SECTION 3

AGING MANAGEMENT REVIEW RESULTS

This section of the safety evaluation report (SER) evaluates aging management programs (AMPs) and aging management reviews (AMRs) for Kewaunee Power Station (KPS), by the staff of the U.S. Nuclear Regulatory Commission (NRC) (the staff).

In Appendix B of its license renewal application (LRA), Dominion Energy Kewaunee, Inc., (Dominion, DEK, or the applicant) described the 34 AMPs it relies on to manage or monitor the aging of passive, long-lived structures and components (SCs).

In LRA Section 3, the applicant provided the results of the AMRs for those SCs identified in LRA Section 2 as within the scope of license renewal and subject to an AMR.

3.0 Applicant's Use of the Generic Aging Lessons Learned Report

In preparing its LRA, the applicant credited NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 1, dated September 2005. The GALL Report contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification, and where existing programs should be augmented for the period of extended operation. The evaluation results documented in the GALL Report indicate that many of the existing programs are adequate to manage the aging effects for particular SCs for license renewal without change. The GALL Report also contains recommendations concerning specific areas for which existing programs should be augmented for license renewal. An applicant may reference the GALL Report in its LRA to demonstrate that the programs at its facility correspond to those reviewed and approved in the GALL Report.

The purpose of the GALL Report is to provide the staff with a summary of staff-approved AMPs to manage or monitor the aging of SCs subject to an AMR. If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's LRA will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report also serves as a reference for applicants and staff reviewers to quickly identify those AMPs and activities that the staff has determined will adequately manage or monitor aging during the period of extended operation.

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

The staff performed its review in accordance with the requirements of Title 10, Part 54 of the *Code of Federal Regulations* (10 CFR Part 54), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants"; the guidance provