised in the bulletins.

During its initial review of the Alloy 600 program, the staff was aware that the issue of PWSCC-induced degradation of Class 1 nickel-based alloy components may not be resolved prior to issuance of the renewed operating license for FCS and, therefore, the inspection methods proposed for the FCS Alloy 600 program in the LRA may not be acceptable during the period of extended operation for FCS. Therefore, the staff requested from the applicant a commitment to implement any actions, as part of the Alloy 600 program, that are agreed upon between the NRC and the nuclear power industry for the inspection, detection, evaluation (including the establishment of acceptance criteria for the VHP nozzle inspection techniques), and resolution of cracking that may occur in the VHP nozzles of PWRs in the United States, and specifically as the actions relate to the structural integrity of VHP nozzles in the FCS upper reactor vessel head during the period of extended operation. This request was designated as RAI B.3.1-1, Part 1, and issued by letter dated October 11, 2002.

By letter dated December 19, 2002, the applicant provided the following response to RAI B.3.1-1, Part 1:

The FCS Alloy 600 Program currently includes a requirement to monitor industry operating experience and implement program enhancements as necessary. This issue of cracking of Alloy 600 and Alloy 82/182 material is being addressed as a current licensing basis issue.

The applicant's response to RAI B.3.1-1, Part 1, did not provide the type of commitment the staff was requesting to resolve the issues related to the Davis Besse operating experience addressed in NRC Bulletins 2002-01 and 2002-02. The staff's review of the applicant's Alloy 600 program, as well as the applicant's responses to NRC Bulletins 2001-01 and 2002-02, indicate that OPPD is relying highly on its BAC prevention program as the basis for managing PWSCC in the FCS VHP nozzles. Although the staff does concur that the issue of PWSCC in the VHP nozzles of domestic PWRs is a current licensing term issue that is outside of the scope of license renewal pursuant to 10 CFR 54.30, the program attributes for the Alloy 600 program, as they pertain to the evaluation and inspection of the FCS VHP nozzles and reactor vessel head, are not in compliance with the interim augmented evaluation and inspection requirements in NRC Order EA-03-009, dated February 11, 2003. By letter dated February 20, 2003, the staff issued POI-7(f) requesting the applicant to resolve this issue. By letter dated March 14, 2003, the applicant responded to POI-7(f), stating that it is committed to incorporating industry recommendations or mandates as applicable. Specifically, the applicant commits to implement those recommended inspection methods, inspection frequencies, and acceptance criteria resulting from industry initiatives (by the CEOG or the Material Reliability Program Integrated Task Group on nickel-based alloys) that are acceptable to the NRC for managing SCC (including PWSCC) in Class 1 nickel-based alloy components (including Class 1 components fabricated from Alloy 600 base metals and Alloy 182/82 filler materials). The applicant will implement any additional requirements that may result from the staff's resolution of the industry's responses to NRC bulletins or from orders on nickel-based alloy Class 1 components.

The staff reviewed the applicants response to POI-7(f). The staff concludes that the applicant's response to POI-7(f) is acceptable because the applicant will implement any new requirements on Class 1 nickel-based alloy components and because the applicant is committed to implementing any recommended industry initiatives on Class 1 nickel-based alloy components that may be developed in the future and that are found acceptable by the NRC. The applicant's commitment is documented in Appendix A to this SER. POI-7(f) is resolved.

NRC Bulletins 2001-01, 2002-01, and 2002-02 are specific to cracking that has occurred in the reactor vessel heads of domestic PWRs, and do not address the issue of PWSCC that may occur in other Class 1 base metal or weld components fabricated from nickel-based alloys. Therefore, the staff requested additional information regarding how the applicant is addressing the potential for the Alloy 600 and Alloy 82/182 locations in the FCS pressurizer, SGs, and RCS hot-leg piping to develop PWSCC, and what steps the applicant will take to ensure the integrity of these components during the period of extended operation. This request was designated as RAI B.3.1-1, Part 2.

RAI B.3.1-1, Part 2, was requested to resolve a question on how the Alloy 600 program was addressing cracking experience that could occur in Class 1 nickel-based alloy locations other than the FCS VHP nozzles. In relation to the Operating Experience program attribute in GALL program X1M.11, PWSCC has been reported in Alloy 182/82 J-groove welds that are used to join Alloy 600 small-bore nozzles to CE-designed pressurizers, SGs, and/or hot legs.<sup>3</sup> During

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3 These occurrences have been reported as part of relief requests for implementing mechanical nozzle seal assembly repairs or half nozzle replacements for leaking Alloy 600 nozzles to Alloy 600 nozzles of CE-designed pressurizers, steam generators, or hot-leg piping, or through docketed correspondence to the

V.C. Summer refueling outage 12 (October 2000), a through-wall crack was identified in the reactor vessel hot leg piping weld. NRC INs 2000-17 and 2000-17, Supplement 1, dated October 18, 2000, and November 16, 2000, respectively, provide details of the V.C. Summer reactor vessel hot-leg nozzle weld cracking event.

By letter dated December 19, 2002, the applicant provided its response to RAI B.3.1-1, Part 2. In its response, the applicant clarified which Class 1 components were welded with Alloy 182/82 filler metals, discussed its technical basis for concluding that the V.C. Summer cracking issue was not germane to the corresponding reactor vessel hot-leg nozzle safe-end weld at FCS, and reaffirmed that the applicant was a participant in the industry's initiatives on nickel-based alloy components.

The applicant's response to RAI B.3.1-1, Part 2, provides the locations of the remaining Alloy 600 components in the Class 1 portions of the RCS. With regard to the PWSCC-related operating experience that was detected in the reactor vessel hot-leg safe-end nozzle weld of the V.C. Summer plant, the applicant's response to RAI B.3.1-1, Part 2, also provided an assessment of why the applicant does not consider PWSCC to be an issue for the corresponding Alloy 182/82 safe-end welds at FCS. Based on the significant amount of industry experience to date, the staff considers all Class 1 Alloy 600 components and Alloy 182/82 filler materials to be susceptible to PWSCC. The applicant's response to RAI B.3.1-1, Part 2, indicated that the applicant would closely monitor the industry's initiatives and studies on cracking of Alloy 600 and Alloy 182/82 materials, and that the applicant would evaluate the need to implement any recommendations for inspection methods, inspection frequencies, and acceptance criteria that result from these initiatives. However, the response to the RAI did not provide any indication that the applicant is committed to implementing any recommended inspection methods, inspection frequencies, and acceptance criteria that will result from the industry's initiatives. By letter dated February 20, 2003, the staff issued POI-7(f) requesting the applicant to resolve this issue.

By letter dated March 14, 2003, the applicant responded to POI-7(f), stating that it is committed to incorporating industry recommendations or mandates as applicable. Specifically, the applicant plans to implement recommended inspection methods, inspection frequencies, and acceptance criteria resulting from industry initiatives (by the CEOG or the MRP Integrated Task Group on nickel-based alloys) that are acceptable to NRC for managing SCC (including PWSCC) in Class 1 nickel-based alloy components (including Class 1 components fabricated from Alloy 600 base metals and Alloy 182/82 filler materials). The applicant also will implement any additional requirements that may result from the staff's resolution of the industry's responses to NRC bulletins and orders. The staff reviewed the applicant's response to POI-7(f) and finds the response acceptable. The applicant's commitment is documented in Appendix A to this SER. POI-7(f) is resolved.

#### 3.1.2.3.4.3 USAR Supplement

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NRC Document Control Desk. Licensees that have reported leakage in the Alloy 600 nozzles of CE-designed facilities have included Southern California Edison (the licensee for San Onofre), Entergy Operations, Inc. (the licensee for Waterford and ANO-2), Omaha Public Power District (the applicant for FCS), Arizona Public Service (the licensee for Palo Verde), and Florida Power and Light (the licensee for St. Lucie).

The applicant's USAR Supplement for the Alloy 600 program is documented in Section A.2.1 of Appendix A to the LRA and provides an overview of the program as described in Section B.3.1 of Appendix B to the LRA. The CLB description for the Alloy 600 program, as reflected in Section A.2.1 of the USAR Supplement, is only reflective of the applicant's responses to GL 97-01, and not NRC Order EA-03-009 (February 11, 2003), as well as the applicant's responses to NRC Bulletin 2001-01, 2002-01, and 2002-02. In RAI B.3.1-1, Part 3, the staff requested that OPPD incorporate its responses to RAI B.3.1-1, Parts 2 and 3 into the next revision to the USAR Supplement description for the Alloy 600 program because the staff anticipated that the responses to the RAIs would provide clarifying content as to how the AMP would be sufficient to manage cracking in ASME Code Class 1 components made from Alloy 600 or Alloy 182/82 materials (i.e., Inconel alloy materials).

By letter dated December 19, 2002, the applicant provided the following response to RAI B.3.1-1, Part 3:

The level of detail provided in response to Part 2 of this RAI is not consistent with the level of detail provided in the FCS USAR and will not be included in the USAR Supplements. OPPD will incorporate appropriate information from the OPPD responses to GL 97-01 and NRC Bulletins 2001-01, 2002-01, and 2002-02.

The staff's acceptance of the FCS Alloy 600 program is dependent upon a satisfactory description of the Alloy 600 program, that reflects final industry recommendations. Because the current USAR Supplement does not describe the applicant's final program that reflects its commitment to implement the recommendations resulting from industry initiatives, the staff has documented in Appendix A of this SER, the applicant's commitment to submit the AMPs and associated USAR Supplements, prior to the period of extended operation.

#### 3.1.2.3.4.4 Conclusion

On the basis of its review of the applicant's program, the information provided in the applicant's responses to NRC Bulletins 2001-01, 2002-01, and 2002-02, and the commitments discussed above, the staff finds that those portions of the program for which the applicant claims consistency with GALL will be consistent with GALL. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant's program will provide adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that, pending implementation of the applicant's commitments discussed above, the USAR Supplement will provide an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that, pending satisfactory implementation of the commitments discussed above, the applicant has demonstrated that the Alloy 600 program will effectively manage aging in the components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.3.5 Thermal Embrittlement of Cast Austenitic Stainless Steel Program

##### 3.1.2.3.5.1 Summary of Technical Information in the Application

The applicant's thermal embrittlement of cast austenitic stainless steel (CASS) program is discussed in LRA Section B.3.7, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel." The applicant states that the program is consistent with GALL program XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)," as identified in The GALL Report. This AMP is credited with managing crack initiation and growth due to SCC and loss of fracture toughness due to thermal aging embrittlement in CASS piping.

#### 3.1.2.3.5.2 Staff Evaluation

In LRA Section B.3.7, the applicant described its AMP to manage aging in CASS piping. The LRA stated that this AMP is consistent with GALL AMP XI.M12 with no deviations. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

The applicant's operating experience shows no age-related degradation associated with thermal embrittlement of CASS.

The applicant provided its USAR Supplement for the thermal embrittlement of CASS program in Section A.2.24 of the LRA. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d).

#### 3.1.2.3.5.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the thermal aging embrittlement of CASS program will effectively manage aging in the structures and components for which this program is credited so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.1.2.4 Aging Management Review of Plant-Specific Reactor System Components

The following sections provide the results of the staff's evaluation of the adequacy of aging management for components in each of the reactor systems and an evaluation of components that are not in GALL.

##### 3.1.2.4.1 Reactor Vessel Internals

###### 3.1.2.4.1.1 Summary of Technical Information in the Application

The description of the reactor vessel internals can be found in Section 2.3.1.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA

Table 2.3.1.1-1. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1, 3.1-2, and 3.1-3.

#### Aging Effects

The LRA identified the following applicable aging effects for the reactor vessel internals:

- change in dimension due to void swelling
- loss of fracture toughness due to thermal and neutron embrittlement
- cracking
- loss of preload
- fatigue

#### Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the reactor vessel internals:

- Chemistry Program (B.1.2)
- Inservice Inspection Program (B.1.6)
- Fatigue Monitoring Program (B.2.4)
- Reactor Vessel Internals Inspection Program (B.2.8)
- Alloy 600 Program (B.3.1)

The applicant concluded that these AMPs will manage the effects of aging such that the intended function of the reactor vessel internals will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3). The applicant identified fatigue as a TLAA in Section 3.1.1 of the LRA that is applicable to reactor vessel internals. This TLAA is described in Section 4.3 of the LRA and is discussed in Section 4.3 of this SER.

#### 3.1.2.4.1.2 Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in reactor vessel internals. The staff also reviewed the applicable USAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

#### Aging Effects

In accordance with Section 3.1 of the LRA, the applicant has performed a review of industry experience and NRC generic communications relative to the reactor vessel internals components to provide reasonable assurance that the AERMs for a specific material-environment combination are the only aging effects of concern for FCS.

The LRA identified the following applicable aging effects for the reactor vessel internals:

- change in dimension due to void swelling
- loss of fracture toughness due to thermal and neutron embrittlement



- cracking
- loss of preload
- fatigue

The passive, long-lived components in the reactor vessel internals that are subject to an AMR are identified in LRA Tables 3.1-1, 3.1-2, and 3.1-3. LRA Table 3.1-1 includes components which were evaluated in the GALL Report. Components that the applicant indicates are consistent with GALL need no additional evaluation because GALL components and programs that are identified in GALL and require no further evaluation, are acceptable to the staff. Components that require further evaluation are discussed in SER Section 3.1.2.2. The materials and environments for these components are identified in GALL.

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing the aging effects. The staff has reviewed the information in this table and finds that the applicant has identified the applicable aging effects.

LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component material, environment, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and concludes that the applicant has identified the applicable aging effects.

On the basis of its review, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with reactor vessel internals.

#### Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the reactor vessel internals.

- Chemistry Program - SER Section 3.0.3.2
- Inservice Inspection Program - SER Section 3.0.3.5
- Fatigue Monitoring Program - SER Section 3.0.3.8
- Reactor Vessel Internals Inspection Program - SER Section 3.1.2.3.2
- Alloy 600 Program - SER Section 3.1.2.3.4

As discussed above, components that the applicant indicates are consistent with GALL need no additional evaluation because GALL components and programs that are identified in GALL and require no further evaluation, are acceptable to the staff.

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing the aging effect. The staff has reviewed the information in this table and finds that the applicant has identified appropriate AMPs to manage the aging effects identified in LRA Table 3.1-2.

LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component material, environment, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and

concludes that the applicant has identified appropriate AMPs to manage aging effects identified in LRA Table 3.1-3.

LRA Table 3.1-3, row 03, "Bolt-Thermal Shield," credits the ISI program for managing loss of preload in the thermal shield bolts. As stated in the justification column of 3.1.3.03, the basis for crediting ISI is that the material, environment, and aging effects are the same as for components evaluated in Volume 2, IV.B3.4-h, of the GALL Report. This section of the GALL Report states that GALL programs XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and XI.M14, "Loose Part Monitoring," are credited with managing aging in the components similar to the thermal shield bolts. On page B-3 of the LRA, the applicant states that a loose parts monitoring program is not credited for license renewal at FCS. Instead, the RVII program (B.2.8) is credited with managing aging. In RAI 3.1.3-1, the staff requested the applicant to identify plant-specific experience with respect to cracking and loss of preload of thermal shield bolting.

In response to RAI 3.1.3-1, the applicant committed to continue its augmented inspection of the thermal shield bolting or pins within the RVII program. The thermal shield monitoring program generated data from 1988 through 1990 that indicated the early stages of loosening of the thermal sleeve positioning pins. During the 1992 refueling outage, visual inspection of the support lugs and the positioning pins was performed. An analysis of the preload of 11 of the 16 lower positioning pins was also performed. Based on the measurements and an analytical evaluation of preload, seven lower and four upper pins were replaced. This action reduced vibrations back to normal levels.

No abnormal vibration has been detected since 1992, and the applicant continues to monitor thermal shield vibrations as a task within the RVII program. Based on success of the thermal shield monitoring program in detecting loss of preload, and the commitment to incorporate this program in the RVII program, the staff agrees that a loose parts monitoring for thermal shield bolting is not necessary and the RVII program will be adequate for detecting aging effects for the thermal shield bolting or pins. The USAR Supplement for the RVII program (A2.2.20) does not identify that the thermal shield monitoring program is included within the RVII program and the applicant's commitment to continue this program through the license renewal period. By letter dated February 20, 2003, the staff issued POI-8(c) requesting the applicant to revise the USAR Supplement to identify that the thermal shield monitoring program is included in the RVII program. By letter dated March 14, the applicant revised the USAR Supplement to clarify that periodic monitoring of vessel internals vibration is included in the RVII program. This resolves POI-8(c).

LRA Table 3.1-2, rows 3.1.2.08 and 3.1.2.11, indicate that void swelling and reduction in fracture toughness of the reactor vessel internals flow skirt are managed by the RVII program; row 3.1.2.09 indicates that cracking of the reactor vessel internals flow skirt is managed by the Alloy 600 program. In response to RAI 3.1.2-3, the applicant indicates that the way in which the flow skirt is to be managed under the Alloy 600 program is yet to be determined; however, that determination will be made before entry into the period of extended operation. On the basis of the applicant's commitment to provide a program for managing the aging effects associated with the reactor vessel internals flow skirt before entry into the period of extended operation, the staff considers this issue resolved.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with reactor vessel internals. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable.

#### 3.1.2.4.1.3 Conclusions

On the basis of its review, the staff concludes that, pending satisfactory implementation of the commitment discussed above, the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the reactor vessel internals such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program description and concludes that it provides an adequate program description of the AMPs credited for managing aging in the reactor vessel internals, as required by 10 CFR 54.21(d).

#### 3.1.2.4.2 Reactor Coolant System

##### 3.1.2.4.2.1 Summary of Technical Information in the Application

The description of the RCS can be found in Section 2.3.1.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.1.2-1. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1, 3.1-2, and 3.1-3.

#### Aging Effects

The LRA identified the following applicable aging effects for the RCS:

- loss of material
- loss of fracture toughness due to thermal embrittlement
- cracking
- loss of preload
- fatigue

#### Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the RCS:

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Flow-Accelerated Corrosion Program (B.1.5)
- Inservice Inspection Program (B.1.6)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.3)
- Steam Generator Program (B.2.9)
- Alloy 600 Program (B.3.1)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)

- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program (B.3.7)

The applicant concluded that these AMPs will manage the effects of aging such that the intended function of the RCS will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3). The applicant identified fatigue as a TLAA in Section 3.1.1 of the LRA that is applicable to the RCS. This TLAA is described in Section 4.3 of the LRA and is discussed in Section 4.3 of this SER.

#### 3.1.2.4.2.2 Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing them, in the RCS. The staff also reviewed the applicable USAR Supplements to ensure that the program descriptions adequately describe the AMPs.

#### Aging Effects

In accordance with Section 3.1 of the LRA, the applicant has performed a review of industry experience and NRC generic communications relative to the RCS components to provide reasonable assurance that the AERMs for a specific material-environment combination are the only aging effects of concern for FCS.

The LRA identified the following applicable aging effects for the RCS:

- loss of material
- loss of fracture toughness due to thermal embrittlement
- cracking
- loss of preload
- fatigue

The passive, long-lived components in the RCS that are subject to an AMR are identified in LRA Tables 3.1-1, 3.1-2, and 3.1-3. LRA Table 3.1-1 includes components which were evaluated in the GALL Report. Components that the applicant indicates are consistent with GALL need no additional evaluation because GALL components and programs that are identified in GALL, and require no further evaluation, are acceptable to the staff. Components that require further evaluation are discussed in SER Section 3.1.2.2. The materials and environment for these components are identified in GALL.

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing the aging effect. The staff has reviewed the information in this table and finds that the applicant has identified the applicable aging effects.

LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component materials, environments, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and concludes that the applicant has identified the applicable aging effects.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the RCS.

### Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the RCS:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Flow-Accelerated Corrosion Program - SER Section 3.0.3.4
- Inservice Inspection Program - SER Section 3.0.3.5
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- One-Time Inspection Program - SER Section 3.0.3.13
- Steam Generator Program - SER Section 3.1.2.3.3
- Alloy 600 Program - SER Section 3.1.2.3.4
- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program - SER Section 3.1.2.3.5

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing the aging effects. The staff has reviewed the information in this table and finds that the applicant has identified appropriate AMPs to manage the aging effects identified in LRA Table 3.1-2.

LRA Table 3.1-2, rows 3.1.2.04 and 3.1.2.05, indicate that the SG lower head, manway cladding, primary side tubesheet and reactor coolant pump (RCP) thermal barrier are subject to cracking and the AMP is the chemistry program. The chemistry program will, to some extent, mitigate cracking but will not monitor cracking. In RAI 3.1.2-1, the staff requested that the applicant provide its basis for concluding that monitoring of crack initiation and growth is not necessary for these components. The applicant's program for managing the aging effects for the SG lower head, manway cladding, and primary side tubesheet is discussed in SER Section 3.1.2.3.3.

In response to RAI 3.1.2-1, the applicant indicated that the RCP thermal barriers are not accessible for routine maintenance or inspection. During the 2001 refueling outage, the "A" RCP rotating assembly was replaced with a new rotating assembly and the existing assembly was sent to a vendor for refurbishment. As part of the refurbishment, the thermal barrier on the "A" RCP was visually inspected and a dye-penetrant examination was performed. No indications of cracks were identified. A visual inspection was performed on the "C" RCP after it was removed for refurbishment during the 2002 refueling outage. No indication of degradation was identified. The applicant indicates that it will continue to visually inspect and perform a dye-penetrant exam on the two remaining RCP thermal barriers when the rotating assemblies are refurbished. This was confirmed in the response to POI-8(d), which was issued by the staff on February 20, 2003. Based on the operating and inspection results to date on the RCP thermal barriers, the applicant does not believe that periodic ISI of the RCP thermal barriers is necessary. However, the applicant has agreed to include the RCP thermal barriers within its one-time inspection program. Since cracking has not been observed in all the inspections

performed to date, the staff agrees that periodic ISI of the RCP thermal barriers is not necessary and that the one-time inspection program will be an acceptable program to determine whether this cracking is a significant aging effect for the RCP thermal barriers.

Components in Item 3.1.2.02 (pressurizer heater sleeves, etc.) are subject to loss of material due to crevice corrosion. These components are made from nickel-based alloys, including Alloy 600, in a borated treated water environment. This aging effect is managed by the chemistry program. The chemistry program will, to some extent, mitigate crevice corrosion but will not monitor it. To monitor whether crevice corrosion is occurring in the components listed in Item 3.1.2.02, the staff issued RAI 3.1.2-5 by letter dated October 11, 2002, requesting the applicant to identify an inspection program for these components that will monitor whether crevice corrosion is occurring.

In response to RAI 3.1.2-5, the applicant indicated that they conservatively included loss of material as an aging effect for Alloy 600 in borated treated water. This aging effect is not identified in the GALL Report for this same material and environment. To validate the effectiveness of the chemistry program, the applicant proposes to determine the worst-case location for the potential occurrence of this aging effect and perform a one-time inspection of this location prior to the period of extended operation.

GALL AMP XI.M32 indicates the one-time inspection is to be utilized when an aging effect is not expected to occur, but insufficient data exist to completely rule it out, or when an aging effect is expected to progress very slowly. The one-time inspection provides additional assurance that aging is either not occurring or the evidence of aging is so insignificant that aging management is not warranted. In order to determine whether loss of material resulting from crevice corrosion in the presence of sufficient levels of oxygen, halogens, sulfates, or copper is not expected to occur, the applicant must review its inspection records to determine whether this aging effect has previously occurred at FCS for the components listed in Item 3.1.2.02. If it has not occurred, the proposed program is acceptable. If a component has experienced this aging effect in the past, the applicant should identify when it occurred, the corrective action, and the reason for not expecting it to occur in the future. If this aging effect is expected to occur in the future, periodic examination is necessary. By letter dated March 14, 2003, as part of its response to POI-8(d), the applicant indicated that there has been no operating experience at FCS relative to crevice corrosion of nickel-based alloys. It is generally considered not to be a credible aging mechanism for these alloys.

Since loss of material resulting from crevice corrosion is not expected to occur and there has not been any evidence of this aging effect at FCS, a one-time inspection program for components in LRA Table Item 3.1.2.02 is acceptable. This resolves this portion of POI-8(d). Additional discussion of programs for nickel-based alloys can be found in Section 3.1.2.3.4.2 of this SER.

LRA Table 3.1-2, row 3.1.2.16, indicates cracking of pressurizer instrument nozzle inserts are managed by the chemistry and the ISI programs. This aging effect for the pressurizer instrument nozzle inserts is also addressed in license renewal Table 3.1-1, row 3.1.1.11. This item indicates that the aging effect will be managed by the Alloy 600 program. In response to RAI 3.1.2-4, the applicant indicates that the details of this program are still in development, but will be completed prior to the period of extended operation. On the basis of the applicant's commitment to provide a program for managing the aging effects associated with the

pressurizer instrument nozzle inserts before entry into the period of extended operation, the staff considers this issue resolved.

LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component material, environment, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and concludes that the applicant has identified appropriate AMPs to manage the aging effects identified in LRA Table 3.1-3.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the RCS. In addition, the staff reviewed the associated program descriptions in the USAR Supplement and found them acceptable.

#### 3.1.2.4.2.3 Conclusion

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the RCS such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program descriptions and concludes that they provide an adequate program description of the AMPs credited for managing aging in the RCS, as required by 10 CFR 54.21(d)

#### 3.1.2.4.3 Reactor Vessel

##### 3.1.2.4.3.1 Summary of Technical Information in the Application

The description of the reactor vessel can be found in Section 2.3.1.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.1.3-1. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1, 3.1-2, and 3.1-3.

#### Aging Effects

The LRA identified the following applicable aging effects for the reactor vessel:

- loss of fracture toughness due to neutron irradiation embrittlement
- cracking
- loss of preload
- fatigue
- loss of material

#### Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the reactor vessel:

- Bolting Integrity Program (B.1.1)

- Chemistry Program (B.1.2)
- Inservice Inspection Program (B.1.6)
- Reactor Vessel Integrity Program (B.1.7)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Alloy 600 Program (B.3.1)
- One-Time Inspection Program (B.3.5)

The applicant concluded that these AMPs will manage the effects of aging such that the intended function of the reactor vessel will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3). The applicant identified fatigue and neutron irradiation embrittlement as TLAA's in Section 3.1.1 of the LRA that are applicable to the reactor vessel. The fatigue TLAA is described in Section 4.3 of the LRA and is discussed in Section 4.3 of this SER. The neutron irradiation embrittlement TLAA is described in Section 4.2 of the LRA and is discussed in Section 4.2 of this SER.

#### 3.1.2.4.3.2 Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the reactor vessel. The staff also reviewed the applicable USAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

#### Aging Effects

The applicant has performed a review of industry experience and NRC generic communications relative to the reactor vessel components to provide reasonable assurance that the AERMs for a specific material-environment combination are the only aging effects of concern for FCS.

The LRA identified the following applicable aging effects for the reactor vessel:

- loss of fracture toughness due to neutron irradiation embrittlement
- cracking
- loss of preload
- fatigue
- loss of material

The passive, long-lived components in the reactor vessel that are subject to an AMR are identified in LRA Tables 3.1-1, 3.1-2, and 3.1-3. LRA Table 3.1-1 includes components which were evaluated in the GALL Report. Components that the applicant indicates are consistent with GALL need no additional evaluation because GALL components and programs that are identified in GALL, and require no further evaluation, are acceptable to the staff. Components that require further evaluation are discussed in SER Section 3.1.2.2. The materials and environment for these components are identified in GALL.

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing the aging effects. The staff has reviewed the information in this table and finds that the applicant has identified the applicable aging effects.



LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component materials, environments, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and concludes that the applicant has identified the applicable aging effects.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the reactor vessel.

#### Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the reactor vessel:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Inservice Inspection Program - SER Section 3.0.3.5
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- One-Time Inspection Program - SER Section 3.0.3.13
- Reactor Vessel Integrity Program - SER Section 3.1.2.3.1
- Alloy 600 Program - SER Section 3.1.2.3.4

LRA Table 3.1-2 includes components which were not evaluated in GALL. The table identifies the aging effects, materials, environments, and programs proposed for managing them. The staff has reviewed the information in this table and finds that the applicant has identified appropriate AMPs to manage the aging effects identified in LRA Table 3.1-2.

LRA Table 3.1-3 includes components which were not evaluated in GALL, but that the applicant has determined that the component materials, environments, and aging effects can be adequately managed using AMPs evaluated in the GALL Report. The staff has reviewed this table and concludes that the applicant has identified appropriate AMPs to manage aging effects identified in LRA Table 3.1-3.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the reactor vessel. In addition, the staff reviewed the associated program descriptions in the USAR Supplement and found them acceptable.

#### 3.1.2.4.3.3 Conclusion

On the basis of its review, the staff concludes that the applicant has identified the aging effects, and the AMPs credited for managing the aging effects, for the reactor vessel, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program descriptions and concludes that they provide an adequate program description of the AMPs credited for managing aging in the reactor vessel, as required by 10 CFR 54.21(d).

### 3.1.3 Evaluation Findings

The staff has reviewed the information in Section 3.1 of the LRA. On the basis of its review, the staff concludes that, pending satisfactory implementation of the commitments discussed above, the applicant has demonstrated that the aging effects associated with the components of the reactor systems will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). In addition, the staff also concludes that, pending satisfactory implementation of the commitments discussed above, the USAR Supplements for FCS provide an acceptable description of the programs and activities for managing the effects of aging of the components of the reactor systems for the period of extended operation, as required by 10 CFR 54.21(d).

### 3.2 Engineered Safety Features Systems

This section addresses the aging management of the components of the ESF systems group. The systems that make up the ESF systems group are described in the following SER Sections:

- Safety Injection and Containment Spray (2.3.2.1)
- Containment Penetration and System Interface Components for Non-CQE Systems (2.3.2.2)

As discussed in Section 3.0.1 of this SER, the components in each of these ESF systems are included in one of three LRA tables. LRA Table 3.2-1 consists of ESF system components that are evaluated in the GALL Report, LRA Table 3.2-2 consists of ESF system components that are not evaluated in the GALL Report, and LRA Table 3.2-3 consists of ESF system components that are not evaluated in the GALL Report, but that the applicant has determined can be managed using a GALL AMR and associated AMP.

#### 3.2.1 Summary of Technical Information in the Application

In LRA Section 3.2, the applicant described its AMRs for the ESF systems group at FCS. The description of the systems that comprise the ESF systems group can be found in LRA Section 2.3.2. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.2.1-1 and 2.3.2.2-1. The applicant's AMRs include an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management based on FCS operating experience were consistent with the aging effects identified in GALL. The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL. The applicant's ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

#### 3.2.2 Staff Evaluation

In Section 3.2 of the LRA, the applicant described its AMR for the ESF systems. The staff reviewed LRA Section 3.2 to determine whether the applicant has provided sufficient

information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the ESF system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of ESF system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the USAR Supplement to ensure that it provided an adequate description of the programs credited with managing aging for the ESF system components.

Table 3.2-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.2 that are addressed in the GALL Report.

Table 3.2-1

Staff Evaluation for FCS Engineered Safety Features System Components in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation (See Section 3.2.2.2.1 below)
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to general corrosion	Water chemistry and one-time inspection	N/A	BWR
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant-specific	Chemistry Program One-Time Inspection Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.2.2.2.2 below)
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	N/A	BWR

Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to pitting and crevice corrosion	Plant-specific	Chemistry program One-time inspection program	Consistent with GALL. GALL recommends further evaluation (See Section 3.2.2.2.3 below)
Containment isolation valves and associated piping	Loss of material due to microbiologically influenced corrosion	Plant-specific	None	Not applicable to FCS. FCS containment isolation valves and associated piping are not exposed to environments susceptible to MIC (See 3.2.2.2.4 below)
Seals in standby gas treatment system	Changes in properties due to elastomer degradation	Plant-specific	N/A	BWR
High pressure safety injection (charging) pump miniflow orifice	Loss of material due to erosion	Plant-specific	None	Not applicable to FCS (See 3.2.2.2.5 below)
External surface of carbon steel components	Loss of material due to general corrosion	Plant-specific	General corrosion of external surfaces program	Consistent with GALL. GALL recommends further evaluation (see Section 3.2.2.2.6 below)
Drywell and suppression chamber spray system nozzles and flow orifices	Plugging of nozzles and flow orifices due to general corrosion	Plant-specific	N/A	BWR
Piping and fittings of CASS in emergency core cooling system	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement CASS	None	Not applicable to FCS. CASS piping and fittings are not used in the ESF systems at FCS
Components serviced by open-cycle cooling system	Local loss of material due to corrosion and/or buildup of deposit due to biofouling	Open-cycle cooling water system	None	Not applicable. The FCS ESF components are not serviced by open-cycle cooling system
Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system	Closed-cycle cooling water system	Consistent with GALL (See Section 3.2.2.1 below)
Emergency core cooling system valves and lines to and from HPCI and RCIC pump turbines	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	N/A	BWR
Pumps, valves, piping, and fittings in containment spray and emergency core cooling systems	Crack initiation and growth due to SCC	Water chemistry	Water chemistry	Consistent with GALL (See Section 3.2.2.1 below)

Pumps, valves, piping, and fittings in emergency core cooling systems	Crack initiation and growth due to SCC and IGSCC	Water chemistry and BWR stress corrosion cracking	N/A	BWR
Carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric acid corrosion	Consistent with GALL (See Section 3.2.2.1 below)
Closure bolting in high pressure or high temperature systems	Loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC	Bolting integrity	Bolting integrity	Consistent with GALL (See Section 3.2.2.1 below)

The staff's review of the ESF systems for the FCS LRA is contained within four sections of this SER. Section 3.2.2.1 is the staff review of components in the ESF systems that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.2.2.2 is the staff review of components in the ESF systems that the applicant indicates are consistent with GALL and for which GALL recommends further evaluation. Section 3.2.2.3 is the staff evaluation of AMPs that are specific to the ESF systems. Section 3.2.2.4 contains an evaluation of the adequacy of aging management for components in each system in the ESF systems group, and includes an evaluation of components in the ESF systems that the applicant indicates are not in GALL. This section is divided into two subsections, safety injection and containment spray (SI&CS) and containment penetrations and system interface components for non-CQE systems, which are the two systems that the applicant has identified as within the ESF systems group.

### 3.2.2.1 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups during its inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups during its inspection and audit to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. Specifically, the staff sampled the following three audit items for the ESF systems:

1. In LRA Tables 2.3.2.1-1 and 2.3.2.2-1, closure boltings of the ESF systems are linked to rows 3.2.1.11 and 3.2.1.12 of LRA Table 3.2-1. The audit was to confirm that, for all in-scope closure bolting in the ESF systems, the bolt materials are consistent with those specified in The GALL Report, Vol. 2.
2. In LRA Table 3.2-1, row 3.2.1.08, the applicant stated that the ESF components in FCS are not serviced by an open-cycle cooling system. The audit was to confirm that there are no heat exchangers in the ESF systems that will be serviced by the open-cycle cooling water system program of The GALL Report, Vol. 2.

3. In LRA Table 2.3.2.1-1, the heat exchanger is shown to be linked to LRA Table 3.2-1, row 3.2.1.09. The audit was to confirm that the heat exchanger materials and environments are consistent with those specified in The GALL Report, Vol. 2.

Based on the information provided by the applicant, the audit confirmed in Item 1 that the safety injection and containment spray systems have carbon steel, stainless steel, and low-alloy steel bolting and that containment penetrations and system interfaces have carbon steel and low-alloy steel bolting. This is consistent with GALL and is therefore acceptable. The audit also confirmed in Item 3 that the heat exchanger components in the safety injection and containment spray systems, which are managed by AMR Item 3.2.1.09, are stainless steel, carbon steel, and cast iron, and are exposed to corrosion-inhibited treated water. This is consistent with GALL and is therefore acceptable. For audit Item 2, based on the information provided by the applicant, the audit revealed that no ESF heat exchangers are normally serviced by raw water. However, there are several ESF heat exchangers for which raw water would be utilized should component cooling water (CCW) not be available in an emergency situation. These are the shutdown cooling heat exchangers, the high/low pressure safety injection pump bearing oil and seal coolers, and the containment spray pump bearing oil and seal coolers. Although raw water will be utilized only in emergency situations, the staff considered that the worst-case scenario should be accounted for in the AMR for the above ESF heat exchangers. By letter dated February 20, 2003, the staff issued POI-9(a) requesting the applicant to identify the AERMs for the above heat exchangers when exposed to a raw water environment, as well as the associated AMP. By letter dated March 14, 2003, the applicant responded to POI-9(a) by stating that the normal operating condition of the ESF heat exchangers is with the CCW as the medium, not the raw water (RW) system. The RW system is only credited for operation should there be a failure of the CCW system. According to the Statements of Consideration (SOC) for the Rule, "Consideration of ancillary functions would expand the scope of the license renewal review beyond the Commission's intent [III.c(ii)]." The applicant considers the operation of the RW system upon the failure of the CCW to be an ancillary (auxiliary) function, and not an intended function. Therefore, the raw water environment need not be considered for these heat exchangers for the period of extended operation.

The staff reviewed the applicant's response and finds it acceptable because, as stated in the SOC for the Rule, the RW system performs an ancillary function with regard to the CCW system. The details of the staff's AMR inspection and audit can be found in AMR Inspection Report 50-285/03-07 dated March 20, 2003 and audit report dated April 9, 2003. POI-9(a) is resolved.

The staff reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the ESF system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review of the inspection and audit results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for auxiliary system components. Therefore, on this basis, the staff concludes that there is reasonable assurance that the components for which the applicant claimed consistency with GALL will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.2.2.2 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The results of the staff's AMR inspection can be found in Inspection Report 50-285/03-07, dated March 20, 2003.

The GALL Report indicates that further evaluation should be performed for the aging effects described in the following sections.

#### 3.2.2.2.1 Cumulative Fatigue Damage

As stated in the SRP-LR, the GALL Report identifies fatigue as a TLAA. TLAA's are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

On the basis of the staff's review of LRA Section 4.3, the staff concludes that, pending satisfactory resolution of Confirmatory Items 4.3.2-1 and 4.3.2-2, the components in the ESF systems subject to fatigue will be adequately managed during the period of extended operation.

#### 3.2.2.2.2 Loss of Material Due to General Corrosion

As stated in the SRP-LR, loss of material due to general corrosion could occur in the containment spray system header and spray nozzle components and the external surfaces of PWR carbon steel components. The GALL Report recommends further evaluation on a plant-specific basis to ensure that loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of loss of material in these components.

The applicant indicated in LRA Table 3.2-1, row 3.2.1.02, that the applicable FCS components, materials, and environments identified in GALL are covered in LRA row 3.2.1.06. The LRA noted that, although this item is addressed in the GALL Report, it is not identified in the SRP-LR. In Volume 2 of the GALL Report, this is addressed under the component type, "External Surface of Carbon Steel Components." This component grouping is evaluated in Section 3.2.2.2.6 of this SER.

For the internal surfaces of pipes, fittings, and valve bodies in the containment penetrations and system interfaces, LRA Table 2.3.2.2-1 provides a link to LRA Table 3.4-1, row 3.4.2.02. Here, loss of material due to general (as well as pitting and crevice) corrosion, in steam or treated water environments, was identified as an aging effect to be managed by the chemistry and one-time inspection programs. The staff review of these two AMPs is found in Sections 3.0.3.2 and 3.0.3.13, respectively, of this SER.

The staff reviewed the applicant's chemistry program and one-time inspection program to ensure that corrosion is not occurring and that the component's intended function will be

maintained during the period of extended operation. The staff verified that the applicant's AMPs are sufficient to manage the identified aging effect of loss of material.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the ESF system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general corrosion for components in the ESF systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.2.2.2.3 Local Loss of Material Due to Pitting and Crevice Corrosion

As stated in the SRP-LR, local loss of material from pitting and crevice corrosion could occur in containment spray components, containment isolation valves and associated piping, and buried portions of the refueling water tank external surface. The GALL Report recommends further evaluation to ensure that loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to pitting and crevice corrosion of these components.

In LRA Table 3.2-1, row 3.2.1.03, the applicant credited its chemistry program, supplemented by the one-time inspection program, for managing the loss of material due to pitting and crevice corrosion. The applicant stated that the effectiveness of the chemistry program will be verified with an inspection of stagnant flow locations within the subject systems. These inspections will be conducted in accordance with the one-time inspection program.

The staff reviewed the applicant's proposed programs to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. The staff verified that the applicant's one-time inspection of selected components is performed at susceptible locations, based on severity of conditions, time of service, and the lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

The staff reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the ESF system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to pitting and crevice corrosion for components in the ESF systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff



concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.2.2.2.4 Local Loss of Material Due to Microbiologically Influenced Corrosion

As stated in the SRP-LR, local loss of material due to MIC could occur in PWR containment isolation valves and associated piping in systems that are not addressed in other chapters of the GALL Report. The GALL Report recommends further evaluation to ensure that local loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to MIC of the containment isolation barriers.

In LRA Table 3.2-1, row 3.2.1.04, under the "Discussion" column, the applicant stated "No FCS containment isolation valves (CIVs) and associated piping, in systems that are not addressed in this or other sections of this application were determined to be subject to the aging effect of loss of material due to microbiologically influenced corrosion (MIC)." In RAI 3.2.1-1, the staff requested the applicant to clarify this statement, and clarify whether the CIVs and the associated piping at FCS are managed in accordance with the GALL Report. By letter dated December 19, 2002, the applicant stated that the only systems associated with containment penetrations, for which the discussion column of the LRA is applicable, are the demineralized water system, instrument air system, and SG blowdown system. The applicant clarified by stating that the above statement should read, "No FCS containment isolation valves and associated piping in systems that are addressed in this or other sections of this application were determined to be subject to the aging effect of loss of material due to microbiologically influenced corrosion (MIC)."

In addition to this clarification, in a meeting on November 21, 2002, the staff requested the applicant to provide documented evidence of the material/environment combinations for the components related to the containment penetrations and system interfaces, and to provide justification that MIC is not an aging effect requiring management for these components. In its letter of December 19, 2002, the applicant did not provide the requested information, except to state that the operating experience at FCS is such that MIC has not been experienced in any of these FCS systems. The staff considered the response to be insufficient because the requested information regarding the material/environment combinations was not provided. By letter dated February 20, 2003, the staff issued POI-9(b), requesting the above information. By letter dated March 14, 2003, the applicant provided the requested information. Specifically, visual inspections that discover corrosion cannot identify the mechanism that is causing the corrosion. Further evaluation is required. If MIC ever were to occur, it would be discovered by the credited activities that monitor the loss of material. A condition report would be generated, as part of the CAP, to report the corrosion. An evaluation of the corrosion would be performed to determine its cause. If the mechanism was determined to be MIC, appropriate corrective actions would be taken and activities implemented to mitigate and monitor the mechanism. However, as was stated in response to RAI 3.2.1-1, MIC has never been observed in any ESF systems, and for this reason, MIC is not considered a plausible aging mechanism. The staff reviewed the applicant's response to POI-9(b) and finds it acceptable because it provides more detail regarding how MIC would be detected and addressed if it were to occur. POI-9(b) is resolved.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to MIC for components in the ESF systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.2.2.2.5 Local Loss of Material Due to Erosion

As stated in the SRP-LR, local loss of material due to erosion could occur in the high pressure safety injection pump miniflow orifice. This aging mechanism and effect will apply only to pumps that are normally used as charging pumps in the chemical and volume control systems. The GALL Report recommends further evaluation to ensure that local loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place to manage this aging effect.

The applicant stated in LRA Table 3.2-1, row 3.2.1.05, that the high pressure safety injection (charging) pump miniflow orifice, as identified in GALL, is not applicable to FCS. Since this GALL component grouping does not exist in FCS, loss of material due to erosion is not a relevant AERM. Therefore, no AMP is required.

#### 3.2.2.2.6 Loss of Material Due to General Corrosion

As stated in the SRP-LR, loss of material due to general corrosion could occur in the external surfaces of carbon steel pipes and fittings, primary containment penetrations, and valve bodies of the containment penetrations and system interfaces. This component type is only found in Table 2 of GALL, Volume 1. It is not found in Table 3.2-1 of the SRP. The GALL Report recommends further evaluation on a plant-specific basis to ensure that loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

The applicant credited the general corrosion of external surfaces program for managing the aging effect of loss of material due to general corrosion for the above carbon steel components. The staff's evaluation of this AMP is documented in Section 3.0.3.12 of this SER.

The staff reviewed the applicant's general corrosion of external surfaces program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. The staff verified that the applicant's AMPs are sufficient to manage the identified aging effect of loss of material.

The staff reviewed the USAR Supplement for the AMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for the ESF system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general corrosion for components in the ESF systems, as recommended in the GALL Report. On the basis of this finding, and the finding

that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.2.2.2.7 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for components in the ESF systems. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the ESF system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

#### 3.2.2.3 Aging Management Programs for ESF System Components

In SER Section 3.2.2.1, the staff evaluated the applicant's conformance with the aging management recommended by GALL for ESF systems. In SER Section 3.2.2.2, the staff reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation. In this SER section, the staff presents its evaluation of the programs used by the applicant to manage the aging of the component groups within the ESF systems.

The applicant credits nine AMPs to manage the aging effects associated with components in the ESF systems. All nine AMPs are credited with managing aging for components in other system groups (common AMPs). The staff's evaluation of the common AMPs that are credited with managing aging in ESF system components is provided in Section 3.0.3 of this SER. The common AMPs are listed below and have been found acceptable for managing aging in ESF components:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Flow Accelerated Corrosion Program - SER Section 3.0.3.4
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- Periodic Surveillance and Preventive Maintenance Program - SER Section 3.0.3.10
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- One-Time Inspection Program - SER Section 3.0.3.13
- Selective Leaching Program - SER Section 3.0.3.14

#### 3.2.2.4 Aging Management Review of Plant-Specific ESF System Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific components within the ESF systems. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3.2.1 and 2.3.2.2 to determine whether the applicant properly identified the applicable aging effects and the AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects

for each ESF component, ensuring that each aging effect was evaluated in the appropriate LRA AMR table in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided in the following sections.

#### 3.2.2.4.1 Safety Injection and Containment Spray

##### 3.2.2.4.1.1 Summary of Technical Information in the Application

The AMR results for the SI&CS are presented in Tables 3.2-1, 3.2-2, and 3.2-3 of the LRA. The applicant used the GALL Report format to present its AMRs for SI&CS components in LRA Table 3.2-1. In LRA Tables 3.2-2 and 3.2-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) aging management program(s).

The description of the SI&CS system can be found in Section 2.3.2.1 of this SER. The safety injection system injects borated water into the RCS to provide emergency core cooling following a loss-of-coolant accident. The function of the containment spray system is to limit the containment structure pressure rise by providing a means for cooling the containment atmosphere after the occurrence of a loss-of-coolant accident. The passive, long-lived components in these two systems that are subject to an AMR are identified in LRA Table 2.3.2.1-1.

#### Aging Effects

Table 2.3.2.1-1 of the LRA lists the following SI&CS system components:

- leakage accumulators
- bolting, filter/strainers
- flow element/orifice
- heat exchanger
- orifice plate
- pipes and fittings
- pump casings
- injection tanks, and tubing
- valve bodies.

Stainless steel components in these two systems are identified as being subject to loss of material due to pitting and crevice corrosion from exposure to an oxygenated treated water environment. Stainless steel materials are identified as being susceptible to crack initiation and growth due to SCC caused by exposure to chemically treated borated water environments. No aging effects were identified for the external surfaces of stainless steel and brass/bronze components exposed to ambient air.

Carbon and low-alloy steel closure bolting is identified as being subject to loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC resulting from exposure to air, moisture, humidity, and leaking fluid environments. Carbon and low-alloy steel components are identified as being subject to loss of material due to corrosion from exposure to borated water leaks. No aging effects were

identified for the external surface of carbon steel components exposed to dry air/gas environments.

Cast iron materials are identified as being subject to loss of material due to selective leaching from exposure to corrosion-inhibited treated water environments.

Galvanized steel materials are identified as being subject to loss of material due to general or crevice corrosion from exposure to containment air environments.

Stainless steel, carbon steel, and cast iron components in corrosion-inhibited treated water are identified as being subject to loss of material due to general, pitting, and crevice corrosion. Crack initiation and growth due to SCC of carbon steel with stainless steel cladding may result from exposure to chemically treated borated water environments.

Alloy 600 materials are identified as being susceptible to loss of material due to crevice corrosion and cracking due to SCC in treated water environments, Alloy 600 materials may also be susceptible to loss of material due to crevice corrosion and MIC in corrosion-inhibited treated water environments, given the presence of sufficient levels of oxygen, halogens, and sulfates.

Brass material may be susceptible to cracking due to SCC from exposure to a corrosion-inhibited treated water environment because of the ammonium compounds present in the water due to the nitrite corrosion inhibitor. Brass and copper are also identified as being susceptible to loss of material due to crevice and pitting corrosion, galvanic corrosion, and MIC in corrosion-inhibited treated water environments.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the SI&CS system:

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- Selective Leaching Program (B.3.6)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the SI&CS system will be adequately managed by these AMPs during the period of extended operation.

#### 3.2.2.4.1.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.2.1-1, 3.2-1, 3.2-2, and 3.2-3 for the SI&CS system. During its evaluation, the staff determined that additional information was needed to complete its review.

In LRA Table 3.2-1, row 3.2.1.12, the applicant stated that for closure bolting in high-pressure or high-temperature systems, the plant-specific bolting integrity program will be used to manage the aging effects of loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC. The applicant stated in LRA Appendix B that the bolting integrity program is consistent with GALL program XI.M18, "Bolting Integrity," with the exception that FCS has not identified SCC as a credible aging effect requiring management for high-strength carbon steel bolting in plant indoor air. In addition, FCS stated that it will utilize ASME Section XI, Subsection IWF, visual VT-3 inspection requirements rather than volumetric inspection for inspection of supports.

In RAI 3.2.1-2, the staff requested the applicant to provide a basis on which to conclude that SCC will not be considered as a credible AERM, and to address the adequacy of using VT-3 visual examination of Subsection IWF to detect the identified aging effects of loss of material, loss of preload, and cracking. By letter dated December 12, 2002, the applicant responded by stating that for the carbon steel bolting in question, (1) the material is not readily susceptible to SCC, (2) a caustic or mixed acid solution environment is not present, and (3) elevated temperatures are not present. The applicant, therefore, stated that SCC is not a credible AERM for the closure bolting. The applicant also stated that support bolting does not perform a pressure retention function like flange bolting, pump casing bolting, etc., therefore, a VT-3 inspection is deemed to be adequate.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff finds that the aging effects that result from contact of the SI&CS system components to the environments described in LRA Tables 2.3.2.1-1, 3.2-1, 3.2-2, and 3.2-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the SI&CS system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the SI&CS system:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- Periodic Surveillance and Preventive Maintenance Program - SER Section 3.0.3.10
- Selective Leaching Program - SER Section 3.0.3.14

The above AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the SI&CS system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff

verified that the applicant credited the AMP(s) recommended by the GALL Report. For the components identified in LRA Tables 3.2-2 and 3.2-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s). In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.2.2.4.1.3 Conclusion

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the SI&CS system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program descriptions and concludes that they provide adequate program descriptions of the AMPs credited for managing aging in the SI&CS system to satisfy 10 CFR 54.21(d).

#### 3.2.2.4.2 Containment Penetrations and System Interface Components for Non-CQE Systems

##### 3.2.2.4.2.1 Summary of Technical Information in the Application

The AMR results for the containment penetrations and system interface components for non-CQE systems are presented in Tables 3.2-1, 3.2-2, and 3.2-3 of the LRA. The applicant used the GALL Report format to present its AMR of these components in LRA Table 3.2-1. In LRA Tables 3.2-2 and 3.2-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) aging management program(s).

The description of the containment penetration and system interface components for non-CQE systems can be found in Section 2.3.2.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2.2-1. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1, 3.2-2, and 3.2-3.

#### Aging Effects

Components of the containment penetration and system interface are described in LRA Section 2.3.2.2 as being within the scope of license renewal and subject to an AMR. Table 2.3.2.2-1 of the LRA lists individual components of the system including bolting, heat exchanger, pipes and fittings, primary containment penetrations, and valve bodies.

Stainless steel components are identified as being subject to loss of material due to crevice and pitting corrosion from exposure to oxygenated treated water environments and halogen and sulfates, respectively. Stainless steel components in corrosion-inhibited treated water are subject to loss of material due to general, pitting, and crevice corrosion.

Carbon and low-alloy steel closure bolting may be subject to loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC resulting from exposure to air, moisture, humidity and leaking fluid environments. Carbon and low-alloy steel components are identified as being subject to loss of material due to corrosion from the exposure to borated water environments. Carbon steel

components are identified as being subject to the aging effect of loss of material due to general, pitting, and crevice corrosion from exposure to steam or treated water environments. Carbon steel components are identified as being subject to loss of material (wall thinning) due to FAC from exposure to treated water and saturated steam.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the containment penetrations and system interfaces:

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Flow Accelerated Corrosion Program (B.1.5)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the containment penetrations and system interfaces will be adequately managed by these AMPs during the period of extended operation.

#### 3.2.2.4.2.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.2.2-1, 3.2-1, 3.2-2, and 3.2-3 for the containment penetrations and system interfaces. During its review, the staff determined that additional information was needed to complete its review. The staff's RAIs (see RAIs 3.2.1-1 and 3.2.1-2 in SER Sections 3.2.2.2.4 and 3.2.2.4.1.2, respectively), along with the applicant's responses provided in letters dated December 19 and December 12, 2002, respectively, addressed the staff's concerns.

On the basis of its review of the information provided in the LRA, and the applicant's responses to the staff's RAIs, the staff finds that the aging effects that result from contact of containment penetrations and system interface SCCs to the environments described in LRA Tables 2.3.2.2-1, 3.2-1, 3.2-2, and 3.2-3, are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the containment penetrations and system interfaces.

##### Aging Management Program

The applicant credited the following AMPs for managing the aging effects in the containment penetrations and system interfaces:

- Bolting Integrity Program - SER Section 3.0.3.1



- Chemistry Program - SER Section 3.0.3.2
- Flow-Accelerated Corrosion Program - SER Section 3.0.3.4
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- One-Time Inspection Program - SER Section 3.0.3.13

The above AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, 3.0.3.4, 3.0.3.6, 3.0.3.7, 3.0.3.12, and 3.0.3.13, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the containment penetration and system interface components for non-CQE systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMP(s) recommended by the GALL Report. For the components identified in LRA Tables 3.2-2 and 3.2-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s). In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.2.2.4.2.3 Conclusion

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the containment penetrations and system interface components for non-CQE systems such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program descriptions and concludes that they provide adequate program descriptions of the AMPs credited for managing aging in the containment penetrations and system interface components for non-CQE systems to satisfy 10 CFR 54.21(d).

#### 3.2.3 Evaluation Findings

The staff has reviewed the information in Section 3.2 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components of the ESF systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also concludes that the USAR Supplements contain acceptable descriptions of the programs and activities for managing the effects of aging for the ESF for the period of extended operation to satisfy 10 CFR 54.21(d).

### 3.3 Auxiliary Systems

This section addresses the aging management of the components of the auxiliary systems group. The systems that make up the auxiliary systems group are described in the following SER Sections:

- Chemical and Volume Control (2.3.3.1)
- Spent Fuel Pool Cooling (2.3.3.2)
- Emergency Diesel Generators (2.3.3.3)
- Diesel Generator Lube Oil and Fuel Oil (2.3.3.4)
- Auxiliary Boiler Fuel Oil and Fire Protection Fuel Oil (2.3.3.5)
- Emergency Diesel Generator Jacket Water (2.3.3.6)
- Diesel Starting Air (2.3.3.7)
- Instrument Air (2.3.3.8)
- Nitrogen Gas (2.3.3.9)
- Containment Ventilation (2.3.3.10)
- Auxiliary Building HVAC (2.3.3.11)
- Control Room HVAC and Toxic Gas Monitoring (2.3.3.12)
- Ventilating Air (2.3.3.13)
- Fire Protection (2.3.3.14)
- Raw Water (2.3.3.15)
- Component Cooling (2.3.3.16)
- Liquid Waste Disposal (2.3.3.17)
- Gaseous Waste Disposal (2.3.3.18)
- Primary Sampling (2.3.3.19)
- Radiation Monitoring - Mechanical (2.3.3.20)

As discussed in Section 3.0.1 of this SER, the components in each of these auxiliary systems are rolled up into one of three LRA tables. LRA Table 3.3-1 consists of auxiliary system components that are evaluated in the GALL Report, LRA Table 3.3-2 consists of auxiliary system components that are not evaluated in the GALL Report, and LRA Table 3.3-3 consists of auxiliary system components that are not evaluated in the GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP.

#### 3.3.1 Summary of Technical Information in the Application

In LRA Section 3.3, the applicant described its AMRs for the auxiliary systems group at FCS. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.3.1-1 through 2.3.3.20-1.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management based on FCS operating experience were consistent with aging effects identified in GALL. The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL. The applicant's

ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

### 3.3.2 Staff Evaluation

In Section 3.3 of the LRA, the applicant describes its AMR for the auxiliary systems at FCS. The staff reviewed LRA Section 3.3 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the auxiliary system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of auxiliary system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report.

The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the USAR Supplement to ensure that it provided an adequate description of the programs credited with managing aging for the auxiliary system components.

Table 3.3-1 below provides a summary of the staff’s evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.3 that are addressed in the GALL Report.

Table 3.3-1

Staff Evaluation Table for FCS Auxiliary System Components Evaluated in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water chemistry and one-time inspection	Not applicable to FCS	GALL recommends further evaluation (See Section 3.3.2.2.1 below)
Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening, cracking and loss of strength due to elastomer degradation; loss of material due to wear	Plant-specific	General Corrosion of External Surfaces Program, Periodic Surveillance and Preventive Maintenance Program	Consistent with GALL for ventilation systems. GALL recommends further evaluation (See Section 3.3.2.2.2 below)

Components in load handling, chemical and volume control system (PWR), and reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TCAA, evaluated in accordance with 10 CFR 54.21(c)	Time-Limited Aging Analyses	Consistent with GALL. GALL recommends further evaluation (See Section 3.3.2.2.3 below)
Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth to SCC or cracking	Plant-specific	Chemistry Program and One-Time Inspection Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.3.2.2.4 below)
Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion, and MIC	Plant-specific	Periodic Surveillance and Preventive Maintenance, General Corrosion of External Surfaces Program, and Fire Protection Program	GALL recommends further evaluation (See Section 3.3.2.2.5 below)
Components in reactor coolant pump oil collect system of fire protection	Loss of material due to galvanic, general, pitting, and crevice corrosion	One-time inspection	One-Time Inspection Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.3.2.2.6 below)
Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel oil chemistry and one-time inspection	Diesel Fuel Monitoring and Storage Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.3.2.2.7 below)
Piping, pump casing, and valve body and bonnets in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	not applicable	BWR
Heat exchangers in chemical and volume control system	Crack initiation and growth to SCC and cyclic loading	Water chemistry and a plant-specific verification program	Chemistry Program, Cooling Water Corrosion Program, Inservice Inspection Program	GALL recommends further evaluation (See Section 3.3.2.2.8 below)
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant-specific	Periodic Surveillance and Preventive Maintenance Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.3.2.2.9 below). These components are scoped under structures and are addressed in Section 3.5.2.4.3 of this SER.

New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures monitoring	Structures Monitoring Program	Consistent with GALL (See Section 3.5.2.1 of this SER). These components are scoped under structures and are addressed in Section 3.5.2.4.3 of this SER.
Spent fuel storage racks and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to stress corrosion cracking	Water chemistry	Chemistry Program	Consistent with GALL (See Section 3.5.2.1 of this SER). These components are scoped under structures and are addressed in Section 3.5.2.4.3 of this SER.
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex monitoring	not applicable	The applicant has determined that these components are not applicable to FCS because FCS does not have Boraflex in the spent fuel storage racks.
Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid	Boric acid corrosion	Boric Acid Corrosion Program	Consistent with GALL (See Section 3.3.2.1 below)
Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and MIC	Closed-cycle cooling water system	Cooling Water Corrosion Program	Consistent with GALL (See Section 3.3.2.1 below)
Cranes including bridge and trolleys and rail system in load handling systems	Loss of material due to general corrosion and wear	Overhead heavy load and light load handling systems	Overhead Load Handling Systems Inspection Program	Consistent with GALL (See Section 3.5.2.1 of this SER) . These components are scoped under structures and are addressed in Section 3.5.2.4.3 of this SER.
Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice and galvanic corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	Cooling Water Corrosion Program	Consistent with GALL (See Section 3.3.2.1 below)
Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	Buried Surfaces External Corrosion Program, Diesel Fuel Monitoring and Storage Program	GALL recommends further evaluation (See Section 3.3.2.2.10 below)

Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed air monitoring	Not applicable	The environment identified in GALL is not applicable.
Components (doors and barrier penetration seals) and concrete structures in fire protection	Loss of material due to wear; hardening and shrinkage due to weathering	Fire protection	Fire Protection Program	Consistent with GALL (See Section 3.5.2.1 below)
Components in water-based fire protection	Loss of material due to general, pitting, crevice and galvanic corrosion, MIC, and biofouling	Fire water system	Fire Protection Program	Consistent with GALL (See Section 3.3.2.1 below)
Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire protection and fuel oil chemistry	Diesel Fuel Monitoring and Storage Program	Consistent with GALL (See Section 3.3.2.1 below)
Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Above-ground carbon steel tanks	not applicable	The applicant has determined that the tanks at FCS do not match the GALL for this item.
Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting integrity	Bolting Integrity Program	Consistent with GALL (See Section 3.3.2.1 below)
Components in contact with sodium pentaborate solution in standby liquid control system (BWR)	Crack initiation and growth due to SCC	Water chemistry	not applicable	BWR
Components in reactor water cleanup system	Crack initiation and growth due to SCC and IGSCC	Reactor water cleanup system inspection	not applicable	BWR
Components in shutdown cooling system (older BWR)	Crack initiation and growth due to SCC	BWR stress corrosion cracking and water chemistry	not applicable	BWR
Components in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion and MIC	Closed-cycle cooling water system	not applicable	BWR
Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems, and ultimate heat sink	Loss of material due to selective leaching	Selective leaching of materials	Selective Leaching Program	Consistent with GALL (See Section 3.3.2.1 below)

Fire barriers, walls, ceilings and floors in fire protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire protection and structures monitoring	Fire Protection Program, Structures Monitoring Program	Consistent with GALL (See Section 3.5.2.1 of this SER). These components are scoped under structures and are addressed in Section 3.5.2.4.2 of this SER.
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The staff's review of the auxiliary systems for the FCS LRA is contained within four sections of this SER. Section 3.3.2.1 is the staff review of components in the auxiliary systems that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.3.2.2 is the staff review of components in the auxiliary systems that the applicant indicates are consistent with GALL and GALL recommends further evaluation. Section 3.3.2.3 is the staff evaluation of AMPs that are specific to the auxiliary systems group. Section 3.3.2.4 contains an evaluation of the adequacy of aging management for components in each system in the auxiliary systems group and includes an evaluation of components in the auxiliary systems that the applicant indicates are not in GALL.

### 3.3.2.1 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups during the AMR inspection to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

On the basis of its review of the inspection results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for auxiliary system components. Therefore, on this basis, the staff concludes that the applicant has demonstrated that the components for which the applicant claimed consistency with GALL will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.3.2.2 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the LRA to

determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

The GALL Report indicates that further evaluation should be performed for the aging effects described in the following sections.

#### 3.3.2.2.1 Loss of Material Due to General, Pitting, and Crevice Corrosion

Loss of material due to general, pitting, and crevice corrosion could occur in the channel head and access cover, tubes, and tubesheets of the heat exchanger in the spent fuel pool cooling system, while loss of material due to pitting and crevice corrosion could occur in the filter housing, valve bodies, and nozzles of the ion exchanger in the spent fuel pool cooling system. The water chemistry program relies on monitoring and control of reactor water chemistry to manage the effects of loss of material from general, pitting, or crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry program, and the SRP-LR states that a one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The above is described in the GALL and SRP-LR background for LRA Item 3.3.1.01. The applicant has determined that the GALL AMR for the spent fuel pool cooling system, as identified in LRA Table 3.3.1-01, is not applicable to FCS.

Many of the GALL AMR items covered by Item 3.3.1.01 are elastomer-lined carbon steel components, and the applicant has stated that these items are not applicable to FCS. The staff considers this to be a plant-specific design issue and finds the applicant's conclusion acceptable.

GALL/SRP item 3.3.1-01 also addresses the heat exchangers in the spent fuel pool cooling system. For the heat exchangers, the applicant has elected to use the chemistry program and the cooling water corrosion program, as indicated by the LRA Table 2.3.3.2-1 link to item 3.3.1.08. The inspections of the heat exchanger that are performed under the cooling water corrosion program cover both the cooling water side and the spent fuel pool side of the heat exchanger, as was verified during the staff's AMR inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003. The staff finds this acceptable. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2 and 3.0.3.7 of this SER, respectively.

For the piping, fittings, and other stainless steel components in the spent fuel pool cooling system exposed to borated, treated water, the applicant's December 12, 2002, response to RAI 3.3-1 clarified that the aging management is through link 3.3.3-01. This link addresses SCC of stainless steel in borated treated water, and uses the chemistry program with no backup



inspections based on the GALL recommendations for emergency core cooling systems (ECCS) with similar materials and environments. However, for the spent fuel pool cooling system, the GALL (link 3.3.1.01) recommends that the loss of material due to general, pitting, and crevice corrosion be managed by the chemistry program coupled with inspections to verify that aging effects are not occurring, due to the potential for impurities to reach high concentrations in areas of low flow. Therefore, by letter dated February 20, 2003, the staff issued POI-10(h), requesting the applicant to describe the inspections of the spent fuel pool system components that will be performed to verify that a loss of material is not occurring. By letter dated March 14, 2003, the applicant responded to POI-10(h), stating that none of the items in Section VII.A3 of the GALL Report apply to FCS because the spent fuel pool cooling and cleanup system at FCS is stainless steel, while GALL Section VII.A3 applies to carbon steel. Therefore, general, pitting, and crevice corrosion are not applicable to stainless steel. The staff notes that for the spent fuel pool cooling system, the GALL Report also identifies loss of material for stainless steel components, but for a different water chemistry than that used at FCS. The staff agrees that loss of material due to general, pitting, and crevice corrosion is not applicable to the FCS spent fuel pool cooling system. POI-10(h) is resolved.

The staff reviewed link 3.3.3.01 in LRA Table 3.3-3 and compared the material and environment (stainless steel in a borated water environment) to Item V.D1.1-a in GALL, Volume 2, which is provided in the justification column for link 3.3.3.01. Item V.D1.1-a states that, for components made of stainless steel in a chemically treated borated water environment below 200 °F, GALL AMP XI.M2, "Water Chemistry," alone is adequate to manage crack initiation and growth due to SCC. The staff agrees that general, pitting, and crevice corrosion are not applicable to stainless steel under the conditions found in the FCS SFP cooling system. Therefore, the staff concludes that the chemistry program is adequate to manage aging of the SFP cooling system. POI-10(h) is resolved.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, and crevice corrosion for components in the spent fuel pool cooling system that are covered by GALL. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3), for these GALL items.

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

The GALL Report recommends further evaluation of programs to manage hardening and cracking due to elastomer degradation of valves in the spent fuel pool cooling and cleanup system. The GALL Report also recommends further evaluation of programs to manage the hardening and loss of strength due to elastomer degradation of the collars and seals of the duct, and of the elastomer seals of the filters in the control room area, auxiliary and radwaste area, and primary containment heating and ventilation systems, and of the collars and seals of the duct in the diesel generator building ventilation system. The GALL Report also

recommends further evaluation of programs to manage the loss of material due to wear of the collars and seals of the ducts in the ventilation systems. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of these aging effects.

The applicant credited the periodic surveillance and preventive maintenance program and the general corrosion of external surfaces program for managing the aging effects of hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear for the above heating and ventilation components that are applicable to FCS auxiliary systems. The staff's evaluation of these AMPs is documented in Sections 3.0.3.10 and 3.0.3.12 of this SER, respectively.

This GALL/SRP item also addresses the hardening, cracking, and loss of strength due to elastomer degradation in the spent fuel pool cooling system. The applicant has stated that the FCS spent fuel pool cooling system does not contain elastomer-lined components therefore, this item is not applicable to the FCS spent fuel pool cooling system. The staff finds this reasonable and acceptable.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear for components in the applicable FCS auxiliary systems, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.3 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

For the chemical and volume control system, the applicant identified that time-limited aging analyses are applicable to the filter/strainer housing, flow element/orifice, heat exchangers, ion exchangers, pipes, fittings, and tubing, pump casings, tanks, and valve bodies. The applicant also identified a TLAA for the heat exchanger in the primary sampling system. The applicant discussed the TLAAs in Section 4.3.1 of the LRA, "Reactor Coolant and Associated System Fatigue." This TLAA is evaluated in Section 4.3 of this SER.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cumulative fatigue damage for components in the applicable FCS auxiliary systems, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed

during the period of extended operation, as required by 10 CFR 54.21(a)(3), for these components.

#### 3.3.2.2.4 Crack Initiation and Growth Due to Cracking or Stress Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage crack initiation and growth due to cracking of the high-pressure pump in the chemical and volume control system. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

The applicant proposes to use the chemistry program and the one-time inspection program to address crack initiation and growth due to cracking or stress corrosion cracking in the high pressure pump in the chemical and volume control system. The applicant will perform an inspection for cracking to verify that the chemistry program is effective in preventing cracking. The chemistry program and one-time inspection program are evaluated in Sections 3.0.3.2 and 3.0.3.13 of this SER, respectively. The one-time inspection program will be capable of detecting cracking, therefore, the staff finds the proposed inspections to be acceptable for managing the potential for cracking in the pump casing.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack initiation and growth due to cracking or stress corrosion cracking for the high pressure pump in the chemical and volume control system, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.5 Loss of Material Due to General, Microbiologically-Influenced, Pitting, and Crevice Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of the piping and filter housing and supports in (1) the control room area, the auxiliary and radwaste area, and the primary containment heating and ventilation systems, (2) the piping of the diesel generator building ventilation system, and (3) the above ground piping and fittings, valves, and pumps in the diesel fuel oil system, and of the diesel engine starting air, combustion air intake, and combustion air exhaust subsystems in the emergency diesel generator system. The GALL Report also recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion and MIC of the duct fittings, access doors, closure bolts, equipment frames, and housing of the duct due to pitting and crevice corrosion of the heating/cooling coils of the air handler heating/cooling, and due to general corrosion of the external surfaces of all carbon steel structures and components, including bolting exposed to operating temperatures less than

212 °F in the ventilation systems. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

The applicant credited the PS/PMP and the general corrosion of external surfaces program for managing the aging effects of loss of material due to general, pitting, and crevice corrosion, and MIC for the above components that are applicable to FCS auxiliary systems. The staff's evaluation of these AMPs is documented in Sections 3.0.3.10 and 3.0.3.12 of this SER respectively.

For the general corrosion of external surfaces, the applicant credits the PS/PMP, the general corrosion of external surfaces program, and the FPP. These programs periodically inspect for external corrosion, and initiate corrective actions if appropriate. The FPP, PS/PMP, and general corrosion of external surfaces program are evaluated in Sections 3.0.3.9, 3.0.3.10, and 3.0.3.12 of this SER, respectively. The staff finds that these programs can effectively manage the corrosion of external surfaces for the above components that are applicable to FCS auxiliary systems.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, MIC, pitting, and crevice corrosion for the above components in the applicable FCS auxiliary systems, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

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

For the RCP oil collection portion of the fire protection system, the applicant proposes to use the one-time inspection program to manage the potential loss of material. The one-time inspection program is evaluated in Section 3.0.3.13 of this SER and is considered to be an acceptable method for verifying the intended function of the RCP oil collection portion of the fire protection system, and is consistent with GALL recommendations; therefore, the staff finds this acceptable.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the

effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, galvanic, pitting, and crevice corrosion for the above components in the applicable FCS auxiliary systems, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.7 Loss of Material Due to General, Pitting, Crevice, and MIC, and Biofouling

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

The applicant manages the internal surfaces of the tanks via its diesel fuel monitoring and storage program, which is evaluated in Section 3.3.2.3.1 of this SER. This program consists of oil chemistry control and inspections to verify that degradation is being adequately managed, consistent with GALL program XI.M30, "Fuel Oil Chemistry." Because the tank is inaccessible and because leakage detection does not detect leakage until a loss of intended function has already occurred, the applicant proposes to perform a one-time inspection of the fire protection diesel fuel oil prior to the period of extended operation to confirm that no significant degradation is occurring in the tank. The details of this issue are discussed in Section 3.3.2.3.1 of this SER.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, crevice, and MIC, and biofouling for components in the various diesel fuel oil storage systems, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.8 Crack Initiation and Growth Due to Stress Corrosion Cracking and Cyclic Loading

Crack initiation and growth due to SCC and cyclic loading could occur in the channel head and access cover, tubesheet, tubes, shell and access cover, and closure bolting of the regenerative heat exchanger, and in the channel head and access cover, tubesheet, and tubes of the letdown heat exchanger in the chemical and volume control system. The GALL chemistry program relies on monitoring and control of water chemistry based on the guidelines of TR-105714 for primary water chemistry to manage the effects of crack initiation and growth due to SCC and cyclic loading. The GALL Report recommends further evaluation to manage crack initiation and growth from SCC and cyclic loading for this system to verify the effectiveness of the water chemistry program. The staff reviewed the applicant's proposed program to ensure that cracking is not occurring and that the component's intended function will be maintained during the period of extended operation. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that crack initiation and growth are not occurring and that the components' intended functions will be maintained during the period of extended operation.

For the regenerative heat exchanger, the LRA indicates that the heat exchanger and its aging management were consistent with GALL. However, during discussions between the applicant and the NRC staff during the AMR inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, it was identified that the regenerative heat exchanger construction is not consistent with GALL, and the GALL aging management could not be applied. The details of the staff's evaluation of the applicant's management of aging, including cracking of the regenerative heat exchanger, are discussed in Section 3.3.2.4.1 of this SER.

The LRA indicates that the letdown heat exchanger would be inspected for cracking and other aging effects, and that these inspections would be performed under the cooling water corrosion program, which is evaluated in Section 3.0.3.7 of this SER. In discussions with the staff during the AMR inspection and audit, the applicant confirmed that the heat exchanger inspections performed under the cooling water corrosion program would cover both the primary and cooling water sides of the heat exchanger. The staff finds that these inspections are acceptable for verifying the effectiveness of the chemistry program with respect to the letdown heat exchanger. The staff's evaluation of this heat exchanger can be found in Section 3.3.2.4.1 of this SER.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that, with the exception of the heat exchanger described in Section 3.3.2.4.1 of this SER, the applicant has adequately evaluated the management of crack initiation and growth due to stress corrosion cracking and cyclic loading for heat exchangers in the chemical and volume control system, as recommended in the GALL. On the basis of this finding, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.9 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of the spent fuel storage rack. The GALL Report recommends further evaluation of programs to manage these aging effects. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

The applicant stated that the PS/PMP would be used to address the potential reduction of neutron-absorbing capacity and loss of material due to general corrosion. The applicable components are scoped under structures and are discussed in Section 3.5.2.4.3 of this SER. LRA Table 3.3.1 states that the surveillance test evaluates the neutron-absorbing samples for dimensional change, weight change, neutron attenuation change, and specific gravity change. The periodic surveillance and preventive maintenance program is evaluated in Section 3.0.3.10 of this SER.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the reduction of neutron-absorbing capacity and loss of material due to general corrosion for components (scoped in structures and discussed in Section 3.5.2.4.3 of this SER) that use this item, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that these aging effects will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.10 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

Loss of material due to general, pitting, and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system (service water system) and in the diesel fuel oil system. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion, and MIC. The staff reviews the effectiveness of the buried piping and tanks inspection program, including its inspection frequency and operating experience, to ensure that loss of material is not occurring and that the component's intended function will be maintained during the period of extended operation.

The applicant credits the buried surfaces external corrosion program for managing the potential loss of material on buried external surfaces. The staff's evaluation of this program is discussed in Section 3.3.2.3.2 of this SER.

An exception to the use of the buried surfaces external corrosion program is the aging management of the fire protection diesel fuel oil tank and associated piping and fittings. These components are above ground, buried in gravel inside a concrete enclosure, and inaccessible. For these components, the applicant had proposed to use leakage detection under the diesel fuel monitoring and storage program to detect degradation on the internal and external surfaces. In response to the staff's concerns with the use of leakage detection, the applicant

has stated that a one-time inspection will be used to evaluate the condition of the tank. The details of the staff's evaluation of this issue is discussed in Section 3.3.2.3.1 of this SER.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, crevice, and MIC, for buried components in the auxiliary systems, as recommended in the GALL Report. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.2.11 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for components in the auxiliary systems. On the basis of its review, the staff finds that, with the exception of the heat exchanger described in Section 3.3.2.4.1 of this SER, the applicant has provided sufficient information to demonstrate that the issues for which the GALL recommends further evaluation have been adequately addressed, and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the auxiliary system components for which the applicant claimed consistency with GALL, as required by 10 CFR 54.21(d).

#### 3.3.2.3 Aging Management Programs for Auxiliary System Components

In SER Sections 3.3.2.1 and 3.3.2.2, the staff determined that the applicant's AMRs and associated AMPs will adequately manage component aging in the auxiliary systems for components that the applicant claims are consistent with the GALL Report. The staff then reviewed specific components in the auxiliary systems to ensure that they were properly evaluated in the applicant's AMR.

To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3.3.1-1 through 2.3.3.3-20 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the USAR Supplements for the AMPs credited with managing aging in auxiliary system components to determine whether the program description adequately describes the program.



The applicant credits 14 AMPs to manage the aging effects associated with components in the auxiliary systems. Twelve of the AMPs are credited to manage aging for components in other system groups (common AMPs), while two AMPs are credited to manage aging only for auxiliary system components. The staff's evaluation of the common AMPs credited with managing aging in auxiliary system components is provided in Section 3.0.3 of this SER. The common AMPs are listed below:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Inservice Inspection Program - SER Section 3.0.3.5
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- Fatigue Monitoring Program - SER Section 3.0.3.8
- Fire Protection Program - SER Section 3.0.3.9
- Periodic Surveillance and Preventive Maintenance Program - SER Section 3.0.3.10
- Structures Monitoring Program - SER Section 3.0.3.11
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- One-Time Inspection Program - SER Section 3.0.3.13
- Selective Leaching Program - SER Section 3.0.3.14

The staff's evaluation of the two auxiliary system AMPs are provided below.

#### 3.3.2.3.1 Diesel Fuel Monitoring and Storage Program

The diesel fuel monitoring and storage program is described in Section B.2.3 of Appendix B to the LRA. The applicant credits this program with managing components in the diesel generator lube oil and fuel oil system and the auxiliary boiler fuel oil and fire protection fuel oil system. The staff reviewed the diesel fuel monitoring and storage program to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation as required by 10 CFR 54.21(a)(3).

##### 3.3.2.3.1.1 Summary of Technical Information in the Application

The LRA states that the diesel fuel monitoring and storage program is consistent with GALL program XI.M30, "Fuel Oil Chemistry," with the following two clarifications: (1) the applicant does not credit the oil particulate analysis with aging management, and (2) the applicant does not perform ultrasonic testing on the fire protection diesel fuel oil tank due to inaccessibility. The LRA also states that the existing program will be enhanced to (1) add a preventative action to remove sediment and water from the bottom of the fire protection diesel fuel oil tank, (2) inspect the diesel fuel day tanks for corrosion, and (3) perform analysis of fuel in the fire protection day tank. In addressing the operating experience related to the program, the applicant stated that there have been no instances of fuel oil system component failures due to aging effects.

Based on the above, the applicant concluded that the diesel fuel monitoring and storage program provides reasonable assurance that the aging effects will be managed such that the components subject to an AMR will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

#### 3.3.2.3.1.2 Staff Evaluation

Section B.2.3 of the LRA describes the applicant's diesel fuel monitoring and storage program. The LRA states that this AMP is consistent with GALL program XI.M30, "Fuel Oil Chemistry," with the following two clarifications: (1) the applicant does not credit the oil particulate analysis with aging management, and (2) the applicant does not perform ultrasonic testing on the fire protection diesel fuel oil tank due to inaccessibility. The staff confirmed the applicant's claim of consistency, with clarifications, during the AMR inspection. Furthermore, the staff reviewed the clarifications and their justifications to determine whether the program, with the deviations, remains adequate to manage the aging effects for which it is credited, and reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

In addition to the above, the staff verified that the components in Tables 3.3.2 and 3.3.3 of the LRA, to which this program applies, are commensurate with the intent of GALL program XI.M30. The staff finds the components to be generally acceptable, however, the staff notes that the applicant used the diesel fuel monitoring and storage program to manage the external corrosion of buried tanks and piping. In its December 19, 2002, response to RAI 3.3.2-3, the applicant stated that the proposed leakage detection activities, described below, would be used to monitor the loss of material of the internal and external surface of the fire protection diesel fuel oil tank and its associated piping and fittings. As described below, the staff found that the applicant had not proposed adequate aging management for the fire protection diesel fuel oil tank and its associated piping and fittings.

The staff reviewed the justification provided by the applicant relating to the clarifications to the GALL program. Leak detection is being employed to monitor the condition of the fire protection diesel fuel oil tank in lieu of ultrasonic testing due to inaccessibility. The staff believes that ultrasonic testing allows for the detection of aging effects in sufficient time to take corrective action to maintain the component's intended function. Detection of a leak indicates that significant fuel oil tank degradation has already occurred. On this basis, the staff believes that leak detection is an insufficient means to detect tank degradation. Therefore, in RAI B.2.3-1, the staff asked the applicant to (1) provide an aging management program that will adequately detect tank degradation in sufficient time to allow for corrective action before loss of the tank's intended function, or justify how leakage detection will accomplish this goal, (2) discuss the corrective actions that would be taken if leakage is detected, (3) clarify whether inspections will be performed in the other storage tanks which credit this program for aging management, and (4) describe the aging management of other low points of the system where impurities can accumulate.

The applicant responded to RAI B.2.3-1 by letter dated December 19, 2002. With regard to items (1) and (2), the applicant stated that the leakage detection under the diesel fuel monitoring and storage program would be used, since ultrasonic testing cannot be performed on this tank due to inaccessibility. In describing the construction of the tank, the applicant stated that the fire protection diesel fuel oil tank is above ground, surrounded by gravel, and enclosed in a concrete structure. The concrete structure is surrounded by a concrete berm, and the enclosure drains to the berm area. The diesel fuel monitoring and storage program credits two leak detection activities. The first activity involves operator rounds recording whether any oil sheen was seen in this berm area. The second activity is to identify, via level readings, any leakage from the tank between monthly surveillances, while accounting for periodic oil replenishment. The applicant concluded that leak detection is adequate to maintain

system design requirements because the applicant has seven days to restore the inoperable equipment to operable status, and that seven days is ample time to make necessary repairs or bring in a portable diesel fuel supply. The applicant also stated that past visual inspections and UT of the diesel generator tanks, which are of the same material as the fire protection fuel storage tank, have not indicated degradation. Further, new fuel additions to the fire protection diesel fuel oil tank will be analyzed for water and sediment, and the tank bottoms will be monitored to ensure water or biological activity are not accumulating.

The staff notes that the applicant continues to rely on leakage detection to monitor for internal and external corrosion of the fire protection diesel fuel tank and the associated piping. The LRA states that the diesel fuel monitoring and storage program will be enhanced to add the removal of sediment and water from the bottom of the fire protection diesel fuel tank, which indicates that this has not historically been performed. The current condition of the tank is unknown, and the staff does not consider leakage detection to be effective aging management for internal and external corrosion of the tank, pipes, fittings, and tubing. If the applicant is going to rely on leakage detection, additional justification is required. It was the staff's position that, at a minimum, the applicant should provide information on the current condition of the tank, and associated piping and fittings, to justify that the condition of this tank is comparable to other fuel oil storage tanks. In addition, the staff believed that the applicant would need to explain why the inspections of other tanks, performed under this program, would be leading indicators of degradation of the fire protection diesel fuel oil tank, considering that the oil in the fire protection diesel fuel oil tank has not been maintained to the same standards (as implied by the LRA statements that actions would be added to remove water and sediment from the bottom of the tank). Also, in justifying why leakage detection is the appropriate aging detection method, the applicant should explain why boroscopes or other instruments cannot be used to evaluate the condition of the tank internals and piping internals. Finally, the applicant should describe any measures that have been taken to maintain the tank and piping externals in a benign environment, thereby minimizing the potential for loss of material. These concerns were provided to the applicant in POI-7(c), in a letter dated February 20, 2003. By letter dated March 14, 2003, the applicant responded to the POI, by committing to a one-time inspection of the fire protection diesel fuel oil tank prior to the period of extended operation to verify that the tank is not in a degraded condition. The staff finds this approach acceptable. POI-7(c) is resolved.

With regard to item (3) of RAI B.2.3-1, by letter dated December 19, 2002, the applicant stated that UT and/or visual inspections will be performed in the other storage tanks which credit this program for aging management. In response to item (4) of the RAI, the applicant stated that the low point beyond the main tank is the bottom of the day tank, and the day tank sample will be drawn from the bottom of the tank and analyzed for water and sediment. The staff finds these activities reasonable and acceptable, and considers the RAI issues closed.

In RAI B.2.3-2, the staff asked the applicant to discuss the nature of the fuel analysis and day tank inspection, including the constituents to be analyzed, the frequency of the analyses and inspections, the acceptance criteria, and the corrective actions if degradation is found. In its December 19, 2002, response, the applicant stated that the day tank activities addressed in this question are enhancements and are not the only aging management activities for these tanks. The applicant stated that the inspections for the other tanks are consistent with GALL program XI.M30. The specific activities are (1) the DG day/engine tanks will be cleaned, flushed, and visually inspected every third refueling outage; (2) the fire protection day tank will

have a one-time boroscope inspection performed; (3) the DG day tanks have water and sediment analysis performed monthly; (4) the DG engine tanks have water and sediment analysis semi-annually and microbiological activity performed semi-annually; and (5) the fire protection day tank will be sampled quarterly for water and sediment, and semi-annually for microbiological activity. The acceptance criteria for water and sediment is less than 0.05 percent by volume, and the acceptance criteria for microbiological activity is "none detectable." Due to the monthly surveillance runs, the fuel in the day/engine tanks does not remain stagnant and would not warrant quarterly analyses. If degradation is found to exceed Class C cleanliness (thin uniform rust or magnetite films are acceptable, and scattered areas of rust are permissible provided that the area of rust does not exceed 15 square inches in 1 square foot on corrosion resistant alloys), corrective actions are initiated. The staff finds the applicant's response reasonable and acceptable, and the RAI B.2.3-2 issues are resolved.

Regarding the GALL clarification related to the applicant electing not to credit particulate analyses for aging management, in RAI B.2.3-3, the staff asked the applicant to confirm whether the diesel fuel oil quality is monitored for water and sediment contamination in accordance with ASTM Standards D1796 and D2709, as stated in XI.M30 of the GALL. In its response dated December 12, 2002, the applicant clarified that ASTM D2709 is only used for water and sediment analyses. ASTM D2709 is a newer method specific to Middle Distillate Fuels (which includes #2 diesel fuel), whereas ASTM D1796 was an older method for all fuel oils. There would be no need to use both. In accordance with ASTM D2709, test method D1796 is intended for higher viscosity fuel oils. The applicant's response satisfactorily resolves the staff's concern related to RAI B.2.3-3.

The staff reviewed the summary description of the diesel fuel monitoring and storage program in Appendix A of the LRA and finds that the information in the USAR Supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

#### 3.3.2.3.1.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that, pending satisfactory implementation of the commitments discussed above, the applicant has demonstrated that the diesel fuel monitoring and storage program will effectively manage aging in the components for which this program is credited, so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.3.2 Buried Surfaces External Corrosion Program

##### 3.3.2.3.2.1 Summary of Technical Information in the Application

The applicant's buried surfaces external corrosion program is discussed in LRA Section B.3.2, "Buried Surfaces External Corrosion Program." The applicant states that the program will be consistent with GALL program XI.M34, "Buried Piping and Tanks Inspection." This program will include surveillances and preventive measures to mitigate corrosion of external surfaces of buried carbon steel piping and tanks.

The applicant described in its operating experience that tank wall thickness measurements have determined that there is no indication of external corrosion for either the diesel generator or auxiliary boiler fuel oil storage tanks. These measurements were conducted as part of the applicant's diesel fuel oil monitoring and storage program. In addition, visual inspections have been performed on excavated piping. The most recent excavation exposed sections of buried raw water and fire protection systems piping. The applied coatings and wrappings on these exposed sections were found to be in good condition with no indication of loss of material from the base metal.

On the basis of the above discussion, the applicant concluded that the buried surfaces external corrosion program provides reasonable assurance that the identified aging effects will be managed such that the components subject to an AMR will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

#### 3.3.2.3.2.2 Staff Evaluation

In LRA Section B.3.2, the applicant described its AMP to manage the aging effects in buried components. The LRA stated that this AMP will be consistent with GALL AMP XI.M34, "Buried Piping and Tanks Inspection," with no deviations. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

By letter dated October 11, 2002, the staff requested, in RAI B.3.2-1, the applicant to discuss the changes that will be made to the current program in order to make it consistent with the GALL AMP. By letter dated December 12, 2002, the applicant responded that this is a new program which will be implemented prior to the period of extended operation. In addition, this new program will include the following to make it consistent with the GALL AMP:

- A revision has been completed to the FCS maintenance control procedure to require engineering evaluation of concrete, piping, and piping coatings whenever excavations are performed.
- Current routine inspections of diesel fuel oil tanks within the scope of license renewal will be annotated to include commitments required to meet license renewal requirements.
- A program basis document will be developed which will define the program requirements and compile industry and FCS operating experience related to buried components.

In its AMR inspection and audit conducted from January 6-10, 2003, and from January 20-23, 2003, the staff confirmed that the applicant has developed an action request to develop the program basis document. These items are also part of the applicant's commitments, as identified in Appendix A of this SER.

By letter dated October 11, 2002, the staff requested, in RAI B.3.2-2, the applicant to expand the discussion of this AMP to include a breakdown (system name, component, and percentage of total buried components) of the components in systems within the scope of this program, the inspection frequency, and the applicable operating experience. In addition, the staff requested the applicant to discuss how often these buried components have been excavated during the current operating term and how often the components may be excavated during the period of extended operation. The staff also requested a discussion on how the activities used to assess component internal conditions can be used to assess the condition of the component exterior.

In its response dated December 19, 2002, the applicant responded that the scope of the buried surfaces external corrosion program includes the following:

Raw Water System – approximately 900 ft of carbon steel piping running between the Intake Structure and the Auxiliary Building

Diesel Generator Fuel Oil System – the diesel fuel oil tank and approximately 100 ft of carbon steel piping between the tank and the Auxiliary Building

Auxiliary Boiler Fuel Oil System – the auxiliary boiler fuel oil tank, approximately 50 ft of carbon steel pipe between the tank and the Turbine Building, and approximately 50 ft of copper tubing between the tank level indicator and the Turbine Building

Fire Protection System – approximately 56 ductile iron valves and hydrants and the short sections of ductile iron piping connecting them to the asbestos-cement fire protection header

The applicant further responded that buried piping and tanks will be inspected when portions are excavated for maintenance. Part of the applicant's PM tasks includes defueling, cleaning, and inspecting the emergency diesel and auxiliary boiler diesel fuel tanks on a 9-year frequency. The most recent inspection of the emergency diesel and auxiliary boiler fuel tanks was performed in 1995 and resulted in no UT indication of degradation. UT is also performed on the internal surfaces of the tanks to identify any loss of material, which may be occurring due to corrosion on the external surfaces. The applicant has scheduled future tank inspections to be performed in 2004, which will include a UT of the excavated portions of the tanks' surfaces. The top of the tank's exterior surface around the vent and fill pipes will be excavated to conduct a visual inspection of the pipes, tank surface, welded connections, and hold down bands.

The applicant provided the results of maintenance activities performed on the emergency diesel generator fuel oil storage tanks in 1987. The inspection included a UT inspection. The results showed that the original tank wall thickness has been maintained, the welds were satisfactory, and there was no evidence of pitting. In general, the inspection showed the tank to be in excellent condition. The applicant also performed excavations of buried piping in 2000, 2001, and 2002, exposing sections of the fire protection and raw water system piping. These excavations were performed to repair degraded valves, repair potable water piping, and make modifications to fire protection system piping. Based on discussions with FCS system engineers and photos taken of exposed sections of the buried piping, the applicant concluded that the pipe coatings are well maintained with no evidence of degradation. These excavations are typically performed every 2 to 3 years.

Based on the applicant's responses, the staff finds that the elements of this new program will meet the intent of the GALL AMP because it includes visual and non-destructive examination of representative components at a frequency to ensure proper detection and correction of a degraded condition.

The applicant provided its USAR Supplement for the buried surfaces external corrosion program in LRA Section A.2.4. The staff reviewed the USAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d).

#### 3.3.2.3.2.3 Conclusions

On the basis of its review and inspection of the applicant's program, the staff finds that, pending satisfactory implementation of the commitments discussed above, the program is consistent with GALL. The staff also reviewed the USAR Supplement for this aging management program and finds that it provides an adequate summary description of the program to satisfy 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that there is reasonable assurance that the buried surfaces external corrosion program will effectively manage aging in the structures and components for which this program is credited, to ensure that the structures and components will perform their intended functions in accordance with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.3.2.4 Aging Management Reviews of Auxiliary System Components

##### 3.3.2.4.1 Chemical and Volume Control

###### 3.3.2.4.1.1 Summary of Technical Information in the Application

The description of the chemical and volume control system (CVCS) can be found in Section 2.3.3.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.1-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Table 2.3.3.1-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filter/strainer housing, flow element/orifice, heat exchanger, ion exchangers, pipes, fittings, tubing, pump casings, tanks, and valve bodies.

The LRA states that carbon steel, cast iron, galvanized steel, and cadmium-plated steel in air are subject to loss of material due to general external corrosion, while carbon steel and ductile iron in dripping boric acid are subject to boric acid corrosion. Carbon steel and low-alloy steel closure bolting is subject to loss of material and cracking. Stainless steel in chemically-treated borated water is subject to cracking due to SCC and cyclic loading, and stainless steel in corrosion-inhibited treated water is subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Heat-traced stainless steel in indoor plant air is subject to cracking due to possible leaching of chemicals from the adhesives combined with temperatures in

excess of 160 °F. Carbon steel and high-strength low alloy steel with stainless steel cladding in treated water is subject to loss of material due to general, pitting, and crevice corrosion. Several carbon steel and stainless steel components are also subject to fatigue. Brass and copper alloy in treated water are subject to loss of material due to pitting and crevice corrosion, galvanic corrosion due to dissimilar metals and MIC. Brass in treated water is also subject to cracking due to SCC, and brass in lubricating oil (with potential water contamination) is subject to loss of material. The LRA does not identify any aging effects for stainless steel, brass, or bronze in air, or for carbon steel or stainless steel in hydrogen.

### Aging Management Programs

The following AMPs are utilized to manage aging effects in the CVCS:

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Inservice Inspection Program (B.1.6)
- Boric Acid Corrosion Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)

The filter/strainer housing, flow element/orifice, heat exchangers, ion exchangers, pipes, fittings, tubing, pump casings, tanks, and valve bodies are also covered by time-limited aging analyses to address fatigue.

The applicant concluded that the effects of aging associated with the components of the CVCS will be adequately managed by these AMPs and TLAA during the period of extended operation.

#### 3.3.2.4.1.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.1-1, 3.3-1, 3.3-2, and 3.3-3 for the CVCS, as well as the applicant's responses to the staff's requests for additional information.

In its December 12, 2002, response to RAI 3.3-1, the applicant revised links related to stainless steel valve bodies. The new links clarify that the stainless steel valve bodies are subject to cracking and loss of material, and aging management will be consistent with GALL. The staff finds the clarification to be reasonable, and considers the questions regarding these links to be resolved.

In its December 19, 2002, response to RAI 3.3.1-15, the applicant clarified that only the heat exchangers would rely on link 3.3.1.08, and that other items in the CVCS would use link 3.3.3.01. Link 3.3.3.01 is for stainless steel in borated treated water, and uses the chemistry program to manage cracking due to SCC. This aging effect and aging management are consistent with the GALL for components with similar material and environments; therefore, the staff finds this acceptable and considers the issues related to RAI 3.3.1-15 resolved.



Under “valve bodies,” LRA Table 2.3.3.1-1 cites link 3.1.1.25. This link covers several items in the RCS. In its December 12, 2002, response to RAI 3.3-1, the applicant clarified that this link is for a cast austenitic stainless steel valve body in chemically treated borated water, and that the aging management would consist of the chemistry program and the ISI program. The staff considers this clarification reasonable, and notes that the aging management is consistent with GALL; therefore, the staff finds this acceptable and considers this RAI issue resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff’s evaluation of the applicant’s response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

Based on its review of LRA Tables 2.3.3.1-1, 3.3-1, 3.3-2, and 3.3-3, and the applicant’s responses to the requests for additional information, the staff finds that the aging effects identified for the CVCS components are generally consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the CVCS.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the CVCS:

- Bolting Integrity Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Inservice Inspection Program (3.0.3.5)
- Boric Acid Corrosion Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- One-Time Inspection Program (3.0.3.13)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.1, 3.0.3.2, 3.0.3.5, 3.0.3.6, 3.0.3.7, 3.0.3.10, 3.0.3.12, and 3.0.3.13 of this SER, respectively.

The fatigue of the CVCS components is addressed by the TLAAs in Section 4.3.1 of the LRA, “Reactor Coolant and Associated System Fatigue.” This TLAA is evaluated in Section 4.3 of this SER.

In RAI 3.3-1, the staff asked for clarification for several links in the LRA. In its response dated December 12, 2002, the applicant clarified that link 3.3.1.08 would be used instead of 3.4.1.10 for the letdown heat exchanger. Link 3.3.1.08 addresses crack initiation and growth due to SCC and cyclic loading of stainless steel exposed to (for the letdown heat exchanger) chemically treated borated water on the primary side, and closed cycle cooling water on the secondary side. In discussions with the staff during the AMR inspection and audit, the applicant clarified that, for the letdown heat exchanger, inspections performed under the

cooling water corrosion program would be used to verify the effectiveness of the chemistry program, and that the inspections would cover both the primary side and the cooling water side of the heat exchanger. The staff finds that the inspections are consistent with GALL recommendations and, therefore, acceptable. By letter dated February 20, 2003, the staff issued POI-10(a), requesting that this information be provided formally. By letter dated March 14, 2003, the applicant provided the requested information. POI-10(a) is resolved.

For the regenerative heat exchanger, which is constructed of stainless steel and exposed to chemically treated borated water, LRA Table 2.3.3.1-1 cites link 3.3.1.08 for aging management of cracking due to SCC, consistent with the GALL. This link states that the aging management will consist of the chemistry program, with the effectiveness of the chemistry program verified by inspections performed using either the one-time inspection program, cooling water corrosion program, or periodic surveillance and preventive maintenance program. In discussions during the AMR inspection and audit, the applicant stated that the regenerative heat exchanger is welded such that the internals are not accessible. Due to the construction of the regenerative heat exchanger, the applicant stated that the aging management of the regenerative heat exchanger would consist of the chemistry program, with further evaluation of cracking due to SCC provided by inspection of the welds via the ISI program. The applicant considered this adequate aging management to support the pressure boundary intended function of the heat exchanger shell. Though the staff agrees that this is acceptable for the external pressure boundary, the staff notes that it would not detect degradation of the regenerative heat exchanger internals which could allow inventory to flow from the charging to the letdown side of the chemical and volume control system. This would reduce the effectiveness of the CVCS for managing reactor coolant system chemistry, and may also reduce the ability of the system to inject borated water during an event; therefore, the proposed aging management may not be adequate to ensure that this intended function of the heat exchanger is maintained. By letter dated February 20, 2003, the staff issued POI-10(b) and POI-10(i), requesting the applicant to describe inspections of the regenerative heat exchanger internals that would verify the absence of the identified aging effects, or justify that degradation of the internals would not result in loss of function. By letter dated March 14, 2003, the applicant responded to POI-10(b) and POI-10(i), stating that a potential failure of the internal boundary between the two sides of the regenerative heat exchanger would not affect the inventory available for injection during an accident. The only function of the boundary is to provide for heat transfer during normal letdown operation. This function is not required during an accident. On the basis of its review of the information in the POI responses, the staff finds that the applicant's response does not explain how the plant can withstand the regulated events if the pressure boundary fails.

This pressure boundary function is important for at least two reasons over and above the normal CVCS function of maintaining RCS water chemistry. The first is getting adequate boron injection during an event. The second is isolating a letdown line break, which is a containment bypass LOCA (note that the CVCS injection path is the normally used path for the controlled cooldown during Appendix R events).

With regard to injection during an event, letdown is designed to isolate during any event in which there is need for injection. If the letdown heat exchanger tubes leak sufficiently, there could be a continued loss of inventory via the letdown flowpath because one of the two letdown isolation valves is upstream of the heat exchanger, meaning it would be bypassed. This would rely on a single valve to isolate letdown and support injection.

Letdown is also designed to isolate during any breaks in the system to stop containment bypass. Again, if the letdown heat exchanger tubes leak sufficiently, the inboard isolation valve is bypassed and a single train/single valve is now relied on to stop the containment bypass LOCA.

On the basis of this information, the staff requests the applicant to provide additional information to demonstrate how degradation of the heat exchanger internals will not adversely impact on the injection function, or provide information on how the internals will be managed during the period of extended operation to ensure that the injection function is maintained. This is Open Item 3.3.2.4.1.2-1.

RAIs 3.3.1-6 and 3.3.2-2 relate to bolting. In its response dated December 19, 2002, the applicant clarified that, consistent with GALL, bolting in high energy systems would be managed through the bolting integrity program, while the bolting in low and moderate energy systems would be managed through other programs, such as the PS/PMP or the general corrosion of external surfaces program. The response to RAI 3.3.2-2 clarified that the bolting integrity program is credited for aging management of bolting in the CVCS, including stainless steel bolting, even though the cited link (3.3.1.23) only covers carbon steel and low-alloy bolting. The staff finds that the bolting integrity program is appropriate for the bolting in the high-energy portions of the CVCS; therefore, the staff finds this acceptable and considers RAIs 3.3.1-6 and 3.3.2-2, related to bolting in the CVCS, resolved.

The applicant's December 19, 2002, response to RAI 3.3.3-2, clarified the aging management related to link 3.3.3.03. For the CVCS, this link is used for pipes, fittings, and valve bodies for loss of material. The aging management will consist of the chemistry program, and the effectiveness of the chemistry program will be verified through inspections performed under the one-time inspection program. The staff finds that this is consistent with GALL for these material and environment combinations; therefore, the staff finds this acceptable and considers RAI 3.3.3-2 resolved.

For stainless steel pipes that are heat traced and exposed to indoor air, the applicant states that cracking from SCC is possible due to chemicals leaching from the adhesives combined with temperatures exceeding 160 °F. The applicant proposes to use the one-time inspection program to determine whether further actions are required. The staff finds that the one-time inspection program is capable of detecting cracking, and is appropriate for this material and environment combination, and is, therefore, acceptable.

On the basis of its review, pending satisfactory resolution of Open Item 3.3.2.4.1.2-1, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with CVCS. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.1.3 Conclusions

On the basis of its review, the staff concludes that, pending satisfactory resolution of Open Item 3.3.2.4.1.2-1, the applicant has adequately identified the aging effects and has adequate AMPs and TLAAAs for managing the aging effects, for components in the CVCS, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation to satisfy 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the CVCS to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.2 Spent Fuel Pool Cooling

##### 3.3.2.4.2.1 Summary of Technical Information in the Application

The description of the emergency spent fuel pool cooling system (SFPC) can be found in Section 2.3.3.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.2-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Table 2.3.3.2-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filter/strainer housing, heat exchangers, pipes and fittings, pump casings, and valve bodies.

The LRA states that carbon steel in air is subject to loss of material due to general external corrosion, and carbon steel in dripping boric acid is subject to boric acid corrosion. The LRA also identifies that stainless steel in treated borated water, and in corrosion-inhibited treated water, is subject to cracking due to SCC and loss of material. Carbon steel and high strength, low-alloy steel with stainless steel cladding in corrosion-inhibited treated water are subject to loss of material due to general, pitting, and crevice corrosion, and MIC. The LRA does not identify any aging effects for stainless steel in air.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the SFPC:

- Chemistry Program (B.1.2)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)

The applicant concluded that the effects of aging associated with the components of the SFPC will be adequately managed by these AMPs during the period of extended operation.

##### 3.3.2.4.2.2 Staff Evaluation

#### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.2-1, 3.3-1, 3.3-2, and 3.3-3 for SFPC, as well as the applicant's responses to the staff's requests for additional information.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of review of LRA Tables 2.3.3.2-1, 3.3-1, 3.3-2, and 3.3-3, and the information included in the applicant's response to the staff's RAI, the staff finds that the aging effects identified for the SFPC components are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the SFPC system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the SFPC:

- Chemistry Program
- Cooling Water Corrosion Program
- Periodic Surveillance and Preventive Maintenance Program
- General Corrosion of External Surfaces Program
- One-Time Inspection Program

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.2, 3.0.3.7, 3.0.3.10, 3.0.3.12, and 3.0.3.13 of this SER.

For the SFPC heat exchangers, the applicant has elected to use the chemistry program and the cooling water corrosion program, as indicated by LRA Table 2.3.3.2-1 link to item 3.3.1.08. During the AMR inspection and audit, the staff verified that the inspections of the heat exchanger that are performed under the cooling water corrosion program cover both the cooling water side and the spent fuel pool side of the heat exchanger. The staff concludes that the inspections can verify the effectiveness of the chemistry program for the spent fuel pool (SFP) side of the heat exchanger; therefore, the staff finds this acceptable.

For the piping, fittings, and other stainless steel components in the spent fuel pool cooling system exposed to borated treated water, the applicant's December 12, 2002, response to RAI 3.3-1 clarified that the aging management is through link 3.3.3-01. This link addresses SCC of stainless steel in borated treated water, and uses the chemistry program with no backup inspections based on the GALL recommendations for ECCS systems with similar materials and environments.

The staff finds this acceptable as discussed in Section 3.3.2.2.1 of this SER.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with SFPC. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR54.21(d)

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, and crevice corrosion for components in SFPC that are covered by GALL. On the basis of this finding, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3), for these GALL items.

#### 3.3.2.4.2.3 Conclusions

On the basis of its review, the staff concludes that, pending resolution of Open Item 3.3.2.4.1.2-1, the applicant has adequately identified the aging effects and has adequate AMPs for managing the aging effects for components in SFPC, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation to satisfy 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the SPFC to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.3 Emergency Diesel Generators

##### 3.3.2.4.3.1 Summary of Technical Information in the Application

The description of the emergency diesel generators (EDGs) can be found in Section 2.3.3.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.3-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Table 2.3.3.3-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, pipes, and fittings.

The LRA stated that carbon steel in air is subject to loss of material due to general external corrosion. The LRA also identifies that galvanized steel in exhaust is subject to cracking due to embrittlement at high temperatures, loss of material due to crevice corrosion caused by aggressive chemical species and moisture, and pitting due to halides, chlorides, and hypochlorites. Stainless steel in exhaust is subject to cracking due to moisture containing concentrated contaminants, which produce an environment conducive to SCC and IGA, loss of material due to crevice corrosion from aggressive chemical species, and pitting due to halides, chlorides, and hypochlorites. The LRA does not identify any aging effects for stainless steel in air.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the EDGs:

- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

- Selective Leaching Program (B.3.6)

The applicant concluded that the effects of aging associated with the components of the EDGs will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.3.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in Tables 2.3.3.3-1, 3.3-1, 3.3-2, and 3.3-3 for the EDGs, as well as the applicant's responses to the staff's RAIs.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of LRA Tables 2.3.3.3-1, 3.3-1, 3.3-2, and 3.3-3 and the information included in the applicant's responses to the staff's RAIs, the staff finds the aging effects identified for the EDG components consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the EDGs.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the EDGs:

- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.10, 3.0.3.12, and 3.0.3.14 of this SER.

Based on its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the EDGs.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the EDGs. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.3.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for EDG components,

such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the EDG system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.4 Diesel Generator Lube Oil and Fuel Oil

The description of the EDG lube oil and fuel oil (DGLO and DGFO) system can be found in Section 2.3.3.4 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.4-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

##### 3.3.2.4.4.1 Summary of Technical Information in the Application

Table 2.3.3.4-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filters/strainers, flow element/orifice, heat exchanger, hose, hose coupling, indicator (sight glass), pipes and fittings, pump casings, tanks, tubing, and valve bodies.

##### Aging Effects

Carbon steel, galvanized steel, cadmium-plated steel, cast iron, and copper in air are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Stainless steel, carbon steel, galvanized steel, coated carbon steel, cast iron, brass and bronze in fuel oil (with possible water contamination) are subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Carbon steel, cadmium-plated steel, copper alloy, brass, and bronze in lubricating oil (with possible water contamination) are subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Brass and copper alloy in corrosion-inhibited treated water are subject to loss of material due to crevice and pitting corrosion, galvanic corrosion due to dissimilar metals, and MIC, and cracking due to SCC. Copper alloy in corrosion-inhibited treated water is subject to selective leaching. No aging effects are identified for stainless steel, brass, bronze, copper alloy, or copper-zinc alloy in air.

##### Aging Management Programs

The following AMPs are utilized to manage aging effects in the DGLO and DGFO system:

- Chemistry Program (B.1.2)
- Cooling Water Corrosion Program (B.2.2)
- Diesel Fuel Monitoring and Storage Program (B.2.3)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- Buried Surface External Corrosion Program (B.3.2)
- General Corrosion of External Surfaces Program (B.3.3)
- Selective Leaching Program (B.3.6)



The applicant concluded that the effects of aging associated with the components of the DGLO and DGFO system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.4.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.4-1, 3.3-1, 3.3-2, and 3.3-3 for the DGLO and DGFO system. The staff also reviewed the applicant's responses to the staff's requests for additional information.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA and the information included in the applicant's response to the staff's RAI, the staff finds that the aging effects identified for the DGLO and DGFO system components described in LRA Tables 2.3.3.4-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the DGLO and DGFO system.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the DGLO and DGFO system:

- Chemistry Program (3.0.3.2)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)
- Diesel Fuel Monitoring and Storage Program (3.3.2.3.1)
- Buried Surface External Corrosion Program (3.3.2.3.2)

With the exception of the diesel fuel monitoring and storage program and the buried surfaces external corrosion program, these AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These common AMPs are evaluated in Sections 3.0.3.2, 3.0.3.7, 3.0.3.10, 3.0.3.12, and 3.0.3.14, respectively, of this SER. The diesel fuel monitoring and storage program and the buried surfaces external corrosion program are evaluated in Sections 3.3.2.3.1 and 3.3.2.3.2 of this SER, respectively.

Based on its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the DGLO and DGFO system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the DGLO and DGFO systems. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.4.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in the DGLO and DGFO system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the DGLO and DGFO system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.5 Auxiliary Boiler Fuel Oil and Fire Protection Fuel Oil

The description of the auxiliary boiler fuel oil and fire protection fuel oil system can be found in Section 2.3.3.5 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.5-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

##### 3.3.2.4.5.1 Summary of Technical Information in the Application

Table 2.3.3.5-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filters/strainers, hose, hose coupling, indicator (sight glass), pipes and fittings, pump casings, tanks, tubing, and valve bodies.

##### Aging Effects

Carbon steel, cadmium-plated steel, galvanized steel, and cast iron in air (ambient) are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and/or MIC. Stainless steel, carbon steel, galvanized steel, coated carbon steel, cast iron, aluminum, brass, bronze, and copper-zinc alloy in fuel oil (with potential water contamination) are subject to loss of material due to general, pitting, and crevice corrosion, MIC, galvanic corrosion, and biofouling. Buried carbon steel is subject to loss of material due to general, pitting, and crevice corrosion, and MIC; and copper-zinc alloy in a buried environment is subject to loss of material due to general and pitting corrosion, and selective leaching (dezincification). Carbon steel, galvanized steel, and copper-zinc alloy above ground and buried in gravel (and protected from the elements) are subject to loss of material due to general and/or pitting corrosion. No aging effects are identified for stainless steel, aluminum, brass, bronze, copper alloy, or copper-zinc alloy in air (ambient or instrument air), or glass in fuel oil.

##### Aging Management Programs

The following AMPs are utilized to manage aging effects in the auxiliary boiler fuel oil and fire protection fuel oil system:

- Diesel Fuel Monitoring and Storage Program (B.2.3)
- Fire Protection Program (B.2.5)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- Buried Surface External Corrosion Program (B.3.2)
- General Corrosion of External Surfaces Program (B.3.3)
- Selective Leaching Program (B.3.6)

The applicant concluded that the effects of aging associated with the components of the auxiliary boiler fuel oil and fire protection fuel oil system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.5.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.5-1, 3.3-1, 3.3-2, and 3.3-3 for the auxiliary boiler fuel oil and fire protection fuel oil system. The staff also reviewed the applicant's responses to the staff's RAIs. The applicant considers that the fuel oil is potentially contaminated with water, and the applicant has identified the appropriate aging effects for this condition.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in LRA and the information included in the applicant's responses to the staff's RAI, the staff finds that the aging effects identified for the auxiliary boiler fuel oil and fire protection fuel oil system components described in LRA Tables 2.3.3.5-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the auxiliary boiler fuel oil and fire protection fuel oil system.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the auxiliary boiler fuel oil and fire protection fuel oil system:

- Fire Protection Program (3.0.3.9)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)
- Diesel Fuel Monitoring and Storage Program (3.3.2.3.1)
- Buried Surfaces External Corrosion Program (3.3.2.3.2)

With the exception of the diesel fuel monitoring and storage program and the buried surfaces external corrosion program, these AMPs are credited with managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These common AMPs are evaluated in Sections 3.0.3.9, 3.0.3.10, 3.0.3.12, and 3.0.3.14, respectively, of this SER. The diesel fuel monitoring and storage program and the buried surfaces external corrosion program have been evaluated and found to be appropriated for this system. The diesel fuel monitoring and storage program and the buried surfaces external corrosion program are discussed in Sections 3.3.2.3.1 and 3.3.2.3.2 of this SER, respectively.

The staff asked several RAIs related to how the diesel fuel monitoring and storage program would manage the fire protection fuel oil storage tank and its associated piping and fittings. RAI 3.3.2-3 asked how the program, which focuses on internal oil environments, would be used to monitor for the external corrosion of the components. RAI B.2.3-1 asked for information related to the applicant's intention to use leakage detection to manage aging of the components. In its December 19, 2002, response to these RAIs, the applicant confirmed its intention to rely on leakage detection to monitor for internal and external corrosion of the fire protection diesel fuel tank and the associated piping, and provided information related to other testing and oil sampling that would be performed. In response to the staff's concerns with the use of leakage detection, the applicant has stated that a one-time inspection will be used to evaluate the condition of the tank.

On the basis of its review of the information provided in the LRA and the information included in the applicant's responses to the staff's requests for additional information, the staff concludes that the above identified AMPs will effectively manage the aging effects of the auxiliary boiler fuel oil and fire protection fuel oil system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with auxiliary boiler fuel oil and fire protection fuel oil system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.5.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects for components in the auxiliary boiler fuel oil and fire protection fuel oil system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the auxiliary boiler fuel oil and fire protection fuel oil system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.6 Diesel Jacket Water

##### 3.3.2.4.6.1 Summary of Technical Information in the Application

The description of the EDG jacket water system can be found in Section 2.3.3.6 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.6-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Table 2.3.3.6-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, electric heaters (sleeves), heat exchangers (radiators), indicators (sightglasses), pipes and fittings, pump casings, tanks, and valve bodies.

The LRA stated that carbon steel, cast iron, galvanized steel, and cadmium-plated steel in air are subjected to loss of material due to general external corrosion. The LRA also stated that stainless steel, carbon steel, cast iron, brass/copper alloy, and copper alloy in corrosion-inhibited treated water are subject to loss of material due to such mechanisms as general, pitting, and crevice corrosion, MIC, galvanic corrosion, and/or selective leaching. Stainless steel and brass/copper alloy in corrosion-inhibited treated water are subject to cracking due to SCC. The LRA did not identify any aging effects for stainless steel, brass, or copper alloy in air, or for glass in oil, air, or corrosion-inhibited treated water.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the EDG jacket water system:

- Chemistry Program (B.1.2)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- Selective Leaching Program (B.3.6)

The applicant concluded that the effects of aging associated with the components of the EDG jacket water system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.6.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.6-1, 3.3-1, 3.3-2, and 3.3-3 for the EDG jacket water system, as well as the applicant's responses to the staff's RAI.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

In RAI 3.3.3-4, the staff asked for clarification of the temperature of the heater elements, since the LRA's AMR cites a GALL item that has an inherent temperature limit. The applicant's December 19, 2002, RAI response did not fully answer questions of operating temperature;

however, the staff notes that the applicant relies on the chemistry program and the cooling water corrosion program for aging management of the heaters. These programs collectively implement the recommendations in EPRI TR-107396 for this system. This aging management is consistent with the GALL recommendations for other components that do not have restrictive temperature limits; therefore, the staff finds the aging management to be acceptable and considers RAI 3.3.3-4 resolved.

On the basis of its review of LRA Tables 2.3.3.6-1, 3.3-1, 3.3-2, and 3.3-3, and the applicant's responses to the RAI, the staff finds that the aging effects identified for the EDG jacket water system components are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the EDG jacket water system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the EDG jacket water system:

- Chemistry Program (3.0.3.2)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)

These AMPs are credited with managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.2, 3.0.3.7, 3.0.3.10, 3.0.3.12, and 3.0.3.14, respectively, of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the EDG jacket water system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the diesel jacket water system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.6.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in the EDG jacket water system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the EDG jacket water system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.7 Diesel Starting Air

##### 3.3.2.4.7.1 Summary of Technical Information in the Application

The description of the diesel starting air system can be found in Section 2.3.3.7 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.7-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the diesel starting air system are described in LRA Section 2.3.3.7 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.7-1 lists individual components of the system including bolting, filters/strainers, heat exchangers, lubricator body, air motor casings, pipes and fittings, tanks, and valve bodies. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air and have no aging effects from exposure to gas-instrument air. Exposure of stainless steel components to ambient air or gas-instrument air has no aging effects. Exposure of brass, bronze, copper, copper alloy, and copper-zinc alloy components to ambient air or gas-instrument air has no aging effects. Cast iron, cadmium-plated steel and galvanized steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air.

#### Aging Management Programs

The general corrosion of external surfaces program (B.3.3) is utilized to manage aging effects in the diesel starting air system.

A description of this AMP is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel starting air system will be adequately managed by this AMP during the period of extended operation.

##### 3.3.2.4.7.2 Staff Evaluation

#### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.7-1, 3.3-1, 3.3-2, and 3.3-3 for the diesel starting air system. During its review, the staff determined that additional information was needed to complete its review.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.3.5.1 of this SER and is characterized as resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.1-2 pertaining to aging effects for components that are exposed to an instrument air (IA) environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.4.8.2 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the diesel starting air system SSCs to the environments described in LRA Tables 2.3.3.7-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the diesel starting air system.

#### Aging Management Program

The applicant credited the general corrosion of external surfaces program (3.0.3.12) for managing the aging effects in the diesel starting air system

This AMP is credited for managing the aging effects of several components in other structures and systems and is, therefore, considered a common AMP. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMP will effectively manage the aging effects of the diesel starting air system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the diesel starting air system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.7.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the diesel starting air system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the diesel starting air system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.8. Instrument Air

##### 3.3.2.4.8.1 Summary of Technical Information in the Application

The description of the IA system can be found in Section 2.3.3.8 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table



2.3.3.8-1. The components, aging effects, and aging management programs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the IA system are described in LRA Section 2.3.3.8 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.8-1 lists individual components of the system including accumulators, bolting, filters housing, pipes and fittings, tubing, valve body, and valve operator bodies. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air and have no aging effects from exposure to gas-instrument air. Exposure of stainless steel components to ambient air, gas-instrument air or gas-nitrogen air has no aging effects. Exposure of aluminum, brass, bronze, copper, copper alloy, and copper-zinc alloy components to ambient air, gas-instrument air or gas-nitrogen air has no aging effects. Closure bolting and external surfaces of carbon steel and low-alloy steel components are identified as being subject to loss of material due to boric acid corrosion from exposure to borated water leaking from adjacent systems or components containing borated treated water.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the IA system:

- Boric Acid Corrosion Prevention Program (B.2.1)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the instrument air system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.8.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.8-1, 3.3-1, 3.3-2, and 3.3-3 for the IA system. During its review, the staff determined that additional information was needed to complete its review.

Numerous components included in LRA Tables 2.3.3.7-1 and 2.3.3.8-1 referred to LRA Table 3.3-2, row number 3.3.2.23, for the AMR results. These components are made of carbon steel and are exposed to the internal environment of IA. The LRA states that there are no aging effects that require management for this material/environment combination. Similarly, in LRA Table 3.3.1, row number 3.3.1.18, the applicant stated that the components in the IA system at FCS are exposed to dry air, and that the environment (wet air/gas) identified in The GALL Report is not applicable to FCS. It should be noted that in the IA system, components that are located upstream of the air dryers are generally exposed to a wet air/gas environment and, therefore, may be subject to loss of material due to general and pitting corrosion. In addition, it is reasonable to assume that components downstream of the dryers are exposed to dry air/gas environment. However, this may not be supported by some operating experience. For example, NRC IN 87-28, "Air Systems Problems at U.S. Light Water Reactors," provides that

“A loss of decay heat removal and significant primary system heat up at Palisades in 1978 and 1981 were caused by water in the air system.” This experience implies that the air/gas system downstream of the dryer may not be dry. By letter dated October 11, 2002, the staff requested, in RAI 3.3.1-2, the applicant to discuss its plant-specific operating experience related to components that are exposed to an instrument air environment, and to provide a technical basis for not identifying loss of material as an aging effect for these components.

In its response dated December 19, 2002, the applicant stated that the IA system boundary does not include components upstream of the dryers. Those components are part of the compressed air system. The industry operating experience is varied because of the differences in system design and air dryer types in use. For stations with refrigerant dryers, the dewpoint of the air system is typically in the range of +30 °F to +40 °F. While this does prevent water accumulation in the system, it still provides sufficient moisture to allow corrosion. Also, for systems with a single air dryer, wet air can be pumped into the system in the event of a failure of the air dryer. Additionally, if the system dewpoint is not monitored, that condition can go undetected for a significant length of time, which can cause corrosion to occur.

The applicant also stated that the FCS operating experience has not shown that a wet environment exists downstream of the air dryers. The reasons for that are threefold. First, FCS has always used desiccant-type air dryers, which reduce the dewpoint of the instrument air to <-40 °F. This low level of moisture has been shown to preclude the corrosion mechanisms responsible for loss of material that occur in wet systems. Second, FCS has redundant air dryers installed. Lastly, the dewpoint of the instrument air is monitored with a sensor which alarms in the control room in the event the dewpoint exceeds -25 °F. No significant corrosion occurs on iron, zinc, copper, aluminum, or their alloys at relative humidities below 60%. The relative humidity of the instrument air at a dewpoint of -25 °F is less than 2 percent. In addition, the applicant stated that the operating experience review for FCS did identify a single water intrusion event that introduced water into the IA system from the fire protection system due to a crosstie between the two systems downstream of the air dryers. This was a one time event of short duration, however, and not the normal operating environment. The crosstie was eliminated and the IA system was cleaned and dried following that event. Since the modification there has been no incidence of high moisture in the IA system.

On the basis of its review, the staff finds the applicant’s response adequate and acceptable because the applicant has demonstrated that the IA system, including air dryer design, will ensure that loss of material is not an applicable aging effect for the components that are exposed to an instrument air environment, which is validated by the plant operating experience.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff’s evaluation of the applicant’s response is documented in Section 3.3.2.5.1 of this SER and is resolved.

In LRA Table 2.3.3.8-1, the applicant identified a link to LRA AMR Item 3.3.1.07 for the accumulators. During the AMR inspection and audit, the applicant clarified that link 3.3.1.07 should be 3.3.1.05. The staff finds that the revised link (3.3.1.05) is appropriate for the accumulators. By letter dated February 20, 2003, the staff issued POI-10(c), requesting the applicant to provide this information formally. By letter dated March 14, 2003, the applicant provided the requested information. POI-10(c) is resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs and POIs, the staff finds that the aging effects that result from contact of the IA system SSCs to the environments described in LRA Tables 2.3.3.8-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the instrument air system.

### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the IA system:

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- General Corrosion of External Surfaces Program (3.0.3.12)

The boric acid corrosion prevention program and the general corrosion of external surfaces program are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.6 and 3.0.3.12 of this SER, respectively.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the IA system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the instrument air system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.8.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the instrument air system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the instrument air system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.9 Nitrogen Gas

##### 3.3.2.4.9.1 Summary of Technical Information in the Application

The description of the nitrogen gas (NG) system can be found in Section 2.3.3.9 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in

LRA Table 2.3.3.9-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the NG system are described in LRA Section 2.3.3.9 of the submittal as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.9-1 lists individual components of the system including bolting, pipes and fittings, and valve bodies. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air and have no aging effects from exposure to gas-instrument air or gas-nitrogen air. Exposure of stainless steel, brass, and bronze components to ambient air or gas-nitrogen air has no aging effects. Closure bolting and external surfaces of carbon steel and low-alloy steel components are identified as being subject to loss of material due to boric acid corrosion from exposure to borated water leaking from adjacent systems or components containing borated treated water.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the NG system:

- Boric Acid Corrosion Prevention Program (B.2.1)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the NG system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.9.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.9-1, 3.3-1, 3.3-2, and 3.3-3 for the NG system. During its review, the staff determined that additional information was needed to complete its review.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff finds that the aging effects that result from contact of the NG system SSCs to the environments described in LRA Tables 2.3.3.9-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the NG system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the NG system:

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.6 and 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the NG system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the nitrogen gas system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.9.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the nitrogen gas system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the nitrogen gas system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.10 Containment Ventilation

##### 3.3.2.4.10.1 Summary of Technical Information in the Application

The description of the containment ventilation system can be found in Section 2.3.3.10 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.10-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the containment ventilation system are described in LRA Section 2.3.3.10 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.10-1 lists individual components of the system, including blowers and fan housing, bolting, filter housing, duct, dampers, heat exchangers, pipes and fittings, and valve bodies. Carbon steel, cast iron, cadmium-plated steel, and galvanized steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air. Exposure of stainless steel, brass, and bronze components to ambient air

has no aging effects. Closure bolting and external surfaces of carbon steel, low-alloy steel, cast iron, cadmium-plated steel, galvanized steel, and copper alloy components are identified as being subject to loss of material due to boric acid corrosion from exposure to borated water leaking from adjacent systems or components containing borated treated water. Brass, copper, and copper alloy components are identified as being subject to loss of material due to crevice and pitting corrosion, galvanic corrosion, and MIC from exposure to corrosion-inhibited treated water. Elastomer seals are identified as being subject to hardening, cracking, and loss of strength due to elastomer degradation and loss of material due to wear from exposure to ambient (warm, moist) air.

### Aging Management Programs

The following AMPs are utilized to manage aging effects in the containment ventilation system:

- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the containment ventilation system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.10.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.10-1, 3.3-1, 3.3-2, and 3.3-3 for the containment ventilation system. During its review, the staff determined that additional information was needed to complete its review.

In LRA Table 2.3.3.10-1, the applicant identified two intended functions - heat transfer and pressure boundary - for the heat exchanger, and referred to LRA Tables 3.3-1, 3.3-2, and 3.3-3 (rows 3.3.1.05, 3.3.2.10, 3.3.2.39, and 3.3.3.09) for the AMR results for the heat exchanger. In LRA Table 3.3-2, row 3.3.2.39, the applicant identified loss of material as the applicable aging effect and credited the chemistry program and cooling water corrosion program for managing the aging effect. However, the staff notes that fouling is another aging effect that will result in a loss of the intended function of heat transfer. By letter dated October 11, 2002, the staff requested, in RAI 3.3.2-4, the applicant to provide a technical basis for not identifying fouling as an applicable aging effect for the heat exchanger that has an intended function of heat transfer, or to provide a program to manage fouling in the heat exchanger.

In its response dated December 19, 2002, the applicant stated that fouling has not been identified as an AERM because the cooling medium for these coolers is CCW. For these containment ventilation coils, FCS operating experience has shown that fouling does not occur. Consistent with the GALL Report, fouling is only applicable as an AERM for heat exchangers when an open-cycle cooling water system is used. The only open-cycle cooling water heat exchangers at FCS are the CCW/RW heat exchangers. Visual inspections for fouling of the

CCW/RW heat exchangers is currently performed every 18 months, and heat transfer performance verified every six months. The applicant further stated that the exception noted in FCS' cooling water corrosion program (B.2.2) is for fluid flow and not for the heat transfer function. Heat transfer performance testing on applicable heat exchangers is performed per OPPD's response to GL 89-13. Therefore, despite no evidence of fouling, it will monitor for fouling as part of the FCS' cooling water corrosion program.

On the basis of its review, the staff finds that the applicant's response is reasonable and acceptable because heat transfer performance testing on applicable heat exchangers is performed per OPPD's response to GL 89-13 and the FCS' cooling water corrosion program and will adequately monitor for fouling of the heat exchanger in the containment ventilation system.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.1-1 pertaining to aging effects for elastomer components in ventilation systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER and is characterized as resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.3-1 pertaining to aging effects of boric acid corrosion of components in air exposed to leaking and dripping borated treated water. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the containment ventilation system SSCs to the environments described in LRA Tables 2.3.3.10-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the containment ventilation system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the containment ventilation system:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects

identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, and 3.0.3.12, respectively, of this SER.

Based on its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the containment ventilation system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the containment ventilation system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.10.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the containment ventilation system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the containment ventilation system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.11 Auxiliary Building Ventilation

##### 3.3.2.4.11.1 Summary of Technical Information in the Application

The description of the auxiliary building ventilation system can be found in Section 2.3.3.11 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.11-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the auxiliary building ventilation system are described in LRA Section 2.3.3.11 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.11-1 lists individual components of the system including blowers and fan housing, bolting, filter/strainer housing, fire blocking damper, duct, dampers, pipes and fittings, and valve bodies. Carbon steel, cast iron, cadmium-plated steel, and galvanized steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air. Exposure of stainless steel and aluminum components to ambient air has no aging effects. Closure bolting and external surfaces of carbon steel, low-alloy steel, cast iron, cadmium-plated steel, galvanized steel, and copper alloy components are identified as being subject to loss of material due to boric acid corrosion from exposure to borated water leaking from adjacent systems or components containing borated treated water. Elastomer seals are identified as being subject to hardening, cracking, and loss of strength due to elastomer degradation and loss of material due to wear from exposure to ambient (warm, moist) air.



## Aging Management Programs

The following AMPs are utilized to manage aging effects in the auxiliary building ventilation system:

- Boric Acid Corrosion Prevention Program (B.2.1)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the auxiliary building ventilation system will be adequately managed by these AMPs during the period of extended operation.

### 3.3.2.4.11.2 Staff Evaluation

#### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.11-1, 3.3-1, 3.3-2, and 3.3-3 for the auxiliary building ventilation system. During its review, the staff determined that additional information was needed to complete its review.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.1-1 pertaining to aging effects for elastomer components in ventilation systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER and is resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.3-1 pertaining to aging effects of boric acid corrosion of components in air exposed to leaking and dripping borated treated water. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER and is resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the auxiliary building ventilation system SSCs to the environments described in LRA Tables 2.3.3.11-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the auxiliary building ventilation system.

## Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the auxiliary building ventilation system:

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)

- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.6, 3.0.3.10, and 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the auxiliary building ventilation system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the auxiliary building ventilation system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.11.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the auxiliary building ventilation system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the auxiliary building ventilation system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.12 Control Room HVAC and Toxic Gas Monitoring

##### 3.3.2.4.12.1 Summary of Technical Information in the Application

The description of the control room HVAC and toxic gas monitoring system can be found in Section 2.3.3.12 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.12-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

##### Aging Effects

Components of the control room HVAC and toxic gas monitoring system are described in LRA Section 2.3.3.12 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.12-1 lists individual components of the system, including blowers and fan housing, bolting, filter/strainer, duct, heat exchanger, pipes and fittings, and valve bodies. Carbon steel, cast iron, cadmium-plated steel, and galvanized steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air. Exposure of stainless steel, aluminum, brass, bronze, copper, copper alloy, and copper zinc components to ambient air has no aging effects. Copper pipes and fittings exposed to ambient air are identified as being subject to loss of material due to

wear. Exposure of copper, copper alloy, brass, and cast iron components to gas-refrigerant has no aging effects. Brass, copper, and copper alloy components are identified as being subject to loss of material due to crevice, pitting, and galvanic corrosion, and MIC from exposure to corrosion-inhibited treated water. Cast iron components are identified as being subject to loss of material due to general, pitting, and crevice corrosion from exposure to corrosion-inhibited treated water. Carbon steel and stainless steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to corrosion-inhibited treated water. Elastomer seals are identified as being subject to hardening, cracking, and loss of strength due to elastomer degradation and loss of material due to wear from exposure to ambient (warm, moist) air.

### Aging Management Programs

The following AMPs are utilized to manage aging effects in the control room HVAC and toxic gas monitoring system:

- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the control room HVAC and toxic gas monitoring system will be adequately managed by these AMPs during the period of extended operation.

### 3.3.2.4.12.2 Staff Evaluation

#### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.12-1, 3.3-1, 3.3-2, and 3.3-3 for the control room HVAC and toxic gas monitoring system. During its review, the staff determined that additional information was needed to complete its review.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

In LRA Table 2.3.3.12-1, the applicant identified two intended functions, heat transfer and pressure boundary for the heat exchanger, and referred to LRA Tables 3.3-1 and 3.3-2, rows 3.3.1.05, 3.3.2.29, 3.3.2.39, and 3.3.2.40, for the AMR results for the heat exchanger. In LRA Table 3.3-2, rows 3.3.2.29 and 3.3.2.39, the applicant identified loss of material as the applicable aging effect and credited the chemistry program and cooling water corrosion program for managing the aging effect. However, the staff notes that fouling is another aging effect that will result in a loss of the intended function of heat transfer. The applicant was requested to provide a technical basis for not identifying fouling as an applicable aging effect for this heat exchanger, or provide a program to manage fouling in the heat exchanger. By letter dated October 11, 2002, the staff requested, in RAI 3.3.2-5, the applicant to provide a

technical basis for not identifying fouling as an applicable aging effect for the heat exchanger that has an intended function of heat transfer, or to provide a program to manage fouling in the heat exchanger.

In its response dated December 19, 2002, the applicant stated that fouling has not been identified as an AERM because the cooling medium for these coolers is CCW. For these containment ventilation coils, FCS operating experience has shown that fouling does not occur. Consistent with the GALL Report, fouling is only applicable as an AERM for heat exchangers when an open-cycle cooling water system is used. The only open-cycle cooling water heat exchangers at FCS are the CCW/RW heat exchangers. Visual inspections for fouling of the CCW/RW heat exchangers is currently performed every 18 months, and heat transfer performance verified every six months. The applicant further stated that the exception noted in FCS' cooling water corrosion program (B.2.2) is for fluid flow and not for the heat transfer function. Heat transfer performance testing on applicable heat exchangers is performed per OPPD's response to GL 89-13. Therefore, despite no evidence of fouling, it will monitor for fouling as part of the FCS' cooling water corrosion program.

On the basis of its review, the staff finds that the applicant's response is reasonable and acceptable because heat transfer performance testing on applicable heat exchangers is performed per OPPD's response to GL 89-13, and the FCS cooling water corrosion program, and will adequately monitor fouling for the heat exchanger in the control room HVAC and toxic gas monitoring system.

By letter dated October 11, 2002, the staff issued RAI 3.3.1-1 pertaining to aging effects for elastomer components in ventilation systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the control room HVAC and toxic gas monitoring system SSCs to the environments described in LRA Tables 2.3.3.12-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the control room HVAC and toxic gas monitoring system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the control room HVAC and toxic gas monitoring system:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated

these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, and 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the control room HVAC and toxic gas monitoring system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the control room HVAC and toxic gas monitoring system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.12.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the control room HVAC and toxic gas monitoring system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the control room HVAC and toxic gas monitoring system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.13 Ventilating Air

##### 3.3.2.4.13.1 Summary of Technical Information in the Application

The description of the ventilating air system can be found in Section 2.3.3.13 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.13-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Components of the ventilating air system are described in Section 2.3.3.13 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.13-1 lists individual components of the system, including bolting, damper housing, and ducts and fittings. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the ventilating air system:

- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the ventilating air system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.13.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.13-1, 3.3-1, 3.3-2, and 3.3-3 for the ventilating air system. During its review, the staff determined that additional information was needed to complete its review.

In LRA Table 2.3.3.13-1, the applicant identified loss of material as a plausible aging effect for ducts and fittings. The staff noted that for ducts in other ventilation systems, the applicant has also identified aging effects related to elastomer degradation. In order for the staff to understand whether aging effects are applicable to elastomers in the ducts for the ventilating air system, by letter dated October 11, 2002, the staff requested, in RAI 3.3.1-8, the applicant to clarify whether there are elastomer components in the ventilating air system and to provide a technical basis for not considering aging degradation of the elastomer component, if any.

In its response dated December 12, 2002, the applicant stated that there are no elastomers in the ventilating air system; therefore, there are no aging effects requiring management. On the basis of its review, the staff finds the applicant's response acceptable because the information provided by the applicant clarifies that there are no elastomers in the ventilating air system.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the ventilating air system SSCs to the environments described in LRA Tables 2.3.3.13-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the ventilating air system.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the ventilating air system:

- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects

identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.10 and 3.0.3.12 of this SER.

Based on its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the ventilating air system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the ventilating air system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.13.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the ventilating air system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the ventilating air system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.14 Fire Protection

##### 3.3.2.4.14.1 Summary of Technical Information in the Application

The description of the fire protection system can be found in Section 2.3.3.14 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.14-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

LRA Table 2.3.3.14-1 lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filters/strainers, flow element/orifice, fire protection sprinkler/spray nozzle, halon system nozzle, hose, hose cabinet, pipes and fittings, piping spray shield, pressure vessels, pump casings, switch/bistable housing, and valve bodies.

The LRA identifies that carbon steel, galvanized steel, cast iron, and copper in air are subject to loss of material due to general external corrosion, and carbon steel and low alloy steel in dripping boric acid are subject to loss of material due to boric acid corrosion. The LRA also identifies that stainless steel, carbon steel, cast iron, and bronze in raw water are subject to loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling. Galvanized steel in raw water is subject to loss of material from general, pitting and crevice corrosion, MIC, and galvanic corrosion. Brass in raw water is subject to loss of material due to pitting and crevice corrosion, MIC, and galvanic corrosion. Aluminum in raw water is subject to loss of material due to crevice and pitting corrosion, and MIC. Copper in oil (in the RCP oil collection system) is

subject to loss of material due to general, pitting, and crevice corrosion, and galvanic corrosion, and stainless steel in oil is subject to general corrosion due to contamination and pooling. Buried cast iron is subject to general corrosion and selective leaching. The LRA does not identify any aging effects for stainless steel, brass, bronze, copper, copper alloy, zinc alloy, or aluminum in air, coated carbon or brass steel in halon, or concrete in a raw water or buried environment.

### Aging Management Programs

The following AMPs are utilized to manage aging effects in the fire protection system:

- Boric Acid Corrosion Prevention Program (B.2.1)
- Fire Protection Program (B.2.5)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the fire protection system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.14.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.14-1, 3.3-1, 3.3-2, and 3.3-3 for the fire protection system. During its review, the staff determined that additional information was needed to complete its review of the fire protection system.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

In RAI 2.3.3.14-2, sent by letter dated October 11, 2002, the staff questioned why various portions of the fire protection system were not included within the scope of license renewal. In its response dated December 19, 2002, the applicant added several components to the scope of the fire protection system. The addition of these components did not result in the addition of material/environment combinations or AMPs for the fire protection system. The staff's evaluation of the scope of the fire protection system is in Section 2.3.3.14 of this SER.

For buried concrete pipes and concrete pipes exposed to raw water piping, LRA Section 2.3.3.14 cites Items 3.3.2.34 and 3.3.2.35 in LRA Table 3.3-2 for aging management. Both of these items conclude that there are no AERMs. The staff believes that concrete exposed to raw water is potentially subjected to aging degradation and requires aging management. Similarly, buried concrete is subject to aging degradation, unless the soil environment is benign. By letter dated October 11, 2002, the staff requested, in RAI 3.3.2-6, the applicant to provide justification for why concrete components in these environments do not have aging effects that require management, or provide a program to manage the aging for the buried concrete pipe carrying raw water for the fire protection system.



In its response dated December 19, 2002, the applicant stated that there is no flowing water around and within the pipe; therefore, change in material properties due to leaching of calcium hydroxide is not an applicable aging effect. The applicant's response further stated that the ground water and the river water (raw water) have been tested and found to be benign (sulfates < 1,500 ppm, chlorides < 500 ppm, and pH > 5.5); therefore, change of material properties and loss of material due to aggressive chemical attack are not applicable aging effects. Further, the applicant stated that the concrete pipe was recently inspected during a plant modification that required excavation in the vicinity, and that the exterior and interior surfaces of the pipe showed no signs of degradation. Based on the additional information provided by the applicant, the staff finds the aging management of the concrete piping to be acceptable because the concrete pipe is not in an aggressive environment.

In RAI 3.3.1-10, the staff requested clarification of the environments of the fire water pumps, since the LRA did not differentiate between the internal and external environment for the pump. In its response dated December 19, 2002, the applicant stated that the fire pumps are wet pit, vertical turbine pumps so that both the internal and external environments are raw water and, as such, receive the same aging management. The staff finds this response reasonable and acceptable.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects identified for the fire protection system components described in LRA Tables 2.3.3.14-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the fire protection system.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the fire protection system:

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Fire Protection Program (3.0.3.9)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.6, 3.0.3.9, 3.0.3.10, and 3.0.3.12, respectively, of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the fire protection system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with fire protection

system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.14.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in the fire protection system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the fire protection system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.15 Raw Water

##### 3.3.2.4.15.1 Summary of Technical Information in the Application

The description of the raw water system can be found in Section 2.3.3.15 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.15-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

##### Aging Effects

LRA Table 2.3.3.15-1 lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, filters/strainers, flow element/orifice, heat exchanger, indicator (sight glass), orifice plate, pipes and fittings, pump casings, traveling screen frame, and valve bodies.

The LRA states that carbon steel, galvanized steel, cast iron, and copper in air are subject to loss of material due to general external corrosion, and carbon steel and low alloy steel in dripping boric acid are subject to loss of material due to boric acid corrosion. The LRA also states that stainless steel, carbon steel, cast iron, and bronze in raw water are subject to loss of material due to general, pitting, and/or crevice corrosion, galvanic corrosion, MIC, biofouling, buildup of deposits, and/or selective leaching. Stainless steel in oxygenated treated water less than 200 °F is subject to loss of material from crevice and pitting corrosion, while stainless steel in corrosion-inhibited treated water is subject to cracking. Carbon steel in corrosion-inhibited water is subject to loss of material. The LRA does not identify any aging effects for stainless steel in air, or for polysulfone in air or raw water.

##### Aging Management Programs

The following AMPs are utilized to manage aging effects in the raw water system:

- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)

- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- Selective Leaching Program (B.3.6)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the raw water system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.15.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.15-1, 3.3-1, 3.3-2, and 3.3-3 for the raw water system. The staff also reviewed the applicant's responses to the staff's RAIs.

LRA Table 2.3.3.15-1 refers to LRA Table 3.3-1 item 16 for several components. LRA Table 3.3-1 Item 16 covers the loss of material of stainless steel, carbon steel, cast iron, and bronze in raw water, as discussed in GALL. The staff notes that for many of the GALL components that utilize Table 3.3-1 Item 16, the GALL also identifies selective leaching of materials as an applicable aging effect. The selective leaching of these components should be addressed via LRA Table 3.3-1 Item 24, but the LRA does not refer to LRA Table 3.3-1 Item 24 for the raw water system. During the AMR inspection, the staff verified that the cooling water corrosion program will adequately identify and manage any selective leaching that could occur in the raw water system. The staff finds this acceptable.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the information included in the applicant's responses to the the staff's RAI, the staff finds that the aging effects identified for the raw water system components described in LRA Tables 2.3.3.15-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments, with the clarification discussed above. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the raw water system.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the raw water system:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These AMP are evaluated in Sections 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, 3.0.3.12 and 3.0.3.14, respectively, of this SER.

On the basis of its review of the information provided in the LRA, and based on the on-site inspection and audit, as discussed above, the staff concludes that the above identified AMPs will effectively manage the aging effects of the raw water system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with raw water system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.15.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in the raw water system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the raw water system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.16 Component Cooling Water

##### 3.3.2.4.16.1 Summary of Technical Information in the Application

The description of the CCW can be found in Section 2.3.3.16 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.16-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

LRA Table 2.3.3.16-1 lists individual system components that are within the scope of license renewal and subject to an AMR. The components include accumulators, bolting, filters/strainers, flow element/orifice, heat exchanger, indicator (sight glass), pipes and fittings, pump casings, and valve bodies.

The LRA states that carbon steel, galvanized steel, and copper in air are subject to loss of material due to general external corrosion. Carbon steel, low-alloy steel, galvanized steel, cadmium-plated steel, cast iron, and copper alloy in dripping boric acid are subject to loss of material due to boric acid corrosion. The LRA also states that stainless steel and carbon steel exposed to corrosion-inhibited treated water are subject to loss of material due to general, pitting, and/or crevice corrosion, MIC, and/or cracking. Copper alloy and nickel-base alloy in

corrosion-inhibited treated water is subject to loss of material due to crevice and pitting corrosion, galvanic corrosion, and MIC, and copper alloy in corrosion-inhibited treated water is subject to cracking due to SCC. Brass in corrosion-inhibited treated water is subjected to cracking due to SCC. Cast iron and bronze in raw water and soil are subject to selective leaching. Carbon steel and cadmium-plated steel exposed to lubricating oil (with potential water contamination) are subject to loss of material. The LRA does not identify any aging effects for stainless steel or glass in air, or glass in corrosion-inhibited treated water.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the CCW:

- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- Selective Leaching Program (B.3.6)

These programs are described in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of CCW will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.16.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.16-1, 3.3-1, 3.3-2, and 3.3-3 for CCW. During its review, the staff determined that additional information was needed to complete its review.

In the LRA, the applicant identified the environments for cast iron or bronze pump casings as raw water or soil (link 3.3.1.24). The identified environments do not appear consistent with the description of CCW in the LRA or the USAR. By letter dated October 11, 2002, the staff requested, in RAI 3.3.1-11, the applicant to clarify the material and environment for the CCW pumps. By letter dated December 19, 2002, the applicant clarified that the pump casing is cast iron exposed to treated water, and that is consistent with GALL. The applicant credits the selective leaching program, the chemistry program, and the cooling water corrosion program to manage this component. The staff finds this acceptable because the applicant's clarification is consistent with the GALL Report.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3.3-1 pertaining to aging effects of boric acid corrosion for components in air exposed to leaking and dripping borated treated water. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects identified for CCW components described in LRA Tables 2.3.3.16-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in CCW.

#### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in CCW:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- Selective Leaching Program (3.0.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These AMP are evaluated in Sections 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, 3.0.3.12 and 3.0.3.14 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of CCW.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the component cooling water system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.16.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in CCW, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the component cooling water system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.17 Liquid Waste Disposal

##### 3.3.2.4.17.1 Summary of Technical Information in the Application

The description of the liquid waste disposal (LWD) system can be found in Section 2.3.3.17 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.17-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

### Aging Effects

Table 2.3.3.17-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, pipes and fittings, pump casings, and valve bodies.

The LRA states that carbon steel, galvanized steel, and copper in air are subject to loss of material due to general external corrosion, and carbon steel and low alloy steel in dripping boric acid are subject to loss of material due to boric acid corrosion. The LRA also states that stainless steel in borated treated water was subject to cracking due to stress corrosion cracking. The LRA does not identify any aging effects for stainless steel in air or concrete, or for carbon steel or cast iron in concrete.

### Aging Management Programs

The following AMPs are utilized to manage aging effects in the LWD system:

- Bolting Integrity Program (B.1.1)
- Boric Acid Corrosion Prevention Program (B.2.1)
- General Corrosion of External Surfaces Program (B.3.3)

The applicant concluded that the effects of aging associated with the components of the LWD system will be adequately managed by these AMPs during the period of extended operation.

### 3.3.2.4.17.2 Staff Evaluation

#### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.17-1, 3.3-1, 3.3-2, and 3.3-3 for the LWD system. During its review, the staff determined that additional information was needed to complete its review.

The staff noted that LRA Table 2.3.3.17-1 deals primarily with external environments and did not appear to cover the internal environments that would be expected in a LWD system. By letter dated October 11, 2002, the staff requested, in RAI 3.3.1-12, the applicant to describe the internal environment(s) of the system.

In its response dated December 19, 2002, the applicant stated that the system internal environment was primarily borated treated water inside containment, and raw water (fire water) in the auxiliary building. The applicant stated that LRA Table 3.3.2 Item 96 covered the stainless steel piping in the borated water environment. The applicant added a link to Table 3.3.1 Item 16 to cover carbon steel and stainless steel pipes, fittings, and valve bodies in raw water. For these carbon steel and stainless steel components that are exposed to raw water (fire protection water), the corresponding aging effect is loss of material due to general, pitting,

crevice, and galvanic corrosion, MIC, and biofouling. Since for many plants the LWD system is connected to floor drains, the staff questioned the applicant's assertion that the piping inside containment is only subject to borated treated water. The staff believed that the environment may contain higher concentrations of impurities than would be found in borated treated water and, consequently, the applicant may not have adequately identified the aging effects for the piping inside containment. By letter dated February 20, 2003, the staff issued POI-10(d), requesting the applicant to address the potential for higher concentrations of impurities in this system, and the resultant effect on aging. By letter dated March 14, 2003, the applicant responded to POI-10(d) by stating that LRA Table 2.3.3.17-1 has been modified to change the intended functions from "pressure boundary" and "water suppression support" to "fluid boundary." The waste disposal drain piping that is not within scope does not have a pressure retention function because it is never pressurized. It is in scope only for fire water removal in the event of a fire. The applicant stated that a drainage channel is present on the floor once the concrete sets around the embedded piping, and the drainage function would still be completed without the piping.

The applicant also stated that there are no contaminants in containment that would cause additional AERMs beyond those already included for this piping. Stainless steel in a water environment is only subject to cracking, a conservative assumption for this application because for cracking to occur in stainless steel, specific halide levels are required with elevated temperatures and material stress. None of these are present in the LWD piping, therefore, cracking could not occur. Further, in its March 14, 2003, response to POI-10(f) (discussed below), the applicant stated that the drain lines at FCS are pitched to drain, do not contain dead legs, are only subjected to trickle flow, and the water most likely to be drained does not contain sediment. Additionally, the applicant stated that the piping is normally dry. The staff reviewed the applicant's response and finds it acceptable because the AERMs associated with the piping are already addressed. On this basis, POI-10(d) is resolved.

It should be noted that the applicant's response to RAI 3.3.1-12 also stated that the pump casings were not within the scope of license renewal because the pumps are not required for the LWD system to perform its intended license renewal function of firewater removal. However, LRA Table 2.2.3.17-1 includes pump casings as a component that requires an AMR. This is consistent with the system description in the LRA and the associated boundary drawings; therefore, the staff finds this acceptable.

For pipes and fittings in LRA Table 2.3.3.17-1, the LRA refers to carbon steel and stainless steel in a concrete environment (LRA Table 3.3-2, Items 3.3.2.22, 3.3.2.26, and 3.3.2.65) and concludes that there are no applicable aging effects. Industry experience has shown that carbon steel can degrade in a concrete environment. By letter dated October 11, 2002, the staff requested, in RAI 3.3.1-13, the applicant to provide additional information on the concrete environment to demonstrate that there are no applicable aging effects, or provide a program to manage aging of these pipes and fittings. In its response dated December 19, 2002, the applicant stated that, if through-wall perforation of the LWD system piping occurred, there would still be a clear channel for drainage of fire suppression water from the area of concern down to the sump, and therefore no aging management is required. While this is generally in keeping with the intended function of the system, the applicant had not demonstrated that the aging would be limited to a through-wall perforation as opposed to blockage of the piping. By letter dated February 20, 2003, the staff issued POI-10(f), requesting the applicant to justify the assumption that aging of the piping in question will not lead to blockage. By letter dated March



14, 2003, the applicant responded to POI-10(f) by stating that the drain lines at FCS are pitched to drain, do not contain dead legs, are subject to trickle flow rather than full flow, and the water most likely to be drained does not contain any sediment (as is contained in raw water). Also, since the piping is normally dry, any material buildup that could produce blockage is unlikely. Finally, the piping diameter is such that, should swelling occur as a result of corrosion, total blockage of the flow path would not occur. The staff reviewed the applicant's response and finds it acceptable because the information supports the conclusion that blockage of piping is not likely to occur. POI-10(f) is resolved.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to descriptions of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.3.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects identified for the LWD system components described in LRA Tables 2.3.3.17-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, with the exception of the above, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the LWD system.

#### Aging Management Programs

In addition to the three AMPs identified in the LRA, the applicant's response to RAI 3.3.1-12 states that the cooling water corrosion program will be used for the piping in the auxiliary building. The following AMPs are credited for managing the aging effects in the liquid waste disposal system:

- Bolting Integrity Program (3.0.3.1)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- General Corrosion of External Surfaces Program (3.0.3.12)

LRA Table 3.3.2 states that the PS/PMP will provide the aging management for the stainless steel components in the borated treated water environment. Section 2.3.3.17 of the LRA indicates that these components are within the scope of license renewal due to their function to provide containment isolation. The staff notes that, while borated treated water may be the expected environment during an event for which this system has a license renewal intended function, in many plants the LWD system is connected to floor drains and, as such, the piping inside containment is likely to contain water with higher impurities than borated treated water. Therefore, citing this environment may not result in an adequate frequency of inspection or inspection for all applicable aging effects. By letter dated February 20, 2002, the staff issued POI-10(e), requesting the applicant, if there is a potential for higher concentrations of impurities in the system, to verify that the type of inspections and the inspection frequency are appropriate. By letter dated March 14, 2003, the applicant responded to POI-10(e) by restating its response to POI-10(d), that there are no contaminants in containment that would cause additional AERMs beyond those already included for this piping. Stainless steel in a water environment is only subject to cracking (a conservative assumption for this application because for cracking to occur in stainless steel, specific halide levels are required with elevated

temperatures and material stress. None of these are present in the LWD piping. Therefore, cracking could not occur. The staff reviewed the applicant's response and finds it acceptable because all applicable aging effects are already addressed. On this basis, POI-10(e) is resolved.

Section 2.3.3.17 of the LRA indicates that the components in the auxiliary building are in the scope of license renewal due to their function of providing flood mitigation. These components are connected to floor drains. The staff notes that the LRA Table 3.3.1 item 16 link that was added in the response to RAI 3.3.1-12 for these components credits the cooling water corrosion program for aging management. For the raw water environment, the cooling water corrosion program is essentially a GL 89-13 program designed for cooling water systems. It is not clear to the staff how this program will be used to manage the aging of piping in the LWD system. By letter dated February 20, 2003, the staff issued POI-10(g) requesting the applicant to describe how the cooling water corrosion program will be used to manage the aging of piping in the liquid waste system. By letter dated March 14, 2003, the applicant responded to POI-10(g) by clarifying that link 3.3.1.16 in LRA Table 2.3.3.17-1 for "Pipes & Fittings" and "Valve Bodies" was an error and has been deleted (a revised LRA Table 2.3.3.17-1 was provided with the POI response). On the basis of the revision, the staff finds the applicant's response acceptable. POI-10(g) is resolved.

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.1, 3.0.3.6, 3.0.3.7, and 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the staff's RAIs, the staff concludes that the above identified AMPs will effectively manage the aging effects of the liquid waste disposal system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the liquid waste disposal system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.17.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs for managing the aging effects, for components in the liquid waste disposal system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the liquid waste disposal system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.18 Gaseous Waste Disposal

#### 3.3.2.4.18.1 Summary of Technical Information in the Application

The description of the gaseous waste disposal (GWD) system can be found in Section 2.3.3.18 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.18-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

##### Aging Effects

Components of the GWD system are described in LRA Section 2.3.3.18 as being within the scope of license renewal, and subject to an AMR. LRA Table 2.3.3.18-1 lists individual components of the system including bolting, heat exchanger, pipes and fittings, and valve bodies. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion, and MIC from exposure to ambient (warm, moist) air. Exposure of stainless steel components to ambient air and gas-nitrogen air has no aging effects. Closure bolting and external surfaces of carbon steel and low-alloy steel components are identified as being subject to loss of material due to boric acid corrosion from exposure to borated water leaking from adjacent systems or components containing borated treated water. Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion from exposure to corrosion-inhibited treated water. In addition, carbon steel components are identified as being subject to loss of material due to general, pitting, crevice, and galvanic corrosion from exposure to oxygenated treated water with a temperature less than 200 °F. Stainless steel components are identified as being subject to cracking due to exposure to halogens and sulfates. Stainless steel components are also identified as being subject to crevice and pitting corrosion from exposure to oxygenated treated water with a temperature less than 200 °F. In addition, stainless steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion from exposure to corrosion-inhibited treated water.

##### Aging Management Programs

The following AMPs are utilized to manage aging effects in the GWD system:

- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.6)
- Cooling Water Corrosion Program (B.2.2)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the GWD system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.18.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.18-1, 3.3-1, 3.3-2, and 3.3-3 for the GWD system. During its review, the staff determined that additional information was needed to complete its review.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff finds that the aging effects that result from contact of the GWD system SSCs to the environments described in LRA Tables 2.3.3.18-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the GWD system.

#### Aging Management Program

The applicant credited the following AMPs for managing the aging effects in the GWD system:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.10, and 3.0.3.12 of this SER.

On the basis of its review of the information provided in the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the GWD system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the gaseous waste disposal system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.18.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the gaseous waste disposal system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the gaseous waste disposal system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.19 Primary Sampling

##### 3.3.2.4.19.1 Summary of Technical Information in the Application

The description of the primary sampling (PS) system can be found in Section 2.3.3.19 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.19-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

Table 2.3.3.19-1 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include bolting, heat exchanger, pipes and fittings, and valve bodies.

Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion from exposure to ambient (warm, moist) air, dripping boric acid, or corrosion-inhibited treated water. Carbon steel and low-alloy steel bolting are identified as being subject to loss of material and cracking. Stainless steel components exposed to deoxygenated treated water greater than 200 °F and corrosion-inhibited treated water are subject to cracking and loss of material due to crevice and pitting corrosion. Stainless steel exposed to borated treated water is subject to stress corrosion cracking. Brass, copper alloy, and nickel-based alloy in corrosion-inhibited treated water are subject to loss of material due to pitting, crevice, and galvanic corrosion, and/or MIC. Nickel-base alloy exposed to deoxygenated treated water greater than 200 °F is subject to cracking due to crevice corrosion, pitting corrosion, and MIC. No aging effects are identified for the following - stainless steel, brass, bronze, copper, copper alloy, copper-zinc alloy, and nickel-base alloy exposed to ambient air, or copper and copper alloy in refrigerant.

The heat exchanger for primary water, and the pipes, fittings, and valve bodies for secondary water, are subject to time-limiting aging analyses for fatigue.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects in the primary sampling system:

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Cooling Water Corrosion Program (B.2.2)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)

These programs are described in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the PS system will be adequately managed by these AMPs during the period of extended operation.

#### 3.3.2.4.19.2 Staff Evaluation

##### Aging Effects

The staff reviewed the information in LRA Tables 2.3.3.19-1, 3.3-1, 3.3-2, and 3.3-3 for the PS system. The staff also reviewed the applicant's responses to the staff's requests for additional information.

By letter dated October 11, 2002, the staff issued RAI 3.3-2 pertaining to the description of the internal and external environments included in the LRA. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the information included in the applicant's responses to the RAI, the staff finds that the aging effects identified for the PS system components described in Tables 2.3.3.19-1, 3.3-1, 3.3-2, and 3.3-3 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the PS system.

##### Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the PS system:

- Bolting Integrity Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Cooling Water Corrosion Program (3.0.3.7)
- General Corrosion of External Surfaces Program (3.0.3.12)
- One-Time Inspection Program (3.0.3.13)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.1, 3.0.3.2, 3.0.3.6, 3.0.3.7, 3.0.3.12, and 3.0.3.13, respectively, of this SER.

The applicant's response to RAI 3.3-2 clarifies that deoxygenated treated water greater than 200 °F corresponds to secondary water. The staff notes that for nickel-base alloy in this environment, the applicant credits inspections under the cooling water corrosion program to verify the effectiveness of the chemistry program for a heat exchanger; however, the cooling water corrosion program is designed for the closed cooling system, which is the "other side" of the heat exchanger. During the onsite AMR inspection and audit, the staff verified that the applicant is performing inspections of the nickel-base alloy in secondary water as part of the cooling water corrosion program activities. The staff finds this acceptable.

The fatigue of the PS system is addressed by two TLAAs. For the heat exchanger (which cools primary water), the applicant refers to the TLAA in Section 4.3.1 of the LRA, "Reactor Coolant and Associated System Fatigue." For the valves, piping, and fittings associated with the secondary water, the applicant refers to the TLAA in Section 4.3.4 of the LRA, "Fatigue of Class II and III Components." These TLAAs are evaluated in Section 4.3 of this SER.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff concludes that the above identified AMPs and TLAAs will effectively manage the aging effects of the PS system.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with primary sampling system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.19.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and has adequate AMPs and TLAAs for managing the aging effects, for components in the primary sampling system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the primary sampling system to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.20 Radiation Monitoring-Mechanical

##### 3.3.2.4.20.1 Summary of Technical Information in the Application

The description of the radiation monitoring system (RMS) can be found in Section 2.3.3.20 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3.20-1. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1, 3.3-2, and 3.3-3.

#### Aging Effects

LRA Table 2.3.3.20-1 lists individual components of the system including bolting, filters/strainers, pipes and fittings, pump casings, and valve bodies. The LRA states that the components are constructed of stainless steel, brass, bronze, copper, copper alloy and/or copper-zinc alloy, and are exposed to air. In addition, the LRA states that exposure of these components to ambient air does not result in any aging effects requiring management.

#### Aging Management Programs

The LRA states that exposure of the RMS components to ambient air does not result in any aging effects requiring management; therefore, the applicant did not identify any AMPs for this system.

#### 3.3.2.4.20.2 Staff Evaluation

The staff reviewed the information in LRA Tables 2.3.3.20-1, 3.3-1, 3.3-2, and 3.3-3 for the RMS, and the applicant's responses to the staff's RAI. The LRA states that the stainless steel, brass, bronze, copper, copper alloy and/or copper-zinc alloy components are exposed to "ambient air." In its December 19, 2002, response to RAI 3.3-2, the applicant clarified that for the purposes of the AMR, there was no differentiation between indoor air, outdoor air, or containment air relative to the applicable AERMs, and that all applicable AERMs that could apply for worst case ambient air conditions were assumed. The staff finds this clarification reasonable for the RMS. The staff's evaluation of the applicant's response to RAI 3.3-2 is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff finds that the applicant's assessment of the aging effects of the RMS components is consistent with industry experience for these combinations of materials and environments. Therefore, the staff concurs that the above components do not require aging management.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with radiation monitoring-mechanical system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.3.2.4.20.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects for components in the RMS, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in the radiation monitoring-mechanical system to satisfy 10 CFR 54.21(d).

#### 3.3.2.5 General AMR Issues

This section discusses the staff's evaluation of three general AMR issues that are applicable to components in several auxiliary systems included in Section 3.3 of the LRA.

##### 3.3.2.5.1 Internal and External Environments

Numerous tables included in the application list the component material and the environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. It should be noted that aging effect depends on the component material as well as the plant-specific environment characteristic. For example, the aging effect of a component exposed to an air environment is dependent, in part, on the type of air, the temperature, the oxygen content, and the water content (humidity), etc. By letter dated October 11, 2002, the staff requested, in RAI 3.3-2, the applicant to provide a description of these environments included in the LRA.



In its response dated December 19, 2002, the applicant provided a description of the internal and external environments included in the LRA. The applicant stated that in the FCS LRA, the environments used in the Section 3 AMR tables match those that are used in the GALL Report. In all of the 3.X-1 tables, each line item corresponds exactly with a GALL Report line item. The same is true for the 3.X-3 tables. Where there is a differentiation relative to the temperature, oxygen content, use of a corrosion inhibitor, etc., within an environment specified in the GALL Report (e.g., high temperature borated treated water, deoxygenated treated water >200 °F, oxygenated treated water <200 °F, etc.), the same differentiation has been used in the FCS LRA.

For ambient air at FCS, to simplify the IPA and review processes, there was no differentiation made between indoor air, outdoor air, or containment air relative to applicable AERMs. All applicable AERMs that could apply for worst-case ambient air conditions were assumed wherever a material was subjected to an ambient air environment. The use of descriptors such as plant indoor air, outdoor air, ambient air, containment air, etc., were used to address locale only and had nothing to do with the determination of AERMs. In addition, a component in ambient air could be subjected to local borated water leakage. Then, the AERMs associated with exposure to borated water would apply.

On the basis of its review, the staff finds the applicant's response acceptable because the information provided by the applicant defines and clarifies these environments included in the LRA.

#### 3.3.2.5.2 Elastomer Components in Ventilation Systems

Numerous ventilation systems discussed in LRA Section 2.3 include elastomer components in the system. Normally ventilation systems contain elastomer materials in duct seals, flexible collars between ducts and fans, rubber boots, etc. For some plant designs, elastomer components are used as vibration isolators to prevent transmission of vibration and dynamic loading to the rest of the system. In LRA Table 3.3-1, row number 3.3.1.02, the applicant identified the aging effects of hardening, cracks, and loss of strength due to elastomer degradation, and loss of material due to wear for these elastomer components. To manage these aging effects, the applicant relied on its general corrosion of external surfaces program, described in LRA Section B.3.3. The description for this program identifies loss of material and cracking as plausible aging effects. The applicant stated that these aging effects can be detected by visual observation and inspection of external surfaces performed at intervals based on previous inspections and industry experience. By letter dated October 11, 2002, the staff requested, in RAI 3.3.1-1, the applicant to clarify the discrepancy between LRA Table 3.3-1, row number 3.3.1.02, and LRA Section B.3.3 regarding the aging effects of concern. Specifically, the applicant is requested to clarify whether hardening and loss of strength are considered in the general corrosion of external surfaces program, and how these aging effects will be detected and managed using this program. In addition, the applicant was requested to provide the frequency of the subject inspection described in LRA Section B.3.3 for the applicable elastomer components, including a discussion of the operating history to demonstrate that the applicable aging effects will be detected prior to the loss of their intended function.

In its response dated December 19, 2002, the applicant stated that the aging effects of hardening and loss of strength for elastomers are not included in the general corrosion of

external surfaces program (B.3.3). Enhancements will be made to add these AERMs to preventive maintenance tasks under the PS/PMP (B.2.7) to specifically perform hands on type inspections of elastomer expansion joints, seals, and vibration isolators within the scope of license renewal for hardening and loss of strength. Applicable PMs are performed at least once per refueling cycle (approximately 18 months). The PS/PMP has been added to Discussion Item 2 in AMR Item 3.3.1.02.

Relative to monitoring for cracks and loss of material, procedural guidance requires system engineers to perform walkdowns of their assigned systems on a quarterly basis, as a minimum. Operator walkdowns occur multiple times per 12-hour shift. No instances of the loss of ventilation system intended function due to failure of elastomers have been found in existing corrective action documentation.

On the basis of its review, the staff finds the applicant's response adequate and acceptable because the information provided by the applicant clarifies that the aging effects of hardening and loss of strength for elastomers are managed by the PS/PMP that are performed at least once per refueling cycle, the monitoring for cracking and loss of material are performed during the walkdowns by system engineers on a quarterly basis, as a minimum, and no instances of the loss of ventilation system intended function due to failure of elastomers have been found in existing corrective action documentation. Therefore, the applicant has demonstrated that the applicable aging degradations of these elastomer components will be detected prior to the loss of their intended function.

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects for elastomer components in ventilation systems such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program description and concludes that the USAR Supplement provides an adequate program description of the AMP credited for managing aging in elastomer components in ventilation systems to satisfy 10 CFR 54.21(d).

#### 3.3.2.5.3 Boric Acid Corrosion

For several components in the auxiliary systems, the applicant referred to LRA Table 3.3-3, row number 3.3.3.09, for the AMR results for these components. In that table, the applicant identified "ambient air" as the environment and credited the boric acid corrosion prevention program for managing the aging effect. The applicant also referred to row number 3.3.1.13 of LRA Table 3.3-1 as the applicable GALL Report AMR result. The staff noted that the GALL Report item addresses aging effects for the component group in air exposed to leaking and dripping borated treated water. By letter dated October 11, 2002, the staff requested, in RAI 3.3.3-1, the applicant to clarify that "boric water leaks" rather than "ambient air" is the environment characteristic of concern.

In its response dated December 19, 2002, the applicant stated that the normal environment for these components is ambient air. It is possible, although improbable, that there can be leakage of water from borated water systems onto exposed carbon steel surfaces. For this reason, that possibility is covered by providing the link through AMR Item 3.3.3.09 to AMR Item 3.3.1.13, which corresponds to GALL Report Item VII.I.1-a. In addition, LRA Table 3.3-3, row number

3.3.3.09, has been revised to read “Loss of material due to boric acid corrosion” in the FCS AERMs column to correctly match AMR Item 3.3.1.13.

On the basis of its review, the staff finds the applicant’s response adequate and acceptable because the information provided by the applicant clarifies that “boric water leaks” rather than “ambient air” is the environment characteristic of concern and that is consistent with the corresponding GALL Report Item VII.1.1-a.

#### 3.3.2.5.4 Conclusions

The staff has evaluated the general AMR issues discussed above and concludes that on the basis of the staff’s review of the LRA and the applicant’s responses to the staff’s RAIs, the applicant has adequately considered (1) internal and external environments, (2) elastomer components in ventilation systems, and (3) boric acid corrosion, in its aging management evaluations, and that the components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program description and concludes that the USAR Supplement provides an adequate program description of the AMP credited for managing aging in elastomer components in ventilation systems to satisfy 10 CFR 54.21(d).

### 3.3.3 Evaluation Findings

The staff has reviewed the information in Section 3.3 of the LRA. On the basis of its review, the staff concludes that, pending satisfactory resolution of Open Item 3.3.2.4.1.2-1, the applicant has demonstrated that the aging effects associated with the auxiliary systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the auxiliary systems to satisfy 10 CFR 54.21(d).

## 3.4 Steam and Power Conversion Systems

This section addresses the aging management of the components of the steam and power conversion systems (SPCS) group. The systems that make up the SPCS group are described in the following SER sections:

- Feedwater (2.3.4.1)
- Auxiliary Feedwater (2.3.4.2)
- Main Steam and Turbine Steam Extraction (2.3.4.3)

As discussed in Section 3.0.1 of this SER, the components in each of the SPCS are included in one of three LRA tables. LRA Table 3.4-1 consists of SPCS components that are evaluated in the GALL Report, LRA Table 3.4-2 consists of SPCS components that are not evaluated in the GALL Report, and LRA Table 3.4-3 consists of SPCS components that are not evaluated in the

GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP.

#### 3.4.1 Summary of Technical Information in the Application

In LRA Section 3.4, the applicant described its AMRs for the SPCS group at FCS. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.4.1-1, 2.3.4.2-1, and 2.3.4.3-1.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management based on FCS operating experience were consistent with aging effects identified in GALL. The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL. The applicant's ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

#### 3.4.2 Staff Evaluation

In Section 3.4 of the LRA, the applicant described its AMR for the SPCS at FCS. The staff reviewed Section 3.4 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the SPCS components that are determined to be within the scope of license renewal and subject to an AMR.

The systems that make up the SPCS group are (1) feedwater, (2) auxiliary feedwater, and (3) main steam and turbine steam extraction. Generally, the steam generator blowdown system is also within the scope of license renewal and included as one of the SPCS. In RAI 2.3.4-1, the staff requested further information regarding the omission of this system from the SPCS. In response, the applicant stated that the steam generator blowdown system is within the scope of license renewal; however, the system has not been evaluated as a separate system. Rather, the steam generator blowdown system has been evaluated within other in-scope systems. Further discussion regarding the steam generator blowdown system can be found in Section 2.3.4 of this SER.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of SPCS components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report.

Table 3.4-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.4 that are addressed in the GALL Report.

Table 3.4-1

Staff Evaluation Table for FCS Steam and Power Conversion System  
Components Evaluated in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping and Fittings in main feedwater line, steam line and AFW piping (PWR only)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation (See Section 3.4.2.2.1 below)
Piping and fittings, valve bodies and bonnets, pump casings, tanks, tubes, tubesheets, channel head and shell (except main steam system)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water chemistry and one-time inspection	Chemistry Program and One-Time Inspection Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.4.2.2.2 below)
Auxiliary feedwater (AFW) piping	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Plant specific	Not applicable to FCS. AFW piping at FCS is not exposed to untreated water from a backup water supply	Different from GALL (See Section 3.4.2.2.3 below)
Oil coolers in AFW system (lubricating oil side possibly contaminated with water)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, and MIC	Plant specific	Periodic Surveillance and Preventive Maintenance Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.4.2.2.5 below)
External surface of carbon steel components	Loss of material due to general corrosion	Plant-specific	General Corrosion of External Surfaces Program, Chemistry Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.4.2.2.4 below)
Carbon steel piping and valve bodies	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	Flow-accelerated corrosion	Consistent with GALL (See Section 3.4.2.1 below)

Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water chemistry	Water chemistry	Consistent with GALL (See Section 3.4.2.1 below)
Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	Bolting integrity	Consistent with GALL (See Section 3.4.2.1 below)
Heat exchangers and coolers/condensers serviced by open-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	The combinations of materials and environment identified in the GALL Report are not applicable to FCS. The applicable heat exchangers are not serviced by open-cycle cooling water	Program Different from GALL (See Section 3.4.2.3 below)
Heat exchangers and coolers/condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-cycle cooling system	Chemistry Program, Cooling Water Corrosion Program	Program Different from GALL (See Section 3.4.2.3 below)
External surface of above-ground condensate storage tank	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Above-ground carbon steel tanks	Not applicable to FCS	Program Different from GALL (See Section 3.4.2.3 below)
External surface of buried condensate storage tank and AFW piping	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	Not applicable to FCS	Program Different from GALL (See Section 3.4.2.3 below)
External surface of carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Corrosion Prevention	Consistent with GALL (See 3.4.2.1 below)

The staff's review of the SPCS for the FCS LRA is contained within four sections of this SER. Section 3.4.2.1 is the staff review of components in the SPCS that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.4.2.2 is the staff review of components in the SPCS that the applicant indicates are consistent with GALL and GALL recommends further evaluation. Section 3.4.2.3 is the staff evaluation of AMPs that are specific to the SPCS. Section 3.4.2.4 contains an evaluation of the adequacy of aging management for components in each system in the SPCS and includes an evaluation of components in the SPCS that the applicant indicates are not in GALL. This section is divided into three subsections, feedwater, auxiliary feedwater, and main steam and turbine steam extraction, which are the three systems that the applicant has identified as within the SPCS group.

### 3.4.2.1 Aging Management Evaluations in the GALL Report that Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled

components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups during the AMR inspection to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

On the basis of its review of the inspection results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for SPCS components. Therefore, on this basis, the staff concludes that the applicant has demonstrated that the components for which the applicant claimed consistency with GALL will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2 Aging Management Evaluations in the GALL Report that Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

The GALL Report indicates that further evaluation should be performed for the aging effects described in the following sections:

##### 3.4.2.2.1 Cumulative Fatigue Damage

As stated in the SRP-LR, fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

In LRA Table 3.4-1, row number 3.4.1.01 relates to cumulative fatigue damage of auxiliary feedwater piping and fittings, which is managed by a TLAA, as specified in The GALL Report, Volume 2, VIII.G.1-b. In RAI 3.4.1-13, the staff requested the applicant to clarify whether the TLAA covers the entire auxiliary feedwater system, or just a portion of the system. Note that for the main steam and feedwater systems, GALL line item VII.D1.1-b specifies that only a portion of the piping can utilize a TLAA.

In its response dated December 12, 2002, the applicant referred to Section 4.3.4 of the LRA for discussion relative to the fatigue considerations of Class II and III piping. The applicant stated the following:

The design code operational limits for this piping, is based on 7000 cycles, is being treated as a TLAA, and is included within the scope of the Fatigue Monitoring Program (B.2.4). Since the Auxiliary Feedwater system is fed

from a storage tank inside the Auxiliary Building, the only portions of the AFW system which actually see thermal fatigue cycles are the nozzles and a short section of piping off the Steam Generators.

The staff finds the applicant's response acceptable because it clarifies the scope of the AFW components which are subject to the cumulative fatigue TLAA.

Industry operating experience has identified cracking from mechanical vibration as a potential aging effect for the piping system components in the SPCS. Given this experience, the staff requested the applicant, in RAI 3.4.2-1, to explain why mechanical vibration is not identified as an applicable aging effect for components in the SPCS.

In its response dated December 19, 2002, the applicant stated the following:

Cracking is already identified and managed as an AERM for applicable components in the Steam and Power Conversion Systems. Mechanical vibration is a mechanism that can result in cracking. At FCS, mechanical vibration is not considered to be an aging issue. It is a design issue. When it occurs, it typically involves the misapplication of mechanical components, the improper sizing of components or piping, the improper location of piping fittings that change flow direction, or some combination of these. As such, cases of mechanical vibration problems, especially where damage has occurred, are eliminated via design changes.

The staff finds the applicant's response reasonable and acceptable because it provides an explanation of how mechanical vibration problems are eliminated at FCS. The RAI issue is therefore considered resolved.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cumulative fatigue damage for components in the SPCS, as recommended in the GALL Report.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for the SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated cumulative fatigue damage for SPCS components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

As stated in the SRP-LR, the GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of carbon steel piping and fittings, valve bodies and bonnets, pump casings, pump suction and discharge lines, tanks, tubesheets, channel heads, and shells (except for main steam system components), and for loss of material due to crevice and pitting corrosion for stainless steel tanks and heat exchanger/cooler tubes. The GALL water chemistry program relies on monitoring and control of water chemistry, based on the guidelines in EPRI TR-102134, "PWR Secondary Water Chemistry Guideline," Revision 3, May 1993, for secondary water chemistry in PWRs, to



manage the effect of loss of material due to general, pitting, or crevice corrosion. However, corrosion may occur at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring.

The applicant proposed a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring. The staff reviewed the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. The staff also verified that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards.

With regard to the one-time inspection and the water chemistry programs, GALL recommends inspection of stagnant areas based on severity of condition, time of service, and lowest design margin. In RAI 3.4.1-11, the staff requested the applicant to identify these worst-case locations for components in the feedwater, auxiliary feedwater, and main steam and turbine steam extraction systems, which utilize these programs.

In its response dated December 19, 2002, the applicant stated that the "worst-case locations will be evaluated and identified, taking into account severity of condition, time of service, and lowest design margin, as part of the implementation of the one-time inspection program (B.3.5) prior to the period of extended operation."

The staff finds the applicant's response reasonable and acceptable because it commits the applicant to developing a one-time inspection program for SPCS components which evaluates stagnant areas of the system based on severity of condition, time of service, and lowest design margin, as specified in the GALL Report. The applicant's commitment is found in Appendix A of this SER. RAI 3.4.1-11 is resolved.

The applicant has proposed the chemistry program and the one-time inspection program as the AMPs for managing loss of material due to general, pitting, and crevice corrosion. These programs are evaluated in Section 3.0.3 of this SER and are considered appropriate for managing this aging effect.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, and crevice corrosion for components in the SPCS, as recommended in the GALL Report.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that, pending satisfactory implementation of the commitment discussed above, the applicant has adequately evaluated the management of loss of material due to general, pitting, and crevice corrosion for SPCS components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is

reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2.3 Loss of Material Due to General, Pitting, and Crevice Corrosion, Microbiologically Influenced Corrosion, and Biofouling

As stated in the SRP-LR, the GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion, pitting, and crevice corrosion, MIC, and biofouling for carbon steel piping and fittings for untreated water from the backup water supply in the AFW system. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

In LRA Table 3.4-1, the applicant stated that auxiliary feedwater piping at FCS is not exposed to untreated water from a backup water supply, and therefore, the GALL review results are not applicable to FCS. In RAI 3.4.1-4, the staff stated that auxiliary feedwater piping from the emergency feedwater storage tank (EFWST) appears to be exposed to a ground water, soil and/or outdoor environment, and would fall in the category identified in the GALL Report. In addition, since there is no reference to a program for the buried piping portion of the auxiliary feedwater piping in Section 2.3.4.2-1 of the LRA, the staff requested the applicant to clarify how the aging effects for this portion of the auxiliary feedwater piping will be managed. In its response, the applicant stated the following:

The EFWST is not outside. It is located inside the Auxiliary Building, therefore, there is no buried AFW piping. Refer to boundary drawing 11405-M-254, Sheet 2. This drawing shows that the tank is located in the Auxiliary Building.

During the AMR inspection and audit, the staff reviewed the auxiliary feedwater water sources and confirmed that auxiliary feedwater piping is not exposed to untreated water. On the basis of the applicant's response to RAI 3.4.1-4, along with the staff's inspection and audit findings, the staff finds that the applicant has correctly concluded that auxiliary feedwater piping is not exposed to untreated water and this aging effect is not applicable.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of loss of material due to general pitting, and crevice corrosion, microbiologically-influenced corrosion, and biofouling for SPCS components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2.4 Loss of Material Due to General Corrosion

As stated in the SRP-LR, the GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion for external surfaces of all carbon steel

structures and components, including closure bolting, exposed to operating temperatures less than 212 °F. Such corrosion may be due to air, moisture, or humidity. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

LRA Table 2.3.4.2-1, which lists components subject to AMR for the auxiliary feedwater system, refers to items 3.4.1.02 and 3.4.1.05 for AMR results for tanks. These links in LRA Table 3.4-1 lead to the chemistry program (B.1.2), one-time inspection program (B.3.5), and general corrosion for external surfaces program (B.3.3). However, the one-time inspection program (B.3.5) does not have LRA Table 3.4-1 within its scope and therefore, excludes tanks in the auxiliary feedwater system. In RAI 3.4.1-9, the staff requested the applicant to provide clarification for this discrepancy.

In its response the applicant stated the following:

The aging management that is addressed in LRA Tables 3.4-1 and 3.4-3 does not require further discussion in Appendix B of the LRA because it is consistent with the aging management described in the equivalent line items of the GALL Report. Since, however, management of the components in LRA Table 3.4-2 is not addressed in the GALL Report, additional discussion is provided in Appendix B of the LRA and/or in the Discussion column of individual LRA Table 3.4-2 AMR items to clarify how aging management is accomplished.

The staff finds the applicant's response acceptable because it provides a clarification as to why the AFW system tanks are not identified in the scope of the one-time inspection program. Therefore the RAI issue is considered resolved.

The applicant has identified the general corrosion of external surfaces program and the chemistry program as the AMPs for managing this aging effect. These programs are evaluated in Section 3.0.3 of this SER and are considered appropriate for managing this aging effect.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general corrosion for components in the SPCS, as recommended in the GALL Report.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of loss of material due to general corrosion for SPCS components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2.5 Loss of Material due to General, Pitting, Crevice, and MIC

As stated in the SRP-LR, the GALL Report recommends further evaluation of programs to manage the loss of material due to general corrosion (carbon steel only), pitting and crevice

corrosion, and MIC, for stainless steel and carbon steel shells, tubes, and tubesheets within the bearing oil coolers (for steam turbine pumps) in the AFW system. Such corrosion may be due to water contamination that affects the quality of the lubricating oil in the bearing oil coolers. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of the aging effect.

The applicant has identified the PS/PMP as the AMP for managing this aging effect. This program is evaluated in Section 3.0.3 of this SER and is considered appropriate for managing this aging effect.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to general, pitting, and crevice corrosion, and MIC for components in the SPCS, as recommended in the GALL Report.

The staff reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of loss of material due to general, pitting, crevice, and MIC for SPCS components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.4.2.2.6 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for components in the SPCS. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL recommends further evaluation have been adequately addressed and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for SPCS components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

#### 3.4.2.3 Aging Management Programs for Steam and Power Conversion Systems Components

In SER Section 3.4.2.1, the staff evaluated the applicant's conformance with the aging management recommended by GALL for the SPCS. In SER Section 3.4.2.2, the staff reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation. In this SER section, the staff presents its evaluation of the programs used by the applicant to manage the aging of the components in the SPCS.

The applicant credits nine AMPs to manage the aging effects associated with components in the SPCS. All nine of the AMPs are credited with managing aging for components in other system groups (common AMPs). The staff's evaluation of the common AMPs credited with managing aging in SPCS components is provided in Section 3.0.3 of this SER. The common AMPs are listed below:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Flow Accelerated Corrosion Program - SER Section 3.0.3.4
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- Periodic Surveillance and Preventive Maintenance Program - SER Section 3.0.3.10
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- One-Time Inspection Program - SER Section 3.0.3.13
- Selective Leaching Program - SER Section 3.0.3.14

#### 3.4.2.4 Aging Management Review of Plant-Specific Steam and Power Conversion Systems Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific SPCS components. To perform its evaluation, the staff reviewed the components listed in LRA Table 2.3.4.1, 2.3.4.2, and 2.3.4.3 to determine whether the applicant properly identified the applicable aging effects and AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects for each component, ensuring that each component was evaluated in the appropriate LRA AMR Table in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

##### 3.4.2.4.1 Feedwater

###### 3.4.2.4.1.1 Summary of Technical Information in the Application

The AMR results for the feedwater system are presented in Tables 3.4-1, 3.4-2, and 3.4-3 of the LRA. The applicant used the GALL Report format to present its AMR of feedwater system components in LRA Table 3.4-1. In LRA Tables 3.4-2 and 3.4-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

As described in LRA Section 2.3.4.1, the feedwater system consists of a supply line to each of the two steam generators. A feedwater isolation valve in each steam generator supply line is located just outside the containment penetration.

##### Aging Effects

LRA Tables 3.4-1 through 3.4-3 identify the following applicable aging effects for the feedwater system.

- Loss of material of carbon steel components due to general, pitting, and crevice corrosion in treated water

- Loss of material of carbon steel components due to general corrosion of the external surfaces in ambient air
- Wall thinning of carbon steel components due to FAC in steam or treated water
- Loss of material of carbon steel components due to general corrosion, crack initiation, and growth due to cyclic loading in ambient air, in high-pressure or high-temperature systems
- Loss of material of low-alloy steel components due to boric acid corrosion in ambient air and leaking and dripping of chemically treated borated water
- Cracking of stainless steel components in de-oxygenated treated water or saturated steam due to exposure to sulfates or halogens
- Crevice and/or pitting corrosion of stainless steel components due to exposure to dissolved oxygen or halogens and sulfates

### Aging Management Programs

The following AMPs are utilized to manage aging effects to the feedwater system.

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Flow Accelerated Corrosion Program (B.1.5)
- Boric Acid Corrosion Program (B.2.1)
- General Corrosion of External Surface Program (B.3.3)
- One-Time Inspection Program (B.3.5)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effect of aging associated with the components of the feedwater system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

#### 3.4.2.4.1.2 Staff Evaluation

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the feedwater system components at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the feedwater system components.

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the feedwater system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

### Aging Effects

The component groups identified in LRA Table 2.3.4.1-1 for the feedwater system are (1) bolting, (2) pipes and fittings, and (3) valve bodies.

The materials used for bolting in the feedwater system are carbon steel and stainless steel. Consistent with the GALL Report, the applicant identified loss of material as an applicable aging effect for all of the carbon steel bolting in the feedwater system. The different aging mechanisms leading to loss of material for carbon steel bolting in the feedwater system include (1) general corrosion, (2) crack initiation and growth due to SCC, and (3) boric acid corrosion. For stainless steel bolting in ambient air, the applicant did not identify any applicable aging effects.

LRA Table 3.4-1, row 3.4.1.08, discusses aging management of closure bolting, and credits the bolting integrity program (B.1.1) for managing loss of material and crack initiation. LRA Section B.1.1 states that the bolting integrity program will be consistent with GALL Program XI.M3, "Reactor Head Closure Studs" and XI.M18, "Bolting Integrity," with the exception that SCC has not been identified as a creditable aging effect for high-strength carbon steel bolting in plant indoor air. In RAI 3.4.1-3, the staff requested the applicant to discuss the basis for its conclusion that SCC is not a creditable aging effect for bolting.

In its response dated December 19, 2002, the applicant stated the following:

FCS has not identified SCC as a credible AERM for high strength CS [carbon steel] bolting in plant indoor air. The first reason for this position is that stainless steels, high strength aluminum alloys, and brasses are the most susceptible alloys to SCC. Ordinary steels are not as susceptible. Secondly, SCC requires exposure to specific chemical solutions for the mechanism to occur. Stainless steels require chloride-laden solutions. Aluminum alloys require sodium chloride solutions. Brasses require ammonia solutions. Ordinary steels require exposure to caustic or mixed acid solutions. Thirdly, elevated temperature is usually a factor when SCC occurs. For the CS steel bolting in question, therefore, (1) the material is not readily susceptible to SCC, (2) a caustic or mixed acid solution environment is not present, and (3) elevated temperatures are not present.

The staff finds the applicant's response reasonable and acceptable because it provides a satisfactory explanation for excluding SCC as a credible aging effect. The RAI issue is considered resolved.

The materials used for pipes, fittings, and valve bodies in the feedwater system are carbon steel and stainless steel. Consistent with the GALL Report, the applicant identified loss of material as an applicable aging effect for these components in the feedwater system. The aging mechanisms leading to loss of material for carbon steel pipes, fittings, and valve bodies include general corrosion, boric acid corrosion, and FAC, depending on the local environment. For stainless steel pipes, fittings, and valve bodies in the feedwater system, the applicant identified cracking and loss of material as applicable aging effects for the components exposed to de-oxygenated treated water or saturated steam. For stainless steel components in ambient air, the applicant did not identify any applicable aging effects.

In RAI 3.4-1, the staff requested the applicant to indicate if any of the feedwater system components might be susceptible to galvanic corrosion. In response, the applicant stated that they have identified components in the feedwater system, the auxiliary feedwater system, and the main steam system that are potentially subject to galvanic corrosion. However, galvanic corrosion is not specifically managed since the applicant does not consider it to be a plausible aging mechanism for FCS. Galvanic corrosion leads to the aging effect loss of material, which is specifically managed for the components in the SPCS. The staff finds the applicant's response acceptable because the applicant has identified the AMPs to manage loss of material.

On the basis of its review of the LRA and the applicant's RAI responses, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with components in the feedwater system.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects to the feedwater system.

- Bolting Integrity Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Flow Accelerated Corrosion Program (3.0.3.4)
- Boric Acid Corrosion Program (B.0.3.6)
- General Corrosion of External Surfaces Program (3.0.3.12)
- One-Time Inspection Program (3.0.3.13)

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore considered common AMPs. The staff review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the feedwater system components, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMP(s) recommended by the GALL Report. For the components identified in LRA Tables 3.4-2 and 3.4-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with components in the feedwater system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.4.2.4.1.3 Conclusions

The staff has reviewed the information in Sections 2.3.4 and 3.4 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the feedwater system will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the feedwater system to satisfy 10 CFR 54.21(d).

#### 3.4.2.4.2 Auxiliary Feedwater

##### 3.4.2.4.2.1 Summary of Technical Information in the Application



The AMR results for the AFW system are presented in Tables 3.4-1, 3.4-2, and 3.4-3 of the LRA. The applicant used the GALL Report format to present its AMR of the AFW system components in LRA Table 3.4-1. In LRA Tables 3.4-2 and 3.4-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

As described in Section 2.3.4.2, the AFW system contains one EFWST, two pumps, plus related piping, valves, and instrumentation.

### Aging Effects

LRA Tables 3.4-1 through 3.4-3 identify the following applicable aging effects for the AFW system.

- loss of material of carbon steel components due to general corrosion, pitting, and crevice corrosion in treated water
- loss of material of carbon and stainless steel components due to general corrosion, pitting, crevice corrosion, and MIC in lubricating oil possibly contaminated with water
- loss of material of carbon steel components due to general corrosion of the external surfaces in ambient air
- wall thinning of carbon steel components due to FAC in steam or treated water
- loss of material of carbon steel components due to general corrosion, crack initiation and growth due to cyclic loading in ambient air, in high-pressure or high-temperature systems or saturated steam
- loss of material of low-alloy steel components due to boric acid corrosion in ambient air, and leaking and dripping, chemically treated borated water
- loss of material of copper alloy components due to general corrosion resulting from water contamination in lubricating oil
- cracking of stainless steel components in de-oxygenated treated water or saturated steam due to exposure to sulfates or halogens
- selective leaching of copper alloy components in de-oxygenated treated water
- crevice and/or pitting corrosion of stainless steel components due to exposure to dissolved oxygen or halogens and sulfates

### Aging Management Programs

The following AMPs are utilized to manage aging effects to the AFW system.

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Flow Accelerated Corrosion Program (B.1.5)
- Boric Acid Corrosion Program (B.2.1)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)
- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)
- Selective Leaching Program (B.3.6)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effect of aging associated with the components of the AFW system will be adequately managed by these AMPs during the period of extended operation.

#### 3.4.2.4.2.2 Staff Evaluation

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the AFW system components at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the AFW system components.

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the AFW system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### Aging Effects

The component groups identified in LRA Table 2.3.4.2-1 for the AFW system are (1) bolting, (2) filters/strainers, (3) flow element/orifice housing, (4) heat exchanger, (5) indicator/recorder, (6) pipes and fittings, (7) pump casings, (8) tanks, (9) turbine casing, and (10) valve bodies. The materials used for these component groups in the AFW system are (1) steel, (2) copper alloy, (3) aluminum, and (4) glass.

**Steel:** For each of the carbon steel and low-alloy steel components in the AFW system, the applicant identified loss of material as an applicable aging effect. The aging mechanisms leading to loss of material for these carbon and low-alloy steel components include general corrosion, boric acid corrosion, pitting, and crevice corrosion. These aging mechanisms depend on the different environments that the steel components are exposed to such as (1) ambient air, (2) treated water, (3) borated water, and (4) saturated steam. The staff concurs with the applicant's identification of loss of material as an applicable aging effect for each of the carbon and low-alloy steel components in the AFW system.

For stainless steel pipes, fittings, and valves in the AFW system that are exposed to de-oxygenated treated water or saturated steam, the applicant identified loss of material and cracking as applicable aging effects. The applicant also identified loss of material as an applicable aging effect for the stainless steel filter/strainer, flow element/orifice housing, and pipes and fittings that are exposed to de-oxygenated treated water. For stainless steel components that are not exposed to harsh environments (i.e., ambient air), the applicant did not identify any applicable aging effects. The staff concurs with the applicant's identification of loss of material and cracking as applicable aging effects for the stainless steel components in the AFW system that are exposed to harsh environments.

**Copper Alloy:** Copper alloy is used for the heat exchanger, valve bodies, and pipes and fittings in the AFW system. The applicant identified loss of material due to crevice and pitting corrosion, selective leaching, and general corrosion for copper alloy exposed to de-oxygenated

treated water or lubricating oil. For copper alloy exposed only to ambient air, the applicant did not identify any applicable aging effects.

LRA Table 3.4-2 states that copper alloy components operating in a de-oxygenated environment are subject to loss of material due to crevice and pitting corrosion resulting from stagnant or low-flow conditions, or due to wear from flow-induced vibration. The applicant credits the one-time inspection to manage this effect. This program is described in LRA Section B.3.5 and is evaluated in Section 3.0.3.13 of this SER. The staff issued RAI 3.4.1-10 requesting the applicant to provide justification that the one-time inspection program at FCS will provide adequate aging management for both the internal and external surfaces of the copper alloy components in the heat exchangers of the AFW system at FCS.

In its response by letter dated December 19, 2002, the applicant stated the following:

The activities of three separate programs, namely One-time Inspection (B.3.5), Selective Leaching (B.3.6) and Periodic Surveillance and Preventive maintenance (B.2.7) are deemed to be appropriate for providing aging management that is equivalent to the GALL Report for cooling water programs.

The staff concludes that a one-time inspection identified for copper alloy components in a de-oxygenated treated water environment (LRA Table 3.4-2, row numbers 3.2.0.3 and 3.2.0.4) is not an adequate means of managing loss of material for both the internal and external surfaces of the components in that environment. Similarly, for loss of material due to selective leaching of copper alloy in a de-oxygenated treated water environment, the selective leaching program by itself, since it covers only the component internals, is not considered an adequate means of managing loss of material in that environment. By letter dated February 20, 2003, the staff issued POI-11, requesting the applicant to provide for aging management of loss of material for the external surfaces for these copper alloy components. By letter dated March 14, 2003, the applicant responded to POI-11 by stating that for components in de-oxygenated treated water, the one-time inspection and selective leaching program are credited in LRA Table 3.4-2. The chemistry program (B.1.2) has been added to LRA Table 3.4-2, row 3.4.2.03. The periodic surveillance and preventive maintenance program is credited for the lube oil side of the cooler, not the de-oxygenated treated water side.

On the basis of the additional information provided by the applicant in response to POI-11, the staff finds that the applicant has provided adequate aging management for loss of material for both internal and external environments for copper alloy components. Therefore, POI-11 is considered resolved.

**Aluminum:** Aluminum is used for some of the pump casings in the AFW system. For aluminum exposed to lubricating oil, the applicant identified loss of material due to general corrosion as an applicable aging effect. For aluminum exposed only to ambient air, the applicant did not identify any applicable aging effects. The staff concurs with the applicant's identification of loss of material as an applicable aging effect for aluminum pump casings exposed to lubricating oil.

**Glass:** Glass is used for the indicator/recorder portions of the heat exchanger. The applicant did not identify any applicable aging effects for glass. The staff concurs with this finding for glass components.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the AFW system.

#### Aging Management Programs

The following AMPs are utilized to manage aging effects to the AFW system.

- Bolting Integrity Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Flow Accelerated Corrosion Program (3.0.3.4)
- Boric Acid Corrosion Program (3.0.3.6)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- One-Time Inspection Program (3.0.3.13)
- Selective Leaching Program (3.0.3.14)

Each of the above AMPs are credited with managing the aging of several components in different structures and systems and are, therefore considered common AMPs. The staff review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the AFW system components, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMP(s) recommended by the GALL Report. For the components identified in LRA Tables 3.4-2 and 3.4-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the AFW system. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.4.2.4.2.3 Conclusions

The staff has reviewed the information in Sections 2.3.4 and 3.4 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the AFW system will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the AFW system to satisfy 10 CFR 54.21(d).

#### 3.4.2.4.3 Main Steam and Turbine Steam Extraction

##### 3.4.2.4.3.1 Summary of Technical Information in the Application

The AMR results for the main steam and turbine steam extraction system are presented in Tables 3.4-1, 3.4-2, and 3.4-3 of the LRA. The applicant used the GALL Report format to present its AMR of the main steam and turbine steam extraction system components in LRA Table 3.4-1. In LRA Tables 3.4-2 and 3.4-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

Section 2.3.4.3 of the LRA provides a brief description of the portion of the main steam and turbine steam extraction system that is within the scope of license renewal and subject to an AMR. The component groupings for the main steam and turbine steam extraction system are (1) bolting, (2) filters/strainers, (3) pipes and fittings, and (4) valve bodies.

### Aging Effects

The LRA identifies the following applicable aging effects for the main steam and turbine steam extraction system.

- cumulative fatigue damage of carbon steel and stainless steel components due to cyclic loading
- loss of material of carbon steel components due to general corrosion, pitting, and crevice corrosion in treated water
- loss of material of carbon and stainless steel components due to general corrosion, pitting, crevice corrosion, and MIC in lubricating oil possibly contaminated with water
- loss of material of carbon steel components due to general corrosion of the external surfaces in ambient air
- wall thinning of carbon steel components due to FAC in saturated steam or treated water
- loss of material of carbon steel components due to general corrosion, crack initiation, and growth due to cyclic loading in ambient air, in high-pressure or high-temperature systems, or saturated steam
- loss of material of low-alloy steel components due to boric acid corrosion in ambient air and leaking and dripping, chemically treated borated water
- loss of material of copper alloy components due to general corrosion resulting from water contamination in lubricating oil
- cracking of stainless steel components in de-oxygenated treated water or saturated steam due to exposure to sulfates or halogens
- selective leaching of copper alloy components in de-oxygenated treated water.
- crevice and/or pitting corrosion of stainless steel components due to exposure to dissolved oxygen, or halogens and sulfates

### Aging Management Programs

The following AMPs are utilized to manage aging effects to the main steam and turbine steam extraction system.

- Bolting Integrity Program (B.1.1)
- Chemistry Program (B.1.2)
- Flow Accelerated Corrosion Program (B.1.5)
- Boric Acid Corrosion Program (B.2.1)
- Periodic Surveillance and Preventive Maintenance Program (B.2.7)

- General Corrosion of External Surfaces Program (B.3.3)
- One-Time Inspection Program (B.3.5)
- TLAA evaluated in accordance with 10 CFR 54.21(c)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the main steam and turbine steam extraction system will be adequately managed by these AMPs during the period of extended operation.

#### 3.4.2.4.3.2 Staff Evaluation

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the main steam and turbine steam extraction system components at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the main steam and turbine steam extraction system components.

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the main steam and turbine steam extraction system components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

#### Aging Effects

The component groups identified in LRA Table 2.3.4.3-1 for the main steam and turbine steam extraction system are (1) bolting, (2) filters/strainers, (3) pipes and fittings, and (4) valve bodies. The materials used for these component groups are carbon steel and stainless steel.

For carbon steel components in the main steam and turbine steam extraction system, the applicant identified loss of material and cumulative fatigue as applicable aging effects. The aging mechanisms leading to loss of material include (1) general corrosion, (2) wall thinning, (3) boric acid corrosion, (4) pitting, and (5) crevice corrosion. These different aging mechanisms are dependant on the local environment to which the carbon steel components are subjected. These environments include (1) ambient air, (2) borated water, (3) saturated steam, and (4) treated water.

For carbon steel piping and valve bodies in treated water and saturated steam (LRA Table 3.4-1, row entry 3.4.1.06), the applicant credits the FAC program, which is consistent with the GALL Report. However, the applicant also uses the FAC program for carbon steel filter/strainer, pipes and fittings, and valve bodies exposed to saturated steam (LRA Table 3.4-3, row entry 3.4.3.04). In RAI 3.4.1-8, the staff requested that the applicant clarify the use of LRA Table 3.4-3 for carbon steel piping and valve bodies in treated water. In response, the applicant stated that the link to row entry 3.4.3.04 for carbon steel components exposed to saturated steam is for the filters/strainers since they are not specifically addressed in the GALL Report. The applicant also clarified that all the in-scope piping in the main steam and turbine steam

extraction system is included in the FAC program. The staff finds that the applicant's response to RAI 3.4.1-8 is adequate since it explains the aging management for carbon steel piping exposed to saturated steam.

For stainless steel components in the main steam and turbine steam extraction system that are exposed to de-oxygenated treated water or saturated steam, the applicant identified loss of material and cracking as applicable aging effects. For stainless steel components in ambient air the applicant did not identify any applicable aging effects.

The staff concurs with the applicant's identification of loss of material, cracking, and cumulative fatigue as applicable aging effects for steel components in the main steam and turbine steam extraction system. The staff finds that the applicant has adequately identified the applicable aging effects for these carbon and stainless steel components.

### Aging Management Programs

The following AMPs are utilized to manage aging effects to the main steam and turbine steam extraction system.

- Bolting Integrity Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Flow Accelerated Corrosion Program (3.0.3.4)
- Boric Acid Corrosion Program (3.0.3.6)
- Periodic Surveillance and Preventive Maintenance Program (3.0.3.10)
- General Corrosion of External Surfaces Program (3.0.3.12)
- One-Time Inspection Program (3.0.3.13)
- TLAA evaluated in accordance with 10 CFR 54.21(c)

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore considered common AMPs. The staff's review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the main steam and turbine steam extraction system components, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMP(s) recommended by the GALL Report. For the components identified in Tables 3.4-2 and 3.4-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

In RAI 3.4.3-1, the staff requested that the applicant provide further information concerning the management of loss of material due to FAC for the carbon steel filter/strainer components in the main steam and turbine steam extraction system that are exposed to saturated steam. Specifically, the staff noted that the geometry and hydrodynamic conditions of filters and strainers are substantially different from piping/fittings and valve bodies for which the FAC program is normally used. In response to RAI 3.4.3-1, the applicant stated the following:

There are no known analytical tools that can accurately model and predict the corrosion rates in strainer or valve bodies. The FAC Program uses the corrosion rates on the downstream piping as a qualitative indicator of the corrosion rates in the strainer or valve bodies to determine inspection and verification requirements for the

valve or strainer body in this case. This is a conservative approach since the bodies of the components are much thicker than the piping. Additionally the ability to ultrasonically test valve bodies or strainer bodies is very limited so any components that are identified as having a high corrosion rate will be disassembled and visually inspected.

The staff finds the applicant's response reasonable and acceptable because it explains how the FAC program will be used for the filters and strainers. Therefore, RAI 3.4.3-1 is considered resolved.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the main steam and turbine steam extraction system. In addition, the staff found the associated program and TLAAs descriptions in the USAR Supplements to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.4.2.4.3.3 Conclusions

The staff has reviewed the information in Sections 2.3.4 and 3.4 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the main steam and turbine steam extraction system will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the main steam and turbine steam extraction system to satisfy 10 CFR 54.21(d).

#### 3.4.3 Evaluation Findings

The staff has reviewed the information in Section 3.4 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the steam and power conversion systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the steam and power conversion systems to satisfy 10 CFR 54.21(d).

#### 3.5 Containment, Structures, and Component Supports

This section addresses the aging management of structural components. The components in these structures that make up this group are described in the following SER sections:

- Containment (2.4.1)
- Auxiliary Building (2.4.2.1)
- Turbine Building and Service Building (2.4.2.2)



- Intake Structure (2.4.2.3)
- Building Piles (2.4.2.4)
- Fuel Handling Equipment and Heavy Load Cranes (2.4.2.5)
- Component Supports (2.4.2.6)
- Duct Banks (2.4.2.7)

As discussed in Section 3.0.1 of this SER, the structural components are included in one of three LRA tables. LRA Table 3.5-1 consists of structural components that are evaluated in the GALL Report, LRA Table 3.5-2 consists of structural components that are not evaluated in the GALL Report, and LRA Table 3.5-3 consists of structural components that are not evaluated in the GALL Report, but the applicant has determined can be managed using a GALL AMR and associated AMP.

### 3.5.1 Summary of Technical Information in the Application

In LRA Section 3.5, the applicant described its AMR for structural components within the containment, other Class I structures, and component supports at FCS. The passive, long-lived components in these structures that are subject to an AMR are identified in LRA Tables 2.4.1-1 and 2.4.2.1-1 through 2.4.2.7-1.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management, based on FCS operating experience, were consistent with aging effects identified in GALL. The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL. The applicant's ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

### 3.5.2 Staff Evaluation

In Section 3.5 of the LRA, the applicant described its AMR for structural components at FCS. The staff reviewed LRA Section 3.5 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for structural components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of structural components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the items described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate aging management programs as described and evaluated in the GALL Report.

The staff evaluated those aging management issues recommended for further evaluation in the GALL Report as well as the applicant's AMR for structural components that are not addressed in the GALL Report. In addition, the staff evaluated the AMPs used by the applicant to manage the aging of structural components. Finally, the staff reviewed the structural components listed in the tables in LRA Section 2.4 to determine whether the applicant properly identified the applicable aging effects and AMPs needed to adequately manage the aging effects.

Table 3.5-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.5 that are addressed in the GALL Report.

Table 3.5-1  
Staff Evaluation for FCS Structures and Structural Components in the GALL Report

**Common Components of All Types of PWR and BWR Containment**

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
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)	TLAA (4.6)	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.6 below)
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	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.7 below)
Penetration sleeves, penetration bellows, and dissimilar metal welds	Loss of material due to corrosion	Containment ISI and Containment leak rate test	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)i	Consistent with GALL. (See Section 3.5.2.1 below)
Personnel airlock and equipment hatch	Loss of material due to corrosion	Containment ISI and Containment leak rate test	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)	Consistent with GALL. (See Section 3.5.2.1 below)
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	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)	Consistent with GALL. (See Section 3.5.2.1 below)
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	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)	Consistent with GALL. (See Section 3.5.2.1 below)

**PWR Concrete (Reinforced and Prestressed) and Steel Containment  
BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment**

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
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	Containment Inservice Inspection Program (B.1.3)	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.1 below)
Concrete elements: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.1.2 below)
Concrete elements: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.1.2 below)
Concrete elements: foundation, dome, and wall	Reduction of strength and modulus due to elevated temperature	Plant specific	None	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.3 below)
Prestressed containment: tendons and anchorage components	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TCAA evaluated in accordance with 10 CFR 54.21(c)	TCAA (4.5)	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.5 below)
Steel elements: liner plate, containment shell	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and Containment leak rate test	Containment Inservice Inspection Program (B.1.3) and Containment Leak Rate Program (B.1.4)	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.4 below)
Steel elements: vent header, drywell head, torus, downcomers, pool shell	Cumulative fatigue damage (CLB fatigue analysis exists)	TCAA evaluated in accordance with 10 CFR 54.21(c)	None	BWR
Steel elements: protected by coating	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	None	Not Applicable to FCS
Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	Containment Inservice Inspection Program (B.1.3)	Consistent with GALL. (See Section 3.5.2.1 below)
Concrete elements: foundation, dome, and wall	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	Containment Inservice Inspection Program (B.1.3)	Consistent with GALL. (See Section 3.5.2.1 below)
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	None	BWR
Steel elements: Suppression chamber liner	Crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	None	BWR

Steel elements: drywell head and downcomer pipes	Fretting and lock up due to wear	Containment ISI	None	BWR
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## Class I Structures

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
All Groups except Group 6: accessible interior/exterior concrete & steel components	All types of aging effects	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.2.1 below)
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	None	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.2.2 below)
Group 6: all accessible/inaccessible 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	None	Not Applicable to FCS
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	Chemistry Program (B.1.2) Periodic Surveillance and Preventive Maintenance Program (B.2.7)	Consistent with GALL. (See Section 3.5.2.1 below)
Group 1-3, 5, 6: all masonry block walls	Crack due to restraint, shrinkage, creep, and aggressive environment	Masonry Wall	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.1 below)
Group 1-3, 5, 7-9: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.1.2 below)
Group 1-3, 5-9: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.1.2 below)
Group 1-5: concrete	Reduction of strength and modulus due to elevated temperature	Plant-specific	None	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.1.3 below)
Groups 7, 8: liners	Crack initiation and growth due to SCC; Loss of material due to crevice corrosion	Plant-specific	None	Not Applicable to FCS

## Component Supports

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc.	Aging of component support	Structures Monitoring	Structures Monitoring Program (B.2.10)	Consistent with GALL. (See Section 3.5.2.2.3.1 below)
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)	Not Applicable	Consistent with GALL. GALL recommends further evaluation (See Section 3.5.2.2.3.2 below)
All Groups: support members: anchor bolts, welds	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Corrosion Prevention Program (B.2.1)	Consistent with GALL. (See Section 3.5.2.1 below)
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	Inservice Inspection Program (B.1.7)	Consistent with GALL. (See Section 3.5.2.1 below)
Group B1.1: high strength low-alloy bolts	Crack initiation and growth due to SCC	Bolting integrity	Bolting Integrity Program (B.1.1)	Consistent with GALL. (See Section 3.5.2.1 below)

The staff's review of the structural components for the FCS LRA is contained within four sections of this SER. Section 3.5.2.1 is the staff review of structures and structural components that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.5.2.2 is the staff review of structures and structural components that the applicant indicates are consistent with GALL and for which GALL recommends further evaluation. Section 3.5.2.3 is the staff evaluation of the AMPs that are specific to the aging management of structural components. Section 3.5.2.4 contains an evaluation of the adequacy of aging management for components in each structure and includes an evaluation of structures and structural components that the applicant indicates are not in GALL.

### 3.5.2.1 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups are bounded by the GALL evaluation. The staff also sampled component groups during the AMR inspection to determine whether the applicant properly identified those component groups in GALL that are not applicable to its plant. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

On the basis of its review of the inspection results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for structures and structural components. Therefore, on this basis, the staff concludes that the applicant has demonstrated that the components for which the applicant claimed consistency with GALL will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.5.2.2 Aging Management Evaluations in the GALL Report that Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommends further evaluation. In addition, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

The GALL Report indicates that further evaluation should be performed for the following:

#### 3.5.2.2.1 Containment

##### 3.5.2.2.1.1 Aging of Inaccessible Concrete Areas

As stated in the SRP-LR, the GALL Report recommends further evaluation to manage the aging effects for containment concrete components located in inaccessible areas, if the aging mechanisms (1) leaching of calcium hydroxide, (2) aggressive chemical attack, or (3) corrosion of embedded steel are significant. Possible aging effects for containment concrete structural components due to these three aging mechanisms are cracking, change in material properties, and loss of material.

The AMP recommended by the GALL Report for managing the above aging effects for containment concrete components in accessible portions of the containment structures is the ASME Section XI, Subsection IWL (XI.S2) program. The staff's evaluation of the applicant's ASME Section XI, Subsection IWL AMP is found in Section 3.0.3.3 of this SER.

Subsection IWL exempts from examination those portions of the concrete containment that are inaccessible (e.g., foundation, below-grade exterior walls, concrete covered by liner). For inaccessible portions of the containment structure, 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 inaccessible areas.

The applicant addressed the specific criteria defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of containment concrete structural components in inaccessible areas, in LRA Table 3.5-1. The GALL Report recommends further evaluation for containment concrete in inaccessible areas if the aging mechanisms (1) leaching of calcium hydroxide, (2) aggressive chemical attack, or (3) corrosion of embedded steel are significant.

Regarding the aging mechanism leaching of calcium hydroxide, the applicant stated the following in LRA Table 3.5-1:

Leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. The reinforced concrete at FCS is not exposed to flowing water.

Regarding the aging mechanism's aggressive chemical attack and corrosion of embedded steel, the applicant stated the following in LRA Table 3.5-1:

Below-grade exterior reinforced concrete at FCS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate).

Since the below-grade reinforced concrete at FCS is not exposed to an aggressive environment, the staff agrees with the applicant's conclusion that the aging mechanisms aggressive chemical attack and corrosion of embedded steel are not likely to be significant. In addition, since the below-grade reinforced concrete at FCS is not exposed to flowing water, the staff concludes that leaching of calcium hydroxide from reinforced concrete is probably not significant. Since these three aging mechanisms are not significant for below-grade reinforced concrete at FCS, the further evaluation recommended by the GALL Report is not warranted. Further discussion regarding the aging management of inaccessible containment concrete components is found in Section 3.5.2.4.1 of this SER.

The staff reviewed the USAR Supplement for the AMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for containment components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of aging of inaccessible concrete areas for containment, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

As stated in the SRP-LR, for the containment foundation, the GALL Report recommends further evaluation of the aging effects (1) cracking due to settlement and (2) change in material properties as manifested by a reduction of foundation strength due to erosion of the porous concrete subfoundation, if these two effects are not covered by a structures monitoring AMP. In addition, the GALL Report recommends verification of the continued functionality of a de-watering system during the license renewal period, if relied on by the applicant to lower the site ground water level.

The applicant addressed the above criteria defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of the containment foundation, in LRA Table

3.5-1. In row entries 3.5.1.08, 3.5.1.09, 3.5.1.21, and 3.5.1.22 of LRA Table 3.5-1, the applicant stated that they will use their SMP to manage the aging effects (1) cracking and (2) change in material properties as manifested by a reduction in strength for the containment foundation. The staff's evaluation of the applicant's SMP is found in Section 3.0.3.11 of this SER.

Regarding the aging effect cracking due to settlement, the applicant stated the following in LRA Table 3.5-1:

The structures at FCS are supported on end-bearing steel pipe piles driven to bedrock. Settlement of the concrete subfoundation is not a plausible aging mechanism. A de-watering system is not relied upon for control of settlement at FCS.

Regarding change in material properties as manifested by a reduction in strength, the applicant stated the following in LRA Table 3.5-1:

The reinforced concrete at FCS is not exposed to flowing water and a de-watering system is not relied upon for control of erosion of cement from porous concrete subfoundations.

Since the applicant is managing cracking and change in material properties for the containment foundation as recommended by the GALL Report, the staff finds that the applicant has adequately addressed this further evaluation criteria.

The staff reviewed the USAR Supplement for the SMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for containment components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cracking, distortion, and increase in component stress level due to settlement; reduction of foundation strength due to erosion of porous concrete subfoundations for containment components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.1.3 Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature

As stated in the SRP-LR, for the containment structure, the GALL Report recommends further evaluation to manage the aging effect change in material properties as manifested by a reduction in strength and modulus, if any portion of the containment concrete exceeds the temperature limit of 150 °F. 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 staff verified that the applicant's discussion in the renewal application indicates that the affected PWR containment components are not exposed to temperatures that exceed the above temperature limits.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation, in LRA Table 3.5-1. In row entries 3.5.1.10 and 3.5.1.23 of LRA Table 3.5-1, the applicant stated the following regarding temperatures within the containment structure:

The maximum indoor plant temperature is 120 °F inside the main area of containment. This is below the temperature limit of 150 °F. Per USAR Section 5.5.4, sleeve radiation fins and thermal sleeves (in conjunction with pipe insulation) are used to limit maximum temperature at the containment penetration sleeves to 150 °F under operating conditions.

The nuclear detector well cooling system cools the out-of-core neutron detectors, which are located in tubes or wells in the reactor compartment annulus between the lower portion of the reactor vessel and the biological shield, and maintains the shield concrete temperature below 150 °F. Technical Specification Limiting Condition for Operation 2.13 requires that the annulus exit temperature from the nuclear detector cooling system shall not exceed a temperature found to correlate to 150 °F concrete temperature. Therefore, no portions of concrete containment exceed specified temperature limits and no aging management is required.

By letter dated October 11, 2002, the staff issued RAI 3.5.1-3, requesting further information regarding the correlation between the annulus exit temperature from the nuclear detector cooling system and the concrete temperature. By letter dated December 19, 2002, the applicant responded to this RAI, stating the following:

The Nuclear Detector Cooling System is used to cool the air in the annulus between the reactor vessel and the biological shield. While the nuclear detectors can withstand temperatures considerably higher than 150 °F, the elevated temperature could result in reduction in concrete strength through loss of moisture. Each nuclear detector well cooling unit is rated at 100% of the system design capability of 173,000 Btu/hr. A test was performed during Hot Functional and/or Low Power Tests to determine (1) the correlation between annulus air temperature and concrete temperature, and (2) the rate at which the concrete will heat up if no cooling is available. The results of these tests were used to provide control room indication of concrete temperatures (that is annulus air temperature) and allowable reactor operation time in the event both nuclear detector well cooling units were inoperable. The objective for this specification is to hold the concrete bulk temperature to no greater than 150 °F. Temperature sensors are installed in the concrete and in the annulus air discharge. The sensors in the concrete are subjected to neutron flux during operation and are no longer functional. The indicated values for annulus exit temperatures which correlate with concrete temperatures were determined, including a maximum value used to comply with the Tech Spec limit. A reanalysis was performed in 1987 to verify the original data obtained in 1973.

The staff finds that the monitoring of the concrete temperature of the biological shield wall is acceptable since the applicant has adequate procedures for ensuring that the concrete temperature will be no greater than 150 °F. As such, the applicant's response to RAI 3.5.1-3 is acceptable.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the reduction of strength and modulus of concrete structures due to elevated temperatures for containment concrete, as recommended in the GALL Report. Since temperatures within the containment structure have not exceeded the 150 °F limit, the staff concurs with the applicant's conclusion that further evaluation, as recommended by the GALL Report, is not required.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the reduction of strength and modulus of concrete structures due to elevated temperature for containment components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

As stated in the SRP-LR, the GALL Report recommends further evaluation to manage the aging effect loss of material due to corrosion for the embedded containment liner, if corrosion of the embedded liner is significant. The AMP recommended by the GALL Report for managing loss of material for accessible steel elements within the containment structure is the ASME Section XI, Subsection IWE (XI.S1) program. The staff's evaluation of the applicant's ASME Section XI, Subsection IWE AMP is found in Section 3.0.3.3 of this SER.

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 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 inaccessible areas.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of the embedded containment liner, in LRA Table 3.5-1. In row entry 3.5.1.12 of LRA Table 3.5-1, the applicant stated the following regarding the potential for significant corrosion of the embedded steel containment liner:

Corrosion for inaccessible areas (embedded containment liner) is not significant because:

- a. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment liner.
- b. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner.
- c. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with IWE requirements.
- d. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner.

In RAI 3.5.1-10, the staff requested further information regarding the applicant's assertions in items (b), (c), and (d) above. Specifically, the staff requested further information regarding the applicant's previous monitoring, with respect to these three items, of the containment liner and moisture barrier. In its response, the applicant stated the following:

Review of historical and recent maintenance and corrective action documents did not identify any anomalies which could lead to significant corrosion of the inaccessible areas of the FCS containment liner plates. The most recent inspection of the containment liner and moisture barrier was performed in April 2001 to satisfy

ASME Section XI IWE requirements. The inspection identified some areas of corrosion on the liner near the moisture barrier and some separation and trenching of the moisture barrier. Repairs were made to the moisture barrier during the 2002 refueling outage. This included removal of the top portion of the moisture barrier to inspect inaccessible sections of the liner. Only minor surface corrosion was found on the liner extending only 1/8" to 1/4" below the top of the existing joint sealer. Repairs were performed to recoat the liner and restore the moisture barrier. Containment inspections performed under the FCS Containment Inservice Inspection Program and Structures Monitoring Program will ensure the integrity of the liner is maintained. Additional information on the liner inspection results is included in the response to RAI B.1.3-1.

Since the applicant's inspection did not find significant corrosion in the inaccessible portion of the containment liner plates, and since the applicant credits its ASME Section XI, Subsection IWE, AMP for managing loss of material for the accessible portion of the containment liner plate, the staff finds that the applicant's response to RAI 3.5.1-10 to be acceptable. As required by 10 CFR 50.55a(b)(2)(ix), the applicant will inspect the inaccessible portions of the containment liner plates, if significant corrosion of the accessible portions of the liner plate are observed.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of the loss of material due to corrosion in inaccessible areas of the steel containment shell or liner plate for structures and structural components, as recommended in the GALL Report. Since the corrosion of the embedded steel containment liner is not significant, the further evaluation recommended by the GALL Report is not warranted.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of loss of material due to corrosion in inaccessible areas of steel containment shell or liner plate for containment components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

As stated in the SRP-LR, the GALL Report identifies loss of prestress due to relaxation, shrinkage, creep, and elevated temperature for prestressed containment tendons and anchorage components as a TLAA to be performed for the period of extended operation. The applicant covered this TLAA in Section 4.5 of the application and the staff evaluation of this TLAA is addressed in Section 4.5 of this SER.

On the basis of the staff's review of LRA Section 4.5, the staff concludes that the structures and structural components subject to loss of prestress will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.1.6 Cumulative Fatigue Damage

As stated in the SRP-LR, the GALL Report identifies cumulative fatigue damage as a TLAA for penetration sleeves, penetration bellows, and dissimilar metal welds to be performed for the period of extended operation. The applicant covered this TLAA in Section 4.6 of the application and the staff evaluation of this TLAA is addressed in Section 4.6 of this SER.

On the basis of the staff's review of LRA Section 4.6, the staff concludes that the structures and structural components subject to fatigue will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.1.7 Cracking due to Cyclic Loading and SCC

As stated in the SRP-LR, the GALL Report recommends further evaluation of the AMPs 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 containments. Containment ISI and leak rate testing may not be sufficient to detect cracks. The staff evaluated the applicant's proposed programs to verify that adequate inspection methods will be implemented to ensure that cracking of containment penetrations is detected.

The applicant addressed the further evaluation recommendations in the GALL Report with regard to cracking of containment penetrations in LRA Table 3.5-1. In row entry 3.5.1.02 of LRA Table 3.5-1, the applicant stated the following with regard to the aging effect cracking due to cyclic loading or SCC:

Stress corrosion cracking for stainless steel bellows with dissimilar metal welds is applicable only if the susceptible material is exposed to a corrosive environment. The bellows at FCS are not exposed to a corrosive environment; therefore, SCC is not an aging effect requiring management.

In RAI 3.5.1-9, the staff requested that the applicant clarify the above conclusion regarding the susceptibility of bellows to SCC in a non-corrosive environment. In addition, the staff requested the applicant to provide further detail regarding the aging management of cracking of containment penetrations in general. Specifically, the staff requested the applicant to state whether ASME Section XI, Subsection IWE examination categories E-B (visual VT-1) and E-F (surface) of FCS bellows and dissimilar metal welds will be implemented during the period of extended operation. In its response to RAI 3.5.1-9, the applicant stated the following:

Cracking due to cyclic loading of these bellows will be managed, per LRA AMR Item 3.5.1.02 (based on GALL Report Items II.A3.1-c and -d), by the containment ISI (B.1.3) and leak rate (B.1.4) programs which are consistent with programs XI.S1 and XI.S4 outlined in the GALL Report (i.e., the visual examination categories identified in the RAI are included in the credited programs).

Relative to SCC, however, GALL Report Item II.A3.1-d identifies that "In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment." For stainless steel, the corrosive environment needed for SCC to occur is a high-temperature, wetted, chloride environment (see response to RAI 3.2.1-2). At FCS, the bellows are normally in an air environment. There are no bolted connections near these bellows assemblies that could result in leakage that would provide the necessary environmental conditions. LRA AMR Item 3.5.1.02 Discussion column, Item 4 is based on these operating parameter assumptions.

The staff finds the applicant's response to RAI 3.5.1-9 to be adequate since the ASME Section XI, Subsection IWE examination categories E-B (visual VT-1) and E-F (surface) of FCS bellows and dissimilar metal welds will be implemented during the period of extended operation. In addition, since the bellow assemblies are not exposed to a corrosive environment, the staff finds that cracking due to SCC is unlikely. However, the staff notes that cracking as an aging effect will be managed by the applicant's containment ISI and containment leak rate AMPs.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cracking of containment penetrations (including penetration sleeves, penetration bellows, and dissimilar metal welds) due to cyclic loading and SCC, as recommended in the GALL Report. A complete review of the applicant's containment ISI and containment leak rate AMPs can be found in Sections 3.0.3.3 and 3.5.2.3.1, respectively, of this SER.

The staff reviewed the USAR Supplement for the AMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for containment components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of cracking due to cyclic loading and SCC for containment components, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.1.8 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for the containment structural components. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which GALL recommends further evaluation have been adequately addressed and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplements for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for containment components for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

#### 3.5.2.2.2 Class I Structures

##### 3.5.2.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

As stated in the SRP-LR, the GALL Report recommends further evaluation for certain structure/aging effect combinations, if they are not covered by the applicant's SMP. 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 structures; 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 that are not covered by the applicant's SMP.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of concrete and steel structural components, in LRA Table 3.5-1. In row entry 3.5.1.16 of LRA Table 3.5-1, the applicant stated that they will use their SMP to manage the aging effects identified in the preceding paragraph. However, the applicant stated in row entry 3.5.1.16 that (1) none of the above aging effects have been observed, to date, at FCS and (2) the aging mechanisms associated with these aging effects are not applicable.

By letter dated October 11, 2002, the staff issued RAI 3.5.1-6, requesting the applicant to clarify whether the aging of the concrete and steel structural components, encompassed by row entry 3.5.1.16 of LRA Table 3.5-1, will be managed by its SMP, as recommended by the GALL Report. By letter dated December 12, 2002, the applicant responded to RAI 3.5.1-6, stating the following:

In the Discussion column of LRA AMR Item 3.5.1.16, there are nine items. Item number one indicates that the aging management of the concrete at FCS will be performed with a Structures Monitoring Program that is consistent with the GALL Report. Item numbers two through nine provide specific FCS information regarding the aging mechanisms described in Chapter IIA of the GALL Report. Although the plant specific information (items two through nine) indicates aging management is not required, FCS has indicated in item number one that a program will be credited for managing the aging of concrete for the period of extended operation.

Since the applicant is managing the aging effects for the concrete and steel structural items covered by row entry 3.5.1.16 of LRA Table 3.5-1, as recommended by the GALL Report, the staff finds that the applicant has adequately addressed this further evaluation criterion. The staff's evaluation of the applicant's SMP is found in Section 3.0.3.11 of this SER.

The staff reviewed the USAR Supplement for the SMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for Class I structures for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of aging of Class I, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.2.2 Aging Management of Inaccessible Areas

As stated in the SRP-LR, the GALL Report recommends further evaluation for aging of inaccessible concrete areas, such as below-grade foundation and exterior walls exposed to ground water, due to aggressive chemical attack, if an aggressive below-grade environment exists. An aggressive below-grade environment could result in either cracking or loss of material for concrete components subjected to such an environment. The GALL Report recommends that a plant-specific AMP be developed by the applicant, if an aggressive below-grade environment exists.

The applicant addressed the above criterion defined in the GALL Report, regarding the potential aging of below-grade concrete exposed to an aggressive environment, in LRA Table 3.5-1. In row entry 3.5.1.17 of LRA Table 3.5-1, the applicant stated the following:

Below-grade exterior reinforced concrete at FCS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate). Periodic monitoring of below-grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive.

In RAIs 3.5.1-19 and 3.5.1-8, the staff requested further information regarding (1) the ground water chemistry and (2) the monitoring of ground water chemistry to ensure that the below-grade environment is not aggressive. In its response to RAI 3.5.1-19, the applicant stated the following:

The Missouri River water was tested periodically from 1973 to 1981. The results showed a pH average of 8.16, chlorides of 12.7 ppm, and sulfates of 200.6 ppm (USAR Section 2.7.1.4 in Table 2.7-3). River water test results from samples taken annually between 1990 and 1999 showed a pH average of 8.24.

The groundwater was tested in August 1966 and the average results showed a pH of 7.3, chloride content of 34 ppm, and sulfate content of 162 ppm (USAR Section 2.7.2.3 in Table 2.7-4).

To verify the river water and groundwater chemistry had not significantly changed over 20-30 years, a chemical analysis was performed in June 2000. Those test results indicated the groundwater pH was 7.48, chlorides were 8.0 ppm, and sulfates were 79.0 ppm; river water pH was 8.39, chlorides were 14.0 ppm, and sulfates were 229 ppm.

In its response to RAI 3.5.1-8, the applicant stated the following:

Ground water and river water samples were taken in June 2000 and evaluation results were compared to samples taken during plant construction. No significant deviation in sample results was identified. A periodic task will be initiated as part of the Structures Monitoring Program (B.2.10) to take ground water samples on a five year frequency and compare the evaluation results to previous samples.

Since the ground water and river water chemistry parameters (pH, sulfates, and chlorides) indicate a non-aggressive environment, the staff concurs with the applicant's conclusion that further evaluation, as recommended by the GALL Report, is unnecessary. In addition, the applicant has committed to monitor and evaluate the ground water periodically during the period of extended operation. As such, RAIs 3.5.1-8 and 3.5.1-19 are considered closed.

On the basis of its review, the staff finds that the applicant has adequately evaluated the potential aging of below-grade concrete components exposed to ground water due to an aggressive environment. Since the below-grade environment is not aggressive, the further evaluation recommended by the GALL Report is not warranted.

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of inaccessible areas for Class I structures, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.2.3 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for Class I structures. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which GALL recommends further evaluation have been adequately addressed and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplement for the AMPs and concludes that they provide adequate summary descriptions of the programs and activities credited for managing the effects of aging for Class I structures for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

### 3.5.2.2.3 Component Supports

#### 3.5.2.2.3.1 Aging of Supports Not Covered by Structures Monitoring Program

As stated in the SRP-LR, the GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the SMP. 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 the structure/aging effect combinations, listed above, that are not covered by the applicant's SMP.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of component supports, in LRA Table 3.5-1. In row entry 3.5.1.25 of LRA Table 3.5-1, the applicant stated that they will use their SMP to manage the aging effects identified in the preceding paragraph.

Since the applicant is managing the aging effects for the component supports covered by row entry 3.5.1.25 of LRA Table 3.5-1, as recommended by the GALL Report, the staff finds that the applicant has adequately addressed this further evaluation criterion. The staff's evaluation of the applicant's SMP is found in Section 3.0.3.11 of this SER.

The staff reviewed the USAR Supplement for the SMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for component supports for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

On the basis of its review, the staff finds that the applicant has adequately evaluated the management of aging of component supports, as recommended in the GALL Report. On the basis of this finding, and the finding that the remainder of the applicant's program is consistent with GALL, the staff concludes that there is reasonable assurance that this aging effect will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.2.3.2 Cumulative Fatigue Damage due to Cyclic Loading



As stated in the SRP-LR, the GALL Report identifies cumulative fatigue damage as a TLAA for support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports, if a CLB fatigue analysis exists. Since a CLB fatigue analysis does not exist at FCS, cumulative fatigue damage for component supports is not addressed by the applicant.

#### 3.5.2.2.3.3 Conclusions

The staff has reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation for component supports. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL recommends further evaluation have been adequately addressed and that there is reasonable assurance that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the USAR Supplement for the SMP and concludes that it provides an adequate summary description of the programs and activities credited for managing the effects of aging for component supports for which the applicant claimed consistency with GALL to satisfy 10 CFR 54.21(d).

#### 3.5.2.3 Aging Management Programs for Containment, Structures, and Component Supports

In SER Section 3.5.2.1, the staff evaluated the applicant's conformance with the aging management recommended by GALL for containment, other Class I structures, and component support component groupings. In SER Section 3.5.2.2, the staff reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation. In this SER section, the staff presents its evaluation of the programs used by the applicant to manage the aging of the component groups within the containment, other Class I structures, and component supports.

The applicant credits 13 AMPs to manage the aging effects associated with the containment, other Class I structures, and component supports. Eleven of the AMPs are credited to manage aging for components in other system groups (common AMPs) while two AMPs are credited with managing aging only for structures and structural components. The staff's evaluation of the common AMPs credited with managing aging in structures and structural components is provided in Section 3.0.3 of this SER. The common AMPs are listed here:

- Bolting Integrity Program - SER Section 3.0.3.1
- Chemistry Program - SER Section 3.0.3.2
- Containment Inservice Inspection Program - SER Section 3.0.3.3
- Inservice Inspection Program - SER Section 3.0.3.5
- Boric Acid Corrosion Prevention Program - SER Section 3.0.3.6
- Cooling Water Corrosion Program - SER Section 3.0.3.7
- Fire Protection Program - SER Section 3.0.3.9
- Periodic Surveillance and Preventive Maintenance Program - SER Section 3.0.3.10
- Structures Monitoring Program - SER Section 3.0.3.11
- General Corrosion of External Surfaces Program - SER Section 3.0.3.12
- Selective Leaching Program - SER Section 3.0.3.14

The staff's evaluation of the two structure-specific AMPs are provided in the sections below.

#### 3.5.2.3.1 Containment Leak Rate Program

The applicant described its containment leak rate program in Section B.1.4 of the LRA. The applicant credits this program with managing the potential aging of containment structures and components that are within the scope of license renewal. The staff reviewed the containment leak rate program to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

##### 3.5.2.3.1.1 Summary of Technical Information in the Application

The LRA states that the containment leak rate program is consistent with GALL program XI.S4, "10 CFR Part 50, Appendix J," and applicable sections of GALL program XI.S1, "ASME XI, Subsection IWE," related to Appendix J testing. In addressing the operating experience related to the program, the applicant stated that containment leaktight verification and visual examination of the steel components that are part of the leaktight barrier have been conducted at FCS since initial unit startup. Prior to the development of the ASME Section XI, Subsection IWE Inservice Inspection Program, examinations were performed in accordance with 10 CFR 50, Appendix J. No significant age-related degradation has been identified in the inspections performed.

The applicant concluded that the containment leak rate program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

##### 3.5.2.3.1.2 Staff Evaluation

Section B.1.3 of the LRA describes the applicant's containment leak rate program. The LRA states that this AMP is consistent with GALL program XI.S4, "10 CFR Part 50, Appendix J," and applicable sections of GALL program XI.S1, "ASME XI, Subsection IWE," related to Appendix J testing, with no deviations. The staff also reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

In addition to the review of Section B.1.3 of the LRA, the staff also reviewed the relevant portions of Section 3.5, "Aging Management of Containment, Structures, and Component Supports," and Section B.1.3, "Containment Inservice Inspection Program," of the LRA to correlate the results of the AMR and AMPs related to the containment.

The applicant's containment leak rate testing program is consistent with the provisions of GALL program XI.S4. Though the applicant does not explicitly describe the program as the one which assures the leaktight integrity of the FCS containment, GALL program XI.S4 describes the program as one that assures the essentially leaktight characteristics of the containment pressure boundary. Thus, the staff considers the basic purpose of the program is to ensure the leaktight integrity of the FCS containment. However, when a component shows a higher than acceptable leak rate, the cause could be related to the aging degradation of the component.

In response to a question related to the operating experience associated with Type A, Type B, and Type C tests (RAI B.1.4-1, issued by the staff on October 11, 2002), by letter dated December 12, 2002, the applicant indicated that none of the tests have exceeded twice the acceptance criteria for those components, i.e., containment structure, containment penetrations, and containment isolation valves. The staff considers the condition of the components adequate.

The applicant provided a summary description of the containment leak rate program in Section A.2.7 of the LRA. The description of the program cites the references that are being used in implementing the plant-specific program, and specifies that corrective actions are taken if leakage rates exceed the acceptance criteria. The staff considers the description of the program in the USAR Supplement acceptable.

#### 3.5.2.3.1.3 Conclusion

On the basis of its review of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the containment leak rate program will effectively manage aging in the structures and components for which this program is credited, so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.3.2 Overhead Load Handling Systems Inspection Program

The overhead load handling systems inspection program is described in Section B.2.6 of Appendix B to the LRA. The program manages the effects of general corrosion on the crane and trolley structural components for those cranes that are within scope and subject to an AMR and the effects of wear on the rails in the rail system. The staff reviewed the LRA to determine whether the applicant has demonstrated that the overhead load handling systems inspection program will adequately manage the aging effects for the components that credit this program throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

##### 3.5.2.3.2.1 Summary of Technical Information in the Application

The applicant states that the overhead load handling systems inspection program is consistent with GALL program XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Fueling) Handling Systems," with enhancements. The enhancements relate to expansion anchors and cover such items as establishing inspection guidance and acceptance criteria for general corrosion of the expansion anchor and cracking of the surrounding concrete.

Sections 2 and 3 of the LRA identify those components for which the overhead load handling systems inspection program is credited as an AMP. The AMR for the overhead load handling systems refers to Table 3.3.1 of the LRA, which indicates that the aging management of these items is consistent with GALL.

The applicant's operating experience indicates that no aging effects which impact the intended functions of the structures or components were identified in the inspections performed.

Based on the above, the applicant concluded that the overhead load handling systems inspection program provides reasonable assurance that aging effects will be managed such that the components subject to an AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

#### 3.5.2.3.2.2 Staff Evaluation

In LRA Section B.2.6, "Overhead Load Handling Systems Inspection Program," the applicant described its AMP to manage overhead load handling systems. The LRA states that this AMP is consistent with GALL program XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Fueling) Handling Systems," with an enhancement related to the inspection of the anchor bolts for the load handling systems. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancement and its justification to determine whether the AMP, with the enhancement, remains adequate to manage the aging effects for which it is credited, and reviewed the USAR Supplement to determine whether it provides an adequate description of the program.

The staff verified that the components in LRA Table 2.4.2.5-1 to which this program applies are commensurate with the intent of the GALL program X1.M23. The enhancements to several elements in the GALL program identified in the LRA were also reviewed. These enhancements would add more specific guidance for detection of aging effects, acceptance criteria, and corrective actions relating to concrete anchors for the equipment included in the program. Since the applicant is not taking any exception to GALL Report program X1.M23, but simply adding more specific guidance in the inspection procedures, the staff finds the enhancements reasonable and acceptable.

The staff reviewed the summary description of the overhead load handling inspection program in Appendix A of the LRA. The staff finds that the information in the USAR Supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

#### 3.5.2.3.2.3 Conclusion

On the basis of its review and inspection of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with GALL are consistent with GALL. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant's program provides for adequate management of the aging effects for which the program is credited. The staff also reviewed the USAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that the applicant has demonstrated that the overhead load handling systems inspection program will effectively manage aging in the structures and components for which this program is credited, so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

### 3.5.2.4 Aging Management Review of Plant-Specific Structures and Structural Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific structural components. To perform its evaluation, the staff reviewed the components listed in LRA Table 2.4.2.1-1 through 2.4.2.7-1 to determine whether the applicant properly identified the applicable aging effects and AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects for each component, ensuring that each component was evaluated in the appropriate LRA AMR Table in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

#### 3.5.2.4.1 Containment

##### 3.5.2.4.1.1 Summary of Technical Information in the Application

The AMR results for the containment are presented in Tables 3.5-1, 3.5-2, and 3.5-3 of the LRA. The applicant used the GALL Report format to present its AMR of containment components in LRA Table 3.5-1. In LRA Tables 3.5-2 and 3.5-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

As described in Section 2.4.1 of the LRA, the containment structure is a partially prestressed, reinforced concrete, Class I structure composed of a cylindrical wall, domed roof, and a bottom mat. The mat is common to both the containment structure and the auxiliary building and is supported on steel piles driven to bedrock. The containment has a 1/4 in. internal carbon steel liner. The materials of construction for the containment structure, as shown in Table 2.4.1-1 of the LRA, are steel, concrete, and miscellaneous materials such as calcium silicate and elastomers. These materials are exposed to containment air, indoor (ambient) air, outdoor air, borated water, treated water, and a buried environment.

#### Aging Effects

The LRA identifies the following aging effects for the containment structure:

- cracking, loss of material, and change in material properties for concrete components
- cracking, loss of material, and change in material properties for containment grout
- cracking for masonry block walls
- cumulative fatigue, cracking, and loss of material for steel containment penetrations
- loss of material for carbon steel structural components
- loss of prestress for containment tendons
- loss of seal for elastomers

#### Aging Management Programs

The LRA credits the following AMPs with managing the identified aging effects for the containment structure:

- Containment Inservice Inspection Program
- Chemistry Program

- Fire Protection Program
- Containment Leak Rate Program
- Structures Monitoring Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components in the containment structure will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

#### 3.5.2.4.1.2 Staff Evaluation

In addition to Section 3.5 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results: Structures," and the applicable AMP descriptions provided in Appendix B of the LRA, to determine whether the aging effects for the containment components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the containment structural components at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the containment components.

#### Aging Effects

Concrete: For containment concrete components, the applicant's AMR is consistent with the recommendations in the GALL Report. As such, the applicant has committed to manage cracking, change in material properties, and loss of material for containment concrete components that are accessible. However, for several of the table entries in LRA Table 3.5-1, the applicant stated that the aging effect/mechanism combinations identified in the GALL Report are not applicable to FCS. In RAIs 3.5-1, 3.5.1-7, 3.5.1-12, 3.5.1-15, and 3.5.1-16, the staff requested that the applicant clarify its intentions to manage the aging effect/mechanism combinations as recommended by the GALL Report. In its response to these RAIs, the applicant stated the following:

For concrete at FCS, even though OPPD has concluded that the AERMs identified for concrete in the GALL Report are not applicable due to the plant's operating experience, OPPD has committed to be consistent with the GALL Report and monitor for the possibility of the AERMs with the programs identified in the GALL Report.

The staff takes exception to the applicant's claim that the aging effects identified in the GALL Report are not applicable for concrete at FCS; however, since the applicant has committed to monitor for these aging effects using the appropriate AMPs, the staff considers the applicant's response to be adequate. As such, the staff considers RAIs 3.5-1, 3.5.1-7, 3.5.1-12, 3.5.1-15, and 3.5.1-16 closed.

In RAI 3.5.1-2, the staff requested further information regarding the LRA Table 2.4.1-1 entry entitled, "Containment Grout in Ambient Air." Specifically, the staff asked the applicant for

further information regarding the location of the grout within the containment and the aging management of the grout. In response to RAI 3.5.1-2, the applicant stated the following:

“Containment Grout in Ambient Air” includes grout under baseplates that are not typically exposed to fluids, flowing or otherwise. The table referenced in the RAI provides links to LRA AMR Items that are consistent with the recommendations in the GALL Report and credit the recommended AMPs.

Since the applicant has committed to manage the aging of grout within the containment as recommended by the GALL Report, the staff considers the applicant’s response to RAI 3.5.1-2 adequate.

In RAI 3.5.3-1, the staff requested further information regarding the aging management of the ungrouted masonry walls in the containment. Specifically, the staff requested that the applicant provide further information concerning the (1) location of these walls, (2) environment to which they are subjected, (3) time-interval for examining the walls, and (4) operating experience related to these walls. In response to RAI 3.5.3-1, the applicant provided a map showing the location of the ungrouted masonry walls. There are four ungrouted masonry walls at the 989 ft elevation level of the containment. The temperature, humidity, and radiation level that these walls are exposed to are 120 °F, 20 to 100 percent, and 10 R/hr averaged over a 40 year life, respectively. The applicant also stated that the masonry walls in the containment are inspected during the performance of the containment inspection surveillance test, which is performed during every other refueling outage. In addition, the applicant stated that containment inspections performed in 1996, 1999, and 2002 did not identify any degradation of the masonry walls. The staff considers that the applicant’s response to RAI 3.5.3-1 adequately demonstrates that there is no significant degradation of the ungrouted masonry walls in the containment, and that the aging of these walls will be adequately monitored during the period of extended operation.

For below-grade containment concrete components, the GALL Report recommends aging management only for an aggressive below-grade soil/ground water environment. Since ASME Section XI, Subsection IWL exempts from examination those portions of the concrete containment that are inaccessible, the GALL Report recommends that a plant-specific AMP be developed for concrete that may be exposed to an aggressive below-grade soil/ground water environment. As stated previously in SER Sections 3.5.2.2.1.1 and 3.5.2.2.2.2, the applicant adequately demonstrated that the ground water chemistry parameters (pH, sulfates, and chlorides) indicate a non-aggressive environment. Therefore, a plant-specific AMP for below-grade concrete components is not warranted. However, 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 RAI 3.5.1-1, the staff requested further information concerning (1) the condition of the containment tendon gallery, which is below-grade and accessible for inspection, and (2) the possibility of using the condition of the below-grade containment tendon gallery as an indicator for the aging of other inaccessible containment concrete components. In response to RAI 3.5.1-1, the applicant stated the following:

The exterior of the below-grade concrete wall of the tendon gallery is, by definition, inaccessible for inspection. If the reviewer is implying that inspections of the inside of the below-grade tendon gallery wall will provide evidence that the environment on the outside of the wall is not adversely affecting the concrete, then the results of these inspections performed to date indicate that no external degradation is occurring. Although the tendon

gallery is not part of the Containment boundary, it is included as part of the Containment inspections. In October 1999, there was no evidence of active concrete degradation (i.e., no residue indicating spalling concrete). Additionally, there were no signs of active seepage and all surfaces were dry. Fine cracks that had been noted in earlier inspections and monitored in subsequent inspections showed no signs of movement from those previous inspections.

Since the applicant's previous inspections of the containment tendon gallery indicate that there is not any significant aging, and since the ground water chemistry parameters are within the bounds recommended by the GALL Report, the staff concurs with the applicant's assertion that external degradation of below-grade concrete components is not likely to be significant. In the event that below-grade structural components are exposed by excavation, the applicant stated, in LRA Section B.2.10, "Structures Monitoring Program," that guidance will be added to inspect these components.

The staff finds that the applicant's approach for evaluating the applicable aging effects for concrete components in containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for concrete components in containment.

Steel: Consistent with the GALL Report recommendations, the applicant identified loss of material for containment carbon steel structural components, and cumulative fatigue, cracking, and loss of material as applicable aging effects for steel containment penetrations. Loss of prestress for containment tendons is also identified as an applicable aging effect by the applicant.

Loss of material due to corrosion of the embedded containment liner and cracking of containment penetrations due to cyclic loading are identified by the GALL Report as aging effects requiring further evaluation and are covered in detail in Sections 3.5.2.2.1.4 and 3.5.2.2.1.7, respectively, of this SER. Loss of prestress for containment tendons is evaluated as a TLAA and reviewed by the staff in Section 4.5 of this SER.

For stainless steel components that are exposed to only ambient air, the applicant did not identify any applicable aging effects. This latter category includes stainless steel threaded fasteners. In RAI 3.5.1-11, the staff requested that the applicant justify its conclusion regarding the aging management of stainless steel threaded fasteners. Specifically, the staff pointed out that these stainless steel fasteners may be subject to aging effects if exposed to a wetted or moist environment. In its response the applicant stated the following:

These stainless steel threaded fasteners are for the fuel transfer tube blind flange (containment side). The blind flange is removed prior to filling the refueling canal; therefore, the fasteners are not subject to an environment that would support aging effects.

Since the stainless steel threaded fasteners are not exposed to a wetted or moist environment, the staff supports the applicant's conclusion that there are no applicable aging effects for these fasteners. As such, the staff considers RAI 3.5.1-11 to be closed.

The staff finds that the applicant's approach for evaluating the applicable aging effects for steel components in containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for steel components in containment.



Elastomers (moisture barriers, seals)-Consistent with the GALL Report recommendations, the applicant identified loss of seal as an applicable aging effect for the equipment hatch gasket, which is made of neoprene.

The staff finds that the applicant's approach for evaluating the applicable aging effect for elastomers in containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effect for elastomers in containment.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the containment.

#### Aging Management Programs

Tables 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the components in the containment:

- Containment Inservice Inspection Program
- Chemistry Program
- Fire Protection Program
- Containment Leak Rate Program
- Structures Monitoring Program

With the exception of the containment leak rate program, each of the above AMPs are credited with managing the aging of several components in several different structures and systems and are, therefore, considered common AMPs. The staff's review of the common AMPs is in Section 3.0.3 of this SER. The staff's evaluation of the containment leak rate program is presented in Section 3.5.2.3.1 of this SER.

After evaluating the applicant's AMR for each of the components in the containment, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.5-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Tables 3.5-2 and 3.5-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with containment. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.1.3 Conclusions

The staff has reviewed the information in Sections 2.4 and 3.5 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the containment will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the containment to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.2 Other Structures

##### 3.5.2.4.2.1 Summary of Technical Information in the Application

The AMR results for structures outside the containment are presented in Tables 3.3-1, 3.3-2, 3.5-1, 3.5-2, and 3.5-3 of the LRA. The applicant used the GALL Report format to present its AMR of structural components in LRA Table 3.5-1. In LRA Tables 3.5-2 and 3.5-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s). The structural components listed in Tables 3.5-1 through 3.5-3 of the LRA are in the following structures:

- auxiliary building
- turbine building
- service building
- intake structure
- building piles

A brief description of each of the above structures is provided in Section 2.4.2, "Other Structures," of the LRA. The materials of construction identified in the LRA for each of the above structures are (1) steel, (2) concrete, (3) elastomers, (4) fire protection materials, (5) polyvinyl chloride (PVC), (6) earth fill, (7) cast iron, (8) bronze, and (9) brass. These materials are exposed to outdoor, buried, indoor, borated water, and raw water environments.

#### Aging Effects

Tables 3.5-1 through 3.5-3 of the LRA identify the following applicable aging effects for components in structures outside the containment:

- loss of material
- change in material properties
- cracking
- separation
- loss of mechanical function
- reduction in concrete anchor capacity

#### Aging Management Programs

Tables 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the components in structures outside the containment:

- Chemistry Program
- Inservice Inspection Program
- Fire Protection Program
- Periodic Surveillance and Preventive Maintenance Program
- Structures Monitoring Program

- General Corrosion of External Surfaces Program
- Selective Leaching Program
- Cooling Water Corrosion Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components in structures outside the containment will be adequately managed by these AMPs such that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.4.2.2 Staff Evaluation

In addition to Section 3.5 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results: Structures," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the components in structures outside the containment have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of structural components at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the components in structures outside of containment.

#### Aging Effects

Concrete: For concrete components in structures outside the containment, the applicant's AMR is consistent with the recommendations in the GALL Report. As such, the applicant has committed to manage cracking, change in material properties, and loss of material for concrete structural components that are accessible. As stated previously in Section 3.5.2.4.1.2 of this SER, the applicant stated in LRA Table 3.5-1 that, although they are consistent with the GALL Report, they do not consider the aging effects/mechanisms identified by the GALL for concrete to be applicable to concrete structures at FCS. To clarify the applicant's intent with regard to the aging management of concrete structural components, the staff requested in several RAIs (3.5-1, 3.5.1-7, 3.5.1-12, 3.5.1-15, and 3.5.1-16) that the applicant provide further information regarding this apparent discrepancy. In response, the applicant stated that although they do not consider these aging effects to be applicable, they will manage the aging of concrete structures at FCS as recommended by the GALL Report. Since the applicant clarified its intentions to manage the aging of concrete structures at FCS, the staff considers the response to the staff's RAIs adequate.

For below-grade concrete structural components, the GALL Report recommends aging management only for an aggressive below-grade soil/ground water environment. As stated previously in SER Section 3.5.2.2.2.2, the applicant adequately demonstrated that the ground water chemistry parameters (pH, sulfates, and chlorides) indicate a non-aggressive environment. Therefore, aging management of below-grade concrete components is not warranted. To insure that the below-grade environment remains non-aggressive, the applicant

has committed to periodically monitor the ground water chemistry through its structural monitoring program.

The staff finds that the applicant's approach for evaluating the applicable aging effects for concrete components in structures outside the containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for concrete components in these structures.

Steel: Consistent with the recommendations of the GALL Report, the applicant identified loss of material as an applicable aging effect for carbon steel components in structures outside the containment. This includes all Class I structures identified in the GALL Report. For carbon steel expansion/grouted anchors, the applicant identified loss of material and reduction in concrete anchor capacity as applicable aging effects. These steel expansion/grouted anchors are found in the auxiliary building, turbine and service buildings, and intake structure.

For below-grade pipe piles, the applicant did not identify any applicable aging effects. This position is consistent with the agreement in NUREG 1557, "Summary of Technical Information and Agreements from Nuclear Management and Resource Council Industry Reports Addressing License Renewal," which states the following:

Steel piles driven in undisturbed soils have been unaffected by corrosion and those driven in disturbed soil experience minor to moderate corrosion to a small area of metal.

For stainless steel components, the applicant identified loss of material as an applicable aging effect for (1) the intake structure pump gland bolting, which is exposed to raw water and (2) the fuel transfer penetration fasteners, which are exposed to borated treated water. The applicant also identifies cracking as an applicable aging effect for the stainless steel spent fuel pool liner and the refueling canal liner. For structural stainless steel in ambient air the applicant did not identify any applicable aging effects.

The staff finds that the applicant's approach for evaluating the applicable aging effects for steel components in structures outside the containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for steel components in these structures.

Elastomers: For the auxiliary building and intake structure flood panel seals, the applicant identified change in material properties and cracking as applicable aging effects. Since neither of these components are identified in the GALL Report, the applicant lists these items in LRA Table 3.5-2. The staff concurs with the applicant's identification of these two aging effects for elastomer material components.

The staff finds that the applicant's approach for evaluating the applicable aging effects for elastomers in structures outside the containment to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for elastomers in these structures.

Fire Protection Materials (glass, mineral fiber, pyrocrete, masonry) For the glass used in the metal fire penetration barriers, the applicant did not identify any applicable aging effects. For mineral fiber and pyrocrete fire barriers, the applicant identified separation, cracking, and loss

of material as applicable aging effects. For masonry block walls used as fire barriers, the applicant identified cracking as an applicable aging effect.

The staff concurs with the applicant's identification of the applicable aging effects for the pyrocrete fire barriers and masonry block walls. For the glass used in metal fire penetration barriers, the staff concurs with the applicant's conclusion that there are no applicable aging effects.

Miscellaneous Metals (cast iron, bronze, brass): For the cast iron stuffing box floor penetration in the intake structure, the applicant identified loss of material as an applicable aging effect. The applicant did not identify any aging effects for the auxiliary building removable slab lifting devices, which are made from bronze. Cast iron, bronze, and brass are used for gland and gland bolting in the intake structure. Since the gland bolting is in a raw water environment, the applicant identified loss of material as an applicable aging effect.

The staff concurs with the applicant's identification of loss of material as an aging effect for the cast iron stuffing box floor penetration in the intake structure and for the gland bolting in a raw water environment. Since the bronze removable slab lifting devices are not exposed to a harsh environment, the staff concurs with the applicant's conclusion that there are no applicable aging effects.

Miscellaneous Materials (PVC, earth fill)-For the auxiliary building pressure relief panels, made from PVC, the applicant identified change in material properties and cracking as applicable aging effects. For the earth fill, made from sand and gravel, surrounding the diesel fire pump fuel storage tank, the applicant did not identify any applicable aging effects.

The staff concurs with the aging effects identified by the applicant for the PVC pressure relief panels. Since the sand and gravel earth fill is not exposed to wave action or running water, the staff concurs with the applicant's conclusion that there are no applicable aging effects.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the auxiliary, turbine and service buildings, the intake structure, or the building piles.

#### Aging Management Programs

Tables 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the components in structures outside the containment:

- Chemistry Program
- Inservice Inspection Program
- Fire Protection Program
- Periodic Surveillance and Preventive Maintenance Program
- Structures Monitoring Program
- General Corrosion of External Surfaces Program
- Selective Leaching Program
- Cooling Water Corrosion Program

Each of the above AMPs are credited with managing the aging of several components in several different structures and systems and are, therefore, considered common AMPs. The staff's review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the components in structures outside the containment, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.5-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Tables 3.5-2 and 3.5-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the auxiliary, turbine and service buildings, the intake structure, or the building piles to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.2.3 Conclusions

The staff has reviewed the information in Sections 2.4 and 3.5 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in structures outside the containment will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3)

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the auxiliary, turbine and service buildings, the intake structure, and the building piles to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.3 Fuel Handling Equipment and Heavy Load Cranes

##### 3.5.2.4.3.1 Summary of Technical Information in the Application

The AMR results for the fuel handling equipment and heavy load cranes are presented in Tables 3.3-1, 3.3-2, and 3.3-3 of the LRA. The applicant used the GALL Report format to present its AMR of the components in LRA Table 3.3-1. In LRA Table 3.3-2 and 3.3-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

The components comprising the fuel handling equipment and heavy load cranes commodity group include all of the components used in the storage and handling of new/spent fuel and in the hoisting of loads. As stated in Section 2.4.2.5 of the LRA, the fuel handling equipment portion of this commodity consists of the refueling machine, tilting machines in the containment and auxiliary building, fuel transfer conveyor, fuel transfer carrier box, fuel transfer tube, new and spent fuel handling tools, new and spent fuel storage racks, and spent fuel bridge. The heavy load cranes portion of this commodity consists of eight cranes of varying types (i.e., overhead crane, hoist with monorail, and jib crane).

The materials of construction for the fuel handling equipment and heavy load cranes commodity group are (1) carbon steel, (2) stainless steel, (3) aluminum, and (4) boron. These materials are exposed to ambient air and borated water.

#### Aging Effects

Tables 3.3-1 through 3.3-3 of the LRA identify the following applicable aging effects for the fuel handling equipment and heavy load cranes commodity group:

- cracking
- loss of material
- reduction in neutron absorbing capacity

#### Aging Management Programs

Tables 3.3-1 through 3.3-3 of the LRA credit the following AMPs with managing the identified aging effects for the fuel handling equipment and heavy load cranes commodity group:

- Overhead Load Handling Systems Inspection Program
- Chemistry Program
- Structures Monitoring Program
- Periodic Surveillance and Preventive Maintenance Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the fuel handling equipment and heavy load cranes commodity group will be adequately managed by these AMPs, such that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.4.3.2 Staff Evaluation

In addition to Section 3.3 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results: Structures," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the fuel handling equipment and heavy load cranes commodity group have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the fuel handling equipment and heavy load cranes commodity group at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the fuel handling equipment and heavy load cranes commodity group.

#### Aging Effects

Steel: Consistent with the recommendations of the GALL Report, the applicant identified loss of material as an applicable aging effect for each of the carbon steel components in the fuel handling equipment and heavy load cranes commodity group. For stainless steel components in this commodity group that are exposed to ambient air and borated water, the applicant identified cracking and loss of material as applicable aging effects. For stainless steel components that are exposed to only ambient air, the applicant did not identify any applicable aging effects.

The staff finds that the applicant's approach for evaluating the applicable aging effects for steel components for fuel handling equipment and heavy load cranes to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for steel components in the fuel handling equipment and heavy load cranes.

Miscellaneous Metals (aluminum, boral): For the aluminum new and spent fuel handling tools that are exposed to both ambient air and borated water, the applicant identified cracking and loss of material as applicable aging effects. For the aluminum new fuel storage racks that are exposed only to ambient air, the applicant did not identify any applicable aging effects. Similarly, for the boral new fuel storage racks that are exposed only to ambient air, the applicant did not identify any applicable aging effects. However, for the boral spent fuel storage racks that are exposed to both ambient air and borated water, the applicant identified reduction in neutron absorbing capacity as an applicable aging effect, which is consistent with the GALL Report.

The staff concurs with the applicant's identification of cracking and loss of material as applicable aging effects for aluminum and boral components exposed to both borated water and ambient air. In addition, the staff concurs with the applicant's conclusion that there are no applicable aging effects for boral and aluminum components that are exposed only to ambient air.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the fuel-handling equipment and heavy load cranes.

#### Aging Management Programs

Tables 3.3-1 through 3.3-3 of the LRA credit the following AMPs with managing the identified aging effects for the fuel handling equipment and heavy load cranes commodity group:

- Overhead Load Handling Systems Inspection Program
- Chemistry Program
- Structures Monitoring Program
- Periodic Surveillance and Preventive Maintenance Program

With the exception of the overhead load handling system inspection program, each of the above AMPs is credited with managing the aging of several components in several different structures and systems and are, therefore, considered common AMPs. The staff's review of the common AMPs is in Section 3.0.3 of this SER. The staff review of the overhead load handling system inspection program is in Section 3.5.2.3.2 of this SER.



After evaluating the applicant's AMR for each of the components in the fuel handling equipment and heavy load cranes commodity group, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Tables 3.3-2 and 3.3-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the fuel-handling equipment and heavy load cranes. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d)

#### 3.5.2.4.3.3 Conclusion

The staff has reviewed the information in Sections 2.4 and 3.3 of the LRA, as well as the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the fuel handling equipment and heavy load cranes commodity group will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the fuel-handling equipment and heavy load cranes to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.4 Component Supports

##### 3.5.2.4.4.1 Summary of Technical Information in the Application

The AMR results for the component supports are presented in Tables 3.5-1, 3.5-2, and 3.5-3 of the LRA. The applicant used the GALL Report format to present its AMR of the components in LRA Table 3.5-1. In LRA Tables 3.5-2 and 3.5-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

As stated in Section 2.4.2.6 of the LRA, the components comprising the component supports commodity group consist of the structural connection between a system, or component within a system, and a plant building structural concrete or steel member. Supports for both the distributive portion of the systems (pipe, conduit, tubing, raceway) and the system's equipment are included.

The materials of construction for the component supports commodity group are (1) carbon steel, (2) stainless steel, (3) lubrite, and (4) trisodium phosphate. These materials are exposed to ambient air and borated water.

#### Aging Effects

Tables 3.5-1 through 3.5-3 of the LRA identify the following applicable aging effects for the component supports commodity group:

- loss of material
- cracking
- loss of mechanical function

#### Aging Management Programs

Tables 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the component supports commodity group:

- Boric Acid Corrosion Prevention Program
- Bolting Integrity Program
- Chemistry Program
- Structures Monitoring Program
- Inservice Inspection Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the component supports commodity group will be adequately managed by these AMPs such that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.4.4.2 Staff Evaluation

In addition to Section 3.5 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results: Structures," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the component supports commodity group have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the component supports commodity group at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the component supports commodity group.

#### Aging Effects

Steel: Consistent with the recommendations of the GALL Report, the applicant identified loss of material as an applicable aging effect for the carbon steel component supports. In addition, for the high-strength carbon steel threaded fasteners, the applicant identified cracking due to SCC, as well as loss of material, as applicable aging effects. For stainless steel component supports in borated water, the applicant identifies loss of material and cracking as applicable aging effects. However, for stainless structural steel in ambient air, the applicant did not identify any applicable aging effects. Finally, for stainless steel threaded fasteners, the applicant identified cracking as an applicable aging effect.

The staff finds that the applicant's approach for evaluating the applicable aging effects for steel component supports to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for steel component supports.

Miscellaneous Material (lubrite, trisodium phosphate)-For lubrite plates used for component supports, the applicant identified loss of mechanical function as an applicable aging effect. However, this material is not directly specified in LRA Table entry 3.5.1.28. In RAI 3.5.1-18, the staff requested that the applicant clarify its aging management for lubrite plates. In response, the applicant stated that this LRA table entry should have referred also to non-steel components (including lubrite plates) and that loss of mechanical function will be managed for this component. The applicant's response adequately clarifies the aging management for lubrite plates and is therefore, acceptable to the staff.

For trisodium phosphate baskets in ambient air, the applicant did not identify any applicable aging effects. Since these trisodium phosphate baskets are not exposed to a harsh environment, the staff concurs with the applicant's conclusion that there are no applicable aging effects.

The staff finds that the applicant's approach for evaluating the applicable aging effects for miscellaneous material used for component supports to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for miscellaneous material used for component supports.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with component supports.

#### Aging Management Programs

Tables 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the component supports commodity group:

- Boric Acid Corrosion Prevention Program
- Bolting Integrity Program
- Chemistry Program
- Structures Monitoring Program
- Inservice Inspection Program

Each of the above AMPs are credited with managing the aging of several components in several different structures and systems and are, therefore, considered common AMPs. The staff's review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the components in the component supports commodity group, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.5-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Tables 3.5-2 and 3.5-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with component supports. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.4.3 Conclusions

The staff has reviewed the information in Sections 2.4 and 3.5 of the LRA, the applicant's response to the staff's RAI, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the component supports commodity group will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the component supports to satisfy 10 CFR 54.21(d).

#### 3.5.2.4.5 Duct Banks

##### 3.5.2.4.5.1 Summary of Technical Information in the Application

The AMR results for the duct banks are presented in Tables 3.5-1, 3.5-2, and 3.5-3 of the LRA. The applicant used the GALL Report format to present its AMR of the components in LRA Table 3.5-1. In LRA Tables 3.5-2 and 3.5-3, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effect(s), and (4) AMP(s).

As stated in Section 2.4.2.7 of the LRA, duct banks are comprised of conduits encased in concrete and are located below grade. Duct banks are used to route electrical power cables between buildings. Electrical manholes are reinforced concrete box-type structures which allow for inspection and routing of the cables.

The materials of construction for the duct banks are (1) concrete, (2) carbon steel, (3) gray cast iron, and (4) polyurethane foam. These materials are exposed to ambient air, outdoor air, and a buried environment.

#### Aging Effects

Tables 3.5-1 through 3.5-3 of the LRA identify the following applicable aging effects for the duct banks:

- loss of material
- cracking
- change in material properties
- separation

#### Aging Management Programs

Table 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the duct banks:

- Structures Monitoring Program
- Periodic Surveillance and Preventive Maintenance Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the duct banks will be adequately managed by these AMPs such that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.5.2.4.5.2 Staff Evaluation

In addition to Section 3.5 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results: Structures," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the duct banks have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the duct banks at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the duct banks.

#### Aging Effects

Concrete: For the accessible concrete portion of the duct banks, the applicant's AMR is consistent with the recommendations in the GALL Report. As such, the applicant has committed to manage cracking, change in material properties, and loss of material for concrete structural components that are accessible. As stated previously in Section 3.5.2.4.1.2 of this SER, the applicant states in LRA Table 3.5-1 that although they are consistent with the GALL Report, they do not consider the aging effects/mechanisms identified by the GALL for concrete to be applicable to concrete structures at FCS. To clarify the applicant's intent with regard to the aging management of concrete structural components, the staff requested in several RAIs (3.5-1, 3.5.1-7, 3.5.1-12, 3.5.1-15, and 3.5.1-16) that the applicant provide further information regarding this apparent discrepancy. In response, the applicant stated that although they do not consider these aging effects to be applicable, they will manage the aging of concrete structures at FCS as recommended by the GALL Report. Since the applicant clarified its intentions to manage the aging of concrete structures at FCS, the staff considers the RAIs listed above closed.

For the below-grade concrete portion of the duct banks, the GALL Report recommends aging management only for an aggressive below-grade soil/ground water environment. As stated previously in SER Section 3.5.2.2.2.2, the applicant adequately demonstrated that the ground water chemistry parameters (pH, sulfates, and chlorides) indicate a non-aggressive environment. Therefore, aging management of below-grade concrete components is not

warranted. To insure that the below-grade environment remains non-aggressive, the applicant has committed to periodically monitor the ground water chemistry through its SMP.

The staff finds that the applicant's approach for evaluating the applicable aging effects for concrete components in the duct banks to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for concrete components in the duct banks.

Steel: Consistent with the recommendations of the GALL Report for the carbon steel manhole flange, the applicant identified loss of material as an applicable aging effect.

The staff finds that the applicant's approach for evaluating the applicable aging effects for steel components in the duct banks to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for steel in duct banks.

Cast Iron: For the gray cast iron manhole covers and flange, the applicant identified loss of material as an applicable aging effect. The staff concurs with the identification of loss of material as an applicable aging effect for the gray cast iron manhole covers and flange.

Polyurethane Foam: For the manhole polyurethane foam blocks used as a flood protection barrier, the applicant identified cracking and separation as applicable aging effects. The staff concurs with the identification of these two aging effects for the polyurethane foam blocks.

On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the duct banks.

#### Aging Management Programs

Table 3.5-1 through 3.5-3 of the LRA credit the following AMPs with managing the identified aging effects for the duct banks:

- Structures Monitoring Program
- Periodic Surveillance and Preventive Maintenance Program

Each of the above AMPs are credited with managing the aging of several components in several different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is in Section 3.0.3 of this SER.

After evaluating the applicant's AMR for each of the components in the duct banks commodity group, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.5-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Tables 3.5-2 and 3.5-3, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect(s).

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the duct banks. In addition, the staff found the associated program descriptions in the USAR Supplement to be acceptable to satisfy 10 CFR 54.21(d)

### 3.5.2.4.5.3 Conclusions

The staff has reviewed the information in Sections 2.4 and 3.5 of the LRA, the applicant's responses to the staff's RAIs, and the applicable AMP descriptions in Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the components in the duct banks commodity group will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplements provide adequate program descriptions of the AMPs credited for managing aging in the duct banks to satisfy 10 CFR 54.21(d).

### 3.5.3 Evaluation Findings

The staff has reviewed the information in Sections 2.4, 3.3, and 3.5 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment, structures, and structural components will be adequately managed so that there is reasonable assurance that these structures and components will perform their intended functions in accordance with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In addition, the staff also concludes that the USAR Supplement contains an appropriate summary description of the programs and activities for managing the effects of aging for the containment, structures, and structural components for the period of extended operation, as required by 10 CFR 54.21(d).

## 3.6 Electrical and Instrumentation and Controls

This section addresses the aging management of the components of the electrical and instrumentation and control (I&C) systems group. The systems that make up this group are described in the following LRA sections:

- Cables and Connectors (2.5.1)
- Containment Electrical Penetrations (2.5.2)
- Engineered Safeguards (2.5.3)
- Nuclear Instrumentation (2.5.4)
- Reactor Protection System (2.5.5)
- 4160 VAC (2.5.6)
- 480 VAC Bus (2.5.7)
- 480 VAC MCCs (2.5.8)
- 125 VDC (2.5.9)
- 120 VAC (2.5.10)
- Plant Computer - Emergency Response Facility (2.5.11)
- Qualified Safety Parameter Display (2.5.12)
- Radiation Monitoring (2.5.13)
- Electrical Equipment (2.5.14)
- Auxiliary Instrumentation (2.5.15)

- Control Board (2.5.16)
- Diverse Scram System (2.5.17)
- Communications (2.5.18)
- Emergency Lighting (2.5.19)
- Bus Bars (2.5.20)

As discussed in Section 3.0.1 of this SER, the electrical and I&C are included in one LRA table. LRA Table 3.6-1 consists of electrical and I&C components that are evaluated in the GALL Report.

### 3.6.1 Summary of Technical Information in the Application

In LRA Section 3.6, "Aging Management of Electrical and Instrumentation and Controls," the applicant described its AMRs for the electrical and I&C systems group at FCS.

The description of the electrical and I&C systems can be found in LRA Section 2.5.

The passive, long-lived components that are subject to an AMR are identified as follows:

- Cables and connectors (including splices, fuse blocks , terminal blocks)
- Electrical penetration
- Bus bar

The LRA states that cables and their associated connectors provide electrical energy (either continuously or intermittently) to power various equipment and components throughout the plant. Cables and connectors associated with the EQ program are addressed as short-lived TLAAAs and thus are not included in the set of cables and connectors requiring an AMR.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management.

These reviews concluded that the aging effects requiring management based on FCS operating experience were consistent with aging effects identified in GALL.

The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL.

The applicant's ongoing review of plant-specific and industry operating experience is conducted in accordance with the FCS operating experience program.

### 3.6.2 Staff Evaluation

In Section 3.6 of the LRA, the applicant describes its AMR for electrical and I&C systems at FCS. The staff reviewed LRA Section 3.6 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of



extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for electrical and I&C system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of electrical and I&C system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report.

In LRA Section 2.5, the applicant provided brief descriptions of the electrical and I&C systems, and summarized the results of its AMR of the electrical and I&C system components at FCS in LRA Section 3.6.

Table 3.6-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.6 that are addressed in the GALL Report.

Table 3.6-1

Staff Evaluation Table for FCS Electrical Components Evaluated in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental qualification of electrical components	EQ Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.6.2.2 below)

<p>Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements</p>	<p>Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by thermal/thermooxidative degradation of organics; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion</p>	<p>Aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements</p>	<p>AMP consistent with GALL AMP XI.E1</p>	<p>Will be consistent with GALL. (See Section 3.6.2.3.1.2 below)</p>
<p>Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (IR)</p>	<p>Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/thermooxidative degradation of organics; radiation-induced oxidation; moisture intrusion</p>	<p>Aging management program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements</p>	<p>AMP consistent with GALL AMP XI.E2</p>	<p>Will be consistent with GALL (See Section 3.6.2.3.1.2 below)</p>
<p>Inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements</p>	<p>Formation of water trees, localized damage leading to electrical failure (breakdown of insulation); water trees caused by moisture intrusion</p>	<p>Aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements</p>	<p>AMP consistent with GALL AMP XI.E3</p>	<p>Will be consistent with GALL (See Section 3.6.2.3.1.2 below)</p>
<p>Electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage</p>	<p>Corrosion of connector contact surfaces caused by intrusion of borated water</p>	<p>Boric acid corrosion</p>	<p>Boric acid corrosion prevention</p>	<p>Consistent with GALL (See Section 3.6.2.1 below)</p>

The staff's review of the electrical and I&C systems group for the FCS LRA is contained within four sections of this SER. Section 3.6.2.1 is the staff review of components in the electrical and I&C systems that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.6.2.2 is the staff review of components in the electrical and I&C systems that the applicant indicates are consistent with GALL and GALL recommends further evaluation. Section 3.6.2.3 is the staff evaluation of aging management programs that are specific to the reactor systems. Section 3.6.2.4 contains an evaluation of the adequacy of aging management for components in each system in the electrical and I&C systems group and includes an evaluation of components in the electrical and I&C systems that the applicant indicates are not in GALL.

#### 3.6.2.1 Aging Management Evaluations in the GALL Report that Are Relied on for License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups during the AMR inspection to determine whether the plant-specific components contained in these GALL component groups are bounded by the GALL evaluation. The staff also sampled component groups during the AMR inspection to determine whether the applicant had properly identified those component groups in GALL that are not applicable to its plant. The results of the staff's AMR inspection can be found in AMR Inspection Report 50-285/03-07, dated March 20, 2003.

On the basis of its review of the inspection results, the staff finds that the applicant's claim of consistency with GALL is acceptable, and that it is acceptable for the applicant to reference the information in the GALL Report for electrical and I&C components. Therefore, on this basis, the staff concludes that the applicant has demonstrated that the components for which the applicant claimed consistency with GALL will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.6.2.2 Electrical Equipment Subject to Environmental Qualification

As stated in the SRP-LR, environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The environmental qualification TLAA is discussed in LRA Section 4.4. The staff reviewed the evaluation of this TLAA separately in Section 4.4 of this SER, following the guidance in Section 4.4 of the SRP-LR.

#### 3.6.2.3 Aging Management Programs for Electrical and I&C Components

In SER Section 3.6.2.1, the staff determined that the applicant's AMRs and associated AMPs will adequately manage component aging in electrical and I&C systems. The staff then reviewed specific electrical and I&C system components to ensure that they were properly evaluated in the applicant's AMR.

To perform its review, the staff reviewed the components listed in LRA Tables 2.5.1-1 through 2.5.20-1 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the

staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the USAR Supplement for the AMP credited with managing aging in electrical and I&C system components to determine whether the program descriptions adequately describe the programs.

The applicant credits two AMPs to manage the aging effects associated with electrical and I&C components. One of the AMPs is credited to manage aging for components in other system groups (common AMPs) while one AMP is credited with managing aging only for electrical and I&C components. The staff's evaluation of the common AMP credited with managing aging in electrical and I&C components is provided in Section 3.0.3 of this SER. The common AMP is the boric acid corrosion prevention program, and is reviewed in Section 3.0.3.6 of this SER.

The staff's evaluation of the non-EQ cable AMP is provided here.

#### 3.6.2.3.1 Non-EQ Cable Aging Management Program

##### 3.6.2.3.1.1 Summary of Technical Information in the Application

In LRA Section B.3.4, "Non-EQ Cable Aging Management Program," the applicant provides its AMP to manage aging in electrical cables and connectors not subject to 10 CFR 50.49 and the electrical cables used in instrumentation circuits not subject to 10 CFR 50.49. The LRA states that the FCS non-EQ cable AMP establishes a service life value for the non-EQ cable in a similar fashion as the FCS EQ program establishes a qualified life for safety-related equipment. Non-EQ cable was purchased to the same requirements and specifications as that included in the EQ program for the cable installed and qualified under the EQ program. Additional temperature and environmental data utilized to extend the qualified life of the EQ equipment and cable will be utilized to analyze and establish a service life for the non-EQ cables. These analyses are relied upon to predict the life expectancy of the non-EQ cables under the normal and abnormal plant operating conditions. Cables not capable of having a 60-year service life will be further analyzed using state of the art analytical techniques to determine if the service life can be further extended. Industry accepted and regulatory-approved cable inspection techniques that provide aging related data, as well as state-of-the-art in-situ, non-destructive testing of cable performance, and/or laboratory testing of cable to extend life, may also be considered should the aforementioned methodologies not succeed in extending the required service life.

##### 3.6.2.3.1.2 Staff Evaluation

The staff reviewed the applicant's non-EQ cable AMP credited for the aging management of insulated cables and connections at FCS. The staff's evaluation includes a review of the aging effects considered. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on cables will be adequately managed during period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the USAR Supplement for this AMP to determine whether it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

The staff noticed that although the applicant referenced GALL as an AMP, all the elements of the AMP were not consistent with GALL. Therefore, the staff was unclear how the proposed AMP will manage aging of electrical components that are within the scope of the license renewal and subject to an AMR, but that are not subject to 10 CFR 50.49 environmental qualification requirements (including those used in instrument circuits as well as inaccessible medium voltage cables). In addition, for inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements, no aging program was proposed by the applicant. The LRA stated that modifications were made to the duct banks to preclude moisture intrusion; therefore there is no aging effect requiring management. However, it was not clear to the staff what periodic actions will be taken during the period of extended operation to assure that the modifications made to prevent inaccessible non-EQ medium-voltage cables from being exposed to significant moisture will remain intact. By letter dated October 11, 2002, the staff issued RAI B.3.4-1, requesting the applicant to clarify the following three items:

1. How will the Non-EQ aging management program manage aging in accessible and inaccessible electrical cables and connections that are within the scope of license renewal and subject to an AMR, but are not subject to the environmental qualification requirements of 10 CFR 50.49 and that are exposed to adverse localized conditions caused by radiation, temperature or moisture, such that the cables and connectors will perform their intended functions in accordance with the current licensing basis through the period of extended operation?
2. How will the Non-EQ aging management program manage aging in accessible and inaccessible electrical cables and connectors that are within the scope of license renewal and subject to an AMR and are exposed to adverse localized conditions caused by radiation, temperature or moisture, and that are used in circuits with sensitive, low-level signals, but that are not subject to the environmental qualification requirements of 10 CFR 50.49, such that the cables will perform their intended functions in accordance with the current licensing basis through the period of extended operation?
3. How will the Non-EQ aging management program manage aging in inaccessible medium voltage cables that are within the scope of license renewal and subject to an AMR, and are exposed to adverse localized environments caused by moisture while energized, but are not subject to the environmental qualification requirements of 10 CFR 50.49, such that the cables will perform their intended functions in accordance with the current licensing basis through the period of extended operation?

In a letter dated December 19, 2002, the applicant responded to RAI B.3.4-1, stating that, for non-EQ cables and connections within the scope of license renewal and subject to an aging management review

1. Prior to period of extended operation, OPPD will implement a program and inspection consistent with that described in XI.E.1 of the GALL Report.
2. Prior to period of extended operation, OPPD will implement a program and inspection consistent with that described in XI.E.2 of the GALL Report.

3. In response to this item, the applicant stated that in 1994, during an inspection of the cable vault/manhole, it was discovered that moisture ingress around the manhole was causing some of the conduits to corrode. A section of boat foam was added around the conduit nest to preclude water from seeping in through the manhole cover from further corroding the conduit. Additionally, the manhole was sealed.

Medium voltage cables (six shutdown circuits) are routed through the vault and into duct banks from the intake structure to the service building. Although medium voltage cables are routed through the duct banks, by design, they will not accumulate standing water; duct banks are pitched at a minimum of 1/8 in. per foot. The applicant stated that in 30 years, it has not had a cable failure, and committed to implementing a program and inspection consistent with that described in XI.E3 of the GALL Report. The staff found the applicant's response to RAI B.3.4-1 satisfactory.

The staff reviewed the USAR Supplement for the non-EQ cable AMP as described in the LRA and found that the supplement does not provide an adequate description of the revised program, as required by 10 CFR 54.21(d). The AMP provided in the LRA reflected the program as originally envisioned by the applicant. As discussed above, the applicant has committed to revising the AMP to reflect the positions in GALL Report Sections XI.E1, XI.E2, and XI.E3. As a result, the description of the AMP in the USAR Supplement must be revised to reflect the descriptions of XI.E1, XI.E2, and XI.E3. The applicant should submit to the staff a revised USAR Supplement that is consistent with the descriptions for GALL AMPs XI.E1, XI.E2, and XI.E3 and satisfies 10 CFR 54.21(d). This is Open Item 3.6.2.3.1.2-1.

#### 3.6.2.3.1.3 Conclusion

On the basis of its review and inspection of the applicant's program, including the applicant's commitment to implement a program and inspection consistent with GALL, the staff finds that those portions of the program for which the applicant claims consistency with GALL will be consistent with GALL. The staff also reviewed the USAR Supplement for this AMP and finds that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the USAR Supplement will provide an adequate summary description of the program, as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that with the applicant's commitment to develop an AMP consistent with GALL AMPs XI.E1, XI.E2, and XI.E3, the applicant has demonstrated that the non-EQ cable program will effectively manage aging in the structures and components for which this program is credited, so that there is reasonable assurance that the intended functions of the associated components and systems will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.6.2.4 Aging Management Review of Plant-Specific Electrical Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific electrical components. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.5.1-1, 2.5.2-1, and 2.5.20-1, to determine whether the applicant properly identified the applicable aging effects and AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated in the appropriate LRA AMR Table in Section 3, and that management of the aging effect was captured in the appropriate AMP.

The results of the staff's review are provided below.

#### 3.6.2.4.1 Cables and Connectors

##### 3.6.2.4.1.1 Summary of Technical Information in the Application

The AMR results for cables and connectors are presented in LRA Table 3.6-1. All electrical and I&C components within the scope of license renewal and subject to an AMR were addressed in the GALL Report. The applicant used the GALL Report format to present its AMR of electrical and I&C components in LRA Table 3.6-1.

As described in LRA Section 2.5.1, cables and connectors provide electrical energy (either continuously or intermittently) to power various equipment and components throughout the plant. Cables and connectors associated with the EQ program are addressed either as short-lived and periodically replaced, or as long-lived TLAAs. As such, they are not included in the set of cables and connectors requiring additional aging management.

##### Aging Effects

The LRA identifies the following aging effects for cables and connectors:

- degradation due to various aging mechanisms
- embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR)
- electrical failure caused by thermal/thermooxidative degradation of organics
- radiolysis and photolysis (ultraviolet-sensitive materials only) of organics
- radiation-induced oxidation
- moisture intrusion
- formation of water trees; localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees
- corrosion of connector contact surfaces caused by intrusion of borated water

The applicant credited the following AMPs and TLAA with managing the identified aging effects for cables and connectors:

- Boric Acid Corrosion Prevention Program (B.2.1)
- Non-EQ Cable Aging Management Program (B.3.4)
- EQ TLAA

A description of the AMPs is provided in Appendix B of the LRA. The EQ TLAA is described in LRA Section 4.4.

The applicant concluded that the effects of aging associated with cables and connectors will be adequately managed by these AMPs and TLAA such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

##### 3.6.2.4.1.2 Staff Evaluation

In addition to LRA Section 3.6, the staff reviewed the pertinent information in LRA Section 2.5.1, the applicable AMP descriptions provided in LRA Appendix B, and the EQ TLAA, to determine whether the aging effects associated with cables and connectors have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the USAR Supplements for the AMPs credited with managing aging in cables and connectors, as well as the USAR Supplement that describes the TLAA, to determine whether they provide adequate summary descriptions of the programs and TLAA, as required by 10 CFR 54.21(d).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of cables and connectors at FCS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for cables and connectors.

### Aging Effects

As discussed above, the applicant identified the following aging effects for electrical and I&C components at FCS:

- degradation due to various aging mechanisms
- embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR)
- electrical failure caused by thermal/thermooxidative degradation of organics
- radiolysis and photolysis (ultraviolet-sensitive materials only) of organics
- radiation-induced oxidation
- moisture intrusion
- formation of water trees; localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees
- corrosion of connector contact surfaces caused by intrusion of borated water

The staff reviewed the information in LRA Table 3.6-1 for cables and connectors. On the basis of its review, the staff concludes that the aging effects identified for the subject components are consistent with the aging effects evaluated in the GALL Report and, therefore, are acceptable.

The staff also reviewed the applicant's response to the staff's RAI, discussed below.

For inaccessible medium-voltage (2 kV - 15 kV) cables (e.g., installed in conduit or direct buried) not subject to EQ requirements, LRA Table 3.6-1, Item 3.6.1.04, states that modifications were made to the duct banks to preclude moisture intrusion and, therefore, there are no aging effects requiring management. It was not clear to the staff what actions will be taken to assure that the modifications made to prevent inaccessible non-EQ medium-voltage cables from being exposed to significant moisture will be maintained during the period of extended operation. By letter dated October 11, 2002, the staff issued RAI 3.6-1, requesting the applicant to provide a description of the program that will assure that the modifications are maintained to prevent water intrusion into the duct banks, and to provide a description of the AMP that will be relied on for accessible and inaccessible medium-voltage cables installed in conduit, cable trenches, cable troughs, underground vaults, or direct buried installations.



By letter dated December 19, 2002, the applicant responded to RAI 3.6-1 by noting that the information requested by the staff could be found in the applicant's responses to RAIs 2.5-1 and B.3.4-1, both of which were provided in the same response letter.

In its response to RAI 2.5-1, the applicant stated that there are no medium-voltage cables in the substation switchyard associated with station blackout (SBO). Medium voltage SBO cables in the plant have been addressed as part of the cable commodity group, and include cables associated with the 4160 VAC system. Low-voltage (typically 120 V) cable is located in troughs and duct banks. High-voltage cable is located overhead on towers (single phase). The arrangement of the duct banks is such that they are pitched/sloped at no less than 1/8 in per foot to maintain cable out of long-term water immersion by preventing standing water.

In its response to Part 3 of RAI B.3.4-1 concerning aging management of inaccessible medium-voltage electrical cables exposed to adverse localized environments caused by moisture while energized, but are not within the EQ program, the applicant stated that in 1994, during an inspection of a cable vault/manhole containing these cables, it was discovered that moisture had entered through the manhole and was causing some of the cable to corrode. To correct the problem, the applicant applied boat foam around the conduit to preclude water from seeping in through the manhole cover. Additionally, the manhole was sealed. Six medium-voltage safe shutdown circuits are routed through the vault and into duct banks from the intake structure to the service building. Although medium-voltage cables are routed through the duct banks, the duct banks are designed to prevent the accumulation of standing water. The duct banks are pitched at a minimum 1/8 in per foot. In 30 years, the applicant has not had a cable failure; however, to ensure that the cables susceptible to potentially wetted condition will not deteriorate, the applicant committed to implementing a program and inspection consistent with that described in Section XI.E3 of the GALL Report.

On the basis of the applicant's responses contained in RAIs 2.5-1 and B.3.4-1, the staff finds that the applicant has identified the applicable aging effects for the cables and connectors at FCS.

#### Aging Management Programs

The applicant credited the following AMPs and TLAA for managing the aging effects for cables and connectors:

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Non-EQ Cable Aging Management Program (3.6.2.3.1)
- EQ TLAA

The boric acid corrosion program is credited for managing aging effects of components in several systems and structures and, therefore, is considered a common AMP. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. This AMP is evaluated in Section 3.0.3.6 of this SER.

With regard to the non-EQ AMP provided in LRA Section B.3.4, the staff was concerned that the applicant's AMP was not consistent with GALL AMPs XI.E1, XI.E2, and XI.E3, which provide guidance on the management of non-EQ cables within the scope of license renewal and subject to an AMR. By letter dated October 11, 2002, the staff issued RAI B.3.4-1,

requesting the applicant to describe how the non-EQ AMP will manage the aging effects associated with non-EQ cables.

By letter dated December 19, 2002, the applicant responded to RAI B.3.4-1, by committing to develop, prior to the period of extended operation, AMPs that are consistent with GALL AMPs XI.E1, XI.E2, and XI.E3. The staff finds this commitment acceptable because implementation of AMPs consistent with the GALL AMPs will ensure that non-EQ cables within the scope of license renewal and subject to an AMR, and that experience the subject aging effects, will be adequately managed during the period of extended operation. The staff's review of this issue can be found in Section 3.6.2.3.1.2 of this SER.

Aging management of environmentally-qualified cables and connectors will continue to be performed through the applicant's EQ program, which is identified as a TLAA for license renewal. The staff's evaluation of the applicant's EQ TLAA can be found in Section 4.4 of this SER.

On the basis of its review, including the applicant's responses to the staff's RAIs, the staff concludes that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the above identified AMPs and TLAA will effectively manage the aging effects associated with cables and connectors.

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in cables and connectors to satisfy 10 CFR 54.21(d).

#### 3.6.2.4.1.3 Conclusion

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects and, with the fulfillment of the commitments identified in Section 3.6.2.4.1.2 above, will have adequate AMPs and TLAAs for managing the aging effects for cables and connectors, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the USAR Supplement will provide an adequate program description of the AMPs credited for managing aging in cables and connectors to satisfy 10 CFR 54.21(d).

#### 3.6.2.4.2 Containment Electrical Penetrations

##### 3.6.2.4.2.1 Summary of Technical Information in the Application

The AMR results for containment electrical penetrations are presented in LRA Table 3.6-1. All electrical and I&C components within the scope of license renewal and subject to an AMR were addressed in the GALL Report. The applicant used the GALL Report format to present its AMR of electrical and I&C components in LRA Table 3.6-1.

As described in LRA Section 2.5.4, electrical penetrations are containment boundary components that provide electrical energy across the containment boundary (either continuously or intermittently) to power various equipment and components throughout the plant. The electrical penetration provides an electrical connection between two sections of the electrical/I&C circuit. The pigtail at each end of the penetration is connected to the field cable in various ways. The boundary for the electrical penetrations includes the pigtail cable. Penetrations associated with the EQ program are addressed either as short-lived and periodically replaced, or as long-lived TLAAAs.

### Aging Effects

The LRA identifies the following aging effects for containment electrical penetrations:

- degradation due to various aging mechanisms
- embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR)
- electrical failure caused by thermal/thermooxidative degradation of organics
- radiolysis and photolysis (ultraviolet-sensitive materials only) of organics
- radiation-induced oxidation
- moisture intrusion
- corrosion of connector contact surfaces caused by intrusion of borated water
- loss of material due to corrosion for penetration sleeves, penetration bellows, and dissimilar metal welds

The applicant credited the following AMPs and TLAA with managing the identified aging effects for containment electrical penetrations:

- Containment ISI Program (B.1.3)
- Containment Leak Rate Program (B.1.4)
- Boric Acid Corrosion Prevention Program (B.2.1)
- Non-EQ Cable Aging Management Program (B.3.4)
- EQ TLAA

A description of the AMPs is provided in Appendix B of the LRA. The EQ TLAA is described in LRA Section 4.4.

The applicant concluded that the effects of aging associated with the electrical containment penetrations will be adequately managed by these AMPs and TLAA such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

#### 3.6.2.4.2.2 Staff Evaluation

In addition to LRA Section 3.6, the staff reviewed the pertinent information in LRA Section 2.5.2, the applicable AMP descriptions provided in LRA Appendix B, and the EQ TLAA, to determine whether the aging effects associated with containment electrical penetrations have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the USAR Supplements for the AMPs credited with managing aging in cables and connectors, as well as the USAR

Supplement that describes the TLAA, to determine whether they provide adequate summary descriptions of the programs and TLAA, as required by 10 CFR 54.21(d).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of containment electrical penetrations at FCS. The staff's evaluation includes a review of the aging effects considered. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for containment electrical penetrations.

### Aging Effects

The LRA identifies the following aging effects for the containment electrical penetrations:

- degradation due to various aging mechanisms
- embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR)
- electrical failure caused by thermal/thermooxidative degradation of organics
- radiolysis and photolysis (ultraviolet-sensitive materials only) of organics
- radiation-induced oxidation
- moisture intrusion
- corrosion of connector contact surfaces caused by intrusion of borated water
- loss of material due to corrosion for penetration sleeves, penetration bellows, and dissimilar metal welds

In LRA Table 2.5.2-1, the applicant identifies the containment electrical penetrations as components that are within the scope of license renewal and subject to AMR. In this table, the applicant identifies several links, including 3.6.1.01 and 3.6.1.02 in LRA Table 3.6.1. The staff believes that the electrical penetrations may include low-level instrument cable pigtails, which require aging management identified in LRA Table 3.6-1, link 3.6.1.03. By letter dated February 20, 2003, the staff issued POI-12, requesting the applicant to clarify whether low-level instrument cable pigtails are included in the containment electrical penetrations and whether they will be managed by the non-EQ cable AMP. By letter dated March 14, 2003, the applicant responded to POI-12 by stating that LRA Table 2.5.2-1 has been revised to include the containment type "Instrument Cable Pigtails," that have an intended function of "Electrical Continuity," and are linked to LRA AMR Item 3.6.1.03. These components will, therefore, be managed for aging by the non-EQ cable AMP. A revision to LRA Table 2.5.2-1 was included in the applicant's response. The staff finds this acceptable, and POI-12 is resolved.

On the basis of its review, including the applicant's response to POI-12, the staff finds that the applicant has identified the applicable aging effects for the containment electrical penetrations at FCS.

### Aging Management Programs

The applicant credited the following AMPs and TLAA for managing the aging effects for containment electrical penetrations:

- Containment ISI Program (3.0.3.3)

- Boric Acid Corrosion Prevention Program (3.0.3.6)
- Containment Leak Rate Program (3.5.2.3.1)
- Non-EQ Cable Aging Management Program (3.6.2.3.1)
- EQ TLAA

The containment ISI and boric acid corrosion programs are credited for managing aging effects of components in several systems and structures and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These AMPs are evaluated in Sections 3.0.3.3 and 3.0.3.6 of this SER, respectively. The staff's evaluation of the containment leak rate program can be found in Section 3.5.2.3.1 of this SER.

As discussed in Section 3.6.2.3.1.2 above, the applicant committed to develop, prior to the period of extended operation, an AMP to manage non-EQ electrical components consistent with GALL AMPs XI.E1, XI.E2, and XI.E3. The staff considers this commitment adequate to ensure that the containment electrical penetrations will be adequately managed during the period of extended operation.

Aging management of environmentally-qualified containment electrical penetrations will continue to be performed through the applicant's EQ program, which is identified as a TLAA for license renewal. The staff's evaluation of the applicant's EQ TLAA can be found in Section 4.4 of this SER.

On the basis of its review, the staff concludes that the above identified AMPs and TLAA will effectively manage the aging effects associated with the containment electrical penetrations.

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that the USAR Supplement provides an adequate program description of the AMPs credited for managing aging in containment electrical penetrations to satisfy 10 CFR 54.21(d).

#### 3.6.2.4.2.3 Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and, with the fulfillment of the commitments identified in Section 3.6.2.4.1.2 above, will have adequate AMPs and TLAA's for managing the aging effects for containment electrical penetrations, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable USAR Supplement program descriptions and concludes that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the USAR Supplement will provide an adequate program description of the AMPs credited for managing aging in containment electrical penetrations to satisfy 10 CFR 54.21(d).

#### 3.6.2.4.3 Bus Bars

##### 3.6.2.4.3.1 Summary of Technical Information in the Application

Electrical buses electrically connect specified sections of an electrical circuit to deliver voltage or current (either continuously or intermittently) to various equipment and components throughout the plant. The standoffs support the electrical bus bars.

In LRA Section 2.5.20, the applicant states that there are no electrical buses or associated standoffs within the scope of license renewal that are included in the 10 CFR 50.49 program.

#### Aging Effects

In LRA Section 2.5.20, the applicant has identified the bus bars and standoffs as passive, long-lived components that are within the scope of the license renewal and subject to an AMR, and has concluded that these components have no aging effects that require management. The applicant's AMR results for these items show that no aging effects requiring management were identified for this group.

#### Aging Management Programs

Because the applicant did not identify any aging effects requiring management for the bus bars and bus bar standoffs, no AMPs are credited for managing aging.

#### 3.6.2.4.3.2 Staff Evaluation

The staff reviewed the AMR results for the aging management of bus bars and standoffs at FCS to determine whether the applicant has demonstrated that the effects of aging on bus bars and standoffs will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The bus bars are a pre-assembled raceway design, with bus bars mounted on insulated supports (standoffs). The intended function of the standoffs is to support the electrical bus bars.

#### Aging Effects

The LRA stated that there are no aging effects requiring management for the electrical bus bars and bus bar standoffs. As discussed in Section 2.5.2.5.2 of this SER, the staff issued POI-6(b) requesting the applicant to provide information on the components' materials and environments, along with the basis for concluding that these components have no plausible aging effects. By letter dated March 14, 2003, the applicant responded to POI-6(b), stating the following:

The bus bar materials are copper and aluminum; their environment is in indoor air and outdoor air. In accordance with EPRI TR-114882, Non-Class1 Mechanical Implementation Guideline and Mechanical Tools, Revision 2, 1999, no aging effects were identified for aluminum, aluminum alloys, copper, or copper alloys (brass, bronze) in an indoor or outdoor air environment.

The stand offs include fiberglass reinforced polyester resin and porcelain materials that are in ambient air external environment and are not continuously wetted. Internal environments are not applicable.

Table 7-17 of EPRI NP-1558, A Review of Equipment Aging Theory and Technology, lists the continuous use temperature of plastics. The continuous use temperature<sup>(a)</sup> listed for polyester with 40% glass content is 266 °F<sup>(b)</sup> (compared with the bounding temperature value of 122 °F). Applying the Arrhenius methodology, it is clear that fiberglass reinforced polyester is acceptable. Figure C-2 of EPRI NP-1558 contains the relative radiation stability

of thermosetting resins. The threshold for gamma radiation for polyester (glass filled) is 1,000,000,000 Rads (compared with the bounding 60-year radiation dose of less than 1,000 Rads).

- (a) Continuous use temperatures were determined as the temperatures corresponding to 100,000 hours (11.4 years) on the Arrhenius curve of the material for an endpoint of 50% reduction in tensile strength.
- (b) Based on retention of tensile strength taken at 500 degrees F.

On the basis of its review of the applicant's response to POI-6(b), the staff was concerned that the applicant may not have considered all the aging effects of the bus bars/ducts. The staff discussed this issue with the applicant, pointing out that industry experience has indicated several problems with the bus bar/duct, such as loosening of splice plate bolts, degradation of Noryl insulation, presence of moisture or debris, oxidation of aluminum electrical connections, and corrosion of metallic components. On the basis of this experience, the staff requests that the applicant provide a description of the aging management program used to detect the above aging effects, or provide justification why such a program is not needed. This is Open Item 3.6.2.4.3.2-1.

#### 3.6.2.4.3.3 Conclusions

On the basis of its review, the staff concludes that, pending satisfactory resolution of Open Item 3.6.2.4.3.2-1, the applicant has adequately identified the aging effects for the bus bars and will have adequate AMPs and TLAAAs for managing the aging effects for bus bars, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also concludes that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the USAR Supplement will provide an adequate program description of the AMPs credited for managing aging in bus bars to satisfy 10 CFR 54.21(d).

#### 3.6.2.4.4 Aging Management of SBO Components

##### 3.6.2.4.4.1 Summary of Technical Information in the Application

The staff found that the screening results in Section 2.5 did not include any offsite power system structures or components related to the recovery of offsite power from an SBO event. 10 CFR 54.4(a)(3) requires that, "all systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission regulation for SBO (10 CFR 50.63) be included within the scope of license renewal." The function of the offsite power system with the SBO rule is, therefore, to provide a means of recovering from the SBO. This meets the criteria within license renewal 10 CFR 54.4(a)(3) as a system that performs a function that demonstrates compliance with the Commission's regulations on SBO. 10 CFR 54.4(a)(3) also requires that applicable offsite power system structures and components required for compliance with the SBO rule should be included within the scope of license renewal and subject to an AMR, or additional justification for their exclusion should be provided.

##### 3.6.2.4.4.2 Staff Evaluation

In a letter dated October 11, 2002, the staff issued RAI 2.5-1 regarding the scoping and screening of SSCs which are required to comply with the SBO rule. Specifically, the staff requested the applicant to clarify why switchyard systems were not relied upon in safety analyses to perform a function in the recovery from SBO. The applicant responded to RAI 2.5-1 by letter dated December 19, 2002, stating that it will revise the license renewal documentation to comply with the NRC ISG-02 on SBO.

The applicant identified the following passive, long-lived electrical components comprising the offsite power system that are within the scope of license renewal and subject to an AMR:

- high voltage bus work/duct
- aluminum conductor, steel reinforced (ACSR) transmission cables
- insulators associated with the transmission conductors
- transmission towers and supports
- non-EQ cables (4 kV and 600 V)
- 125 volt (120 Vac) control cables

The staff reviewed the applicant's AMR results for the electrical components for SBO restoration system components that were provided in response to RAI 2.5-1. The applicant's AMR results for the electrical components for external environment are shown in Table 2 of the applicant's response to RAI 2.5-1. This table also refers to plant-specific programs that have been credited for aging management of the SBO restoration system components. However, several SBO components (high voltage bus work/duct, ACSR transmission cables and insulators associated with the transmission conductors) are not identified in this table as requiring an AMR. Therefore, it was not clear to the staff whether these components are within the scope of license renewal and subject to an AMR. By letter dated February 20, 2003, the staff issued POI-6(a) requesting the applicant to clarify whether these components are within scope and subject to an AMR.

By letter dated March 14, 2003, the applicant responded to POI-6(a) by providing the requested information. The applicant has also provided the associated aging management information to allow the staff to determine whether the components will be adequately managed during the period of extended operation. Specifically, the applicant responded to POI-6(a) by stating that:

The high-voltage aluminum conductor is steel reinforced (ACSR) transmission cable and is considered within the scope of license renewal for SBO. In accordance with EPRI TR-114882, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Rev. 2, 1999, no aging effects were identified for aluminum, aluminum alloys, copper, or copper alloys (brass, bronze) in an indoor or outdoor air environment. Transmission conductor vibration would be caused by wind loading. Wind loading that can cause a transmission line and insulators to vibrate is considered in the design installation. Loss of material (wear) and fatigue that could be caused by transmission conductor vibration or sway are not aging effects requiring management of the period of extended operation at FCS. A review of internal and external operating experience has not identified any aging effects requiring management.

The insulators associated with the transmission conductors are made of porcelain and are within the scope of license renewal. Aging effects that are considered are buildup of surface contaminants and loss of material due to vibration (wear). As indicated above, (transmission line vibration), vibration due to wind loading is a design consideration and not considered an aging effect requiring management. Buildup of surface contaminants (i.e., dust, dirt, etc.) can occur, however, it is gradual and frequently washed away by rain, consequently the buildup of surface contaminants is not significant and therefore not an aging effect requiring management at Fort Calhoun. Information notices (INs) applicable to insulator contamination (IN 93-95) relate to a loss of power due to salt buildup. Fort Calhoun is not located in an area of any salt concentration (Nebraska) and, therefore does not



consider this IN applicable. On the basis of the above, it has been determined that the porcelain insulators in outside air at Fort Calhoun are not subject to any aging effects requiring management.

The arresters associated with the offsite power system, although within the SBO boundary, do not have any intended functions associated with license renewal, and are eliminated from the scope of license renewal as active components in accordance with NEI 95-10.

The isolated phase bus duct (i.e., isophase or 22 KV bus duct) encloses bus work that connects the main generator output to the main transformer. It is not related to the underground bus duct that may carry low voltage power, control, and instrumentation wiring. The buswork has no AERM. The enclosures supports for the isophase bus are identified in the LRA and assigned to the structures monitoring program for external environment. There is no AERM for internal environment.

The 125 volt dc and 120 volt ac control and instrumentation cables that are associated with breaker controls and instrumentation within the SBO Restoration System have been considered in the scope of License Renewal for SBO. Under non-EQ cables, all cables are subject to the non-EQ cable AMR. All non-EQ cable was identified in, and managed by, the non-EQ cable aging management program (B.3.4).

On the basis of the information provided in response to POI-6(a), the staff concludes that the applicant has provided the associated aging management information to allow the staff to determine whether the components will be adequately managed during the period of extended operation. However, the basis for the applicant's assertion that bus bars/ducts and high voltage ACSR transmission conductors have no aging effects is not clear to the staff. The staff discussed the issues with the applicant, requesting the applicant to clearly describe how the connection from both SBO recovery paths are made, and to discuss the connection path up to and beyond the main transformer.

Also, as discussed in Section 3.6.2.4.3.2 of this SER, the staff pointed out that industry experience has identified several problems with the bus bars/ducts. The staff's review of bus bars/ducts can be found in Section 3.6.2.4.1.2 of this SER. In addition, the aging effect for the transmission ACSR conductor is loss of conductor strength and vibration. The applicant has addressed the vibration and the aluminum portion of the conductor, but did not address the steel portion. The most prevalent mechanism contributing to loss of conductor strength is corrosion, which includes corrosion of steel core and aluminum strand pitting. The staff requests the applicant to provide a description of its aging management programs used to manage the aging effects in high voltage conductors, or provide justification for why such programs are not needed. This is Open Item 3.6.2.4.4.2-1.

#### 3.6.2.4.4.3 Conclusions

The staff reviewed Section 2.5 and 3.6 to determine whether the SCs subject to an AMR have been identified and adequately managed. On the basis of its review, the staff concludes that, pending satisfactory resolution of Open Item 3.6.2.4.4.2-1, the applicant has identified the SCs that are subject to an AMR, and has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

#### 3.6.2.4.5 Fuse Holders

##### 3.6.2.4.5.1 Summary of Technical Information in the Application

In LRA Section 2.5.1, "Cables and Connectors," the applicant identifies fuse blocks as components within the scope of license renewal and subject to an AMR.

#### 3.6.2.4.5.2 Staff Evaluation

In a letter dated May 16, 2002, the staff forwarded to the NEI and UCS, a proposed ISG (ISG-5) on screening of electrical fuse holders. The staff position indicated that fuse holders should be scoped, screened, and included in the AMR in the same manner as terminal blocks and other types of electrical connections that are currently being treated in the process. This position only applies to fuse holders that are not part of a larger assembly such as switchgear, power supplies, power inverters, battery chargers, circuit boards, etc. Fuse holders in these types of active components would be considered to be piece parts of the larger assembly and not subject to an AMR.

The intended functions of a fuse holder are to provide mechanical support for the fuse and to maintain electrical contact with the fuse blades or metal end caps to prevent the disruption of the current path during normal operating conditions when the circuit current is at or below the current rating of the fuse. Fuse holders perform the same primary function as connections of "providing electrical connections to specified sections of an electrical circuit to deliver rated voltage, current, or signals." These intended functions of fuse holders meet the criteria of 10 CFR 54.4(a). In addition, these intended functions are performed without moving parts or without a change in configuration or properties as described in 10 CFR 54.21(a)(1)(I). The fuse holders into which fuses are placed are typically constructed of blocks of rigid insulating material, such as phenolic resins. Metallic clamps are attached to the blocks to hold each end of the fuse. The clamps can be spring loaded clips that allow the fuse ferrules or blades to slip in, or they can be bolt lugs to which the fuse ends are bolted. The clamps are typically made of copper.

Operating experience as discussed in NUREG-1760 (Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants) identified that aging stressors such as vibration, thermal cycling, electrical transients, mechanical stress, fatigue, corrosion, chemical contamination, or oxidation of the connections surfaces can result in fuse holder failure. The final staff position on this issue is under development in discussions with NEI.

In LRA Section 2.5.1, "Cables and Connectors," the applicant identifies fuse blocks as components within the scope of license renewal and subject to an AMR. The staff was unsure whether fuse holders were included within the component type "Fuse Block." By letter dated February 20, 2003, the staff issued POI-1(c), requesting the applicant to clarify whether fuse holders are within the scope of license renewal and subject to an AMR, and, if fuse holders are brought in and require aging management, to provide the associated aging management information.

By letter dated March 14, 2003, the applicant provided the requested information, stating that:

Fuse holders are within the scope of license renewal as part of the cable and connector scoping and screening analysis. There are no fuse holders attached to electrical penetrations at FCS. Fuse holders at FCS that are within active enclosures such as power supplies, switchgear, and motor control centers are considered outside the scope for license renewal. There are no fuse holders at FCS exposed to vibration or environments that would

cause corrosion, chemical contamination, or oxidation of the connecting surfaces. Fuse holders within enclosures that are not considered active and subject to mechanical stress, fatigue and electrical transients will be included in the Fatigue-Monitoring Program(B.2.4).

The staff reviewed the applicant's response to POI-1(c) regarding whether fuse holders within the enclosures are considered active and whether they are subject to stress and fatigue. The staff discussed this issue with the applicant. The applicant believed that there are no fuse holders that would fall within the definition of being in an outside environment that would need aging management review, but was not sure. The staff is still unclear regarding the aging management of fuse holders. ISG-5, which discusses scoping, screening, and aging management of fuse holders, states that fuse holders inside the enclosure of an active component, such as switchgear, power supplies, power inverters, battery chargers, and circuit boards, are considered to be piece parts of the larger assembly, and thus 10 CFR 54.21 considers them outside the scope for license renewal. The staff requests the applicant to make a positive statement that all fuse holders are within active enclosures and hence need not be subject to an AMR. If the applicant cannot make this statement, the applicant should clarify how fuse holders within the scope of license renewal and subject to an AMR will be managed during the period of extended operation. This is Open Item 3.6.2.4.5.2-1(a). The staff was also concerned that the applicant may have missed fuse holders which are used in circuits to isolate safety loads from non-safety loads. The staff requests the applicant to investigate and confirm whether there are no fuse holders which fall into this category. This is Open Item 3.6.2.4.5.2-1(b).

#### 3.6.2.4.5.3 Conclusions

On the basis of its review, the staff concludes that, pending satisfactory resolution of Open Item 3.6.2.4.5.2-1, the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the fuse holders, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable USAR Supplement program description and concludes, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, that the USAR Supplement provides an adequate program description of the AMP credited for managing aging in the fuse holders, as required by 10 CFR 54.21(d).

#### 3.6.3 Evaluation Findings

The staff has reviewed the information in Sections 2.5 and 3.6 of the LRA. On the basis of its review, pending satisfactory resolution of Open Items 3.6.2.3.1.2-1, 3.6.2.4.3.2-1, 3.6.2.4.4.2-1, and 3.6.2.4.5.2-1, the staff concludes that the applicant has demonstrated that the aging effects associated with the identified components of the electrical and I&C systems will be adequately managed so that there is reasonable assurance that these components will perform their intended functions in accordance with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3). In addition, the staff also concludes that, pending satisfactory resolution of Open Item 3.6.2.3.1.2-1, the USAR Supplement provides an acceptable description of the programs and activities for managing the effects of aging of the electrical and I&C system components for the period of extended operation, as required by 10 CFR 54.21(d).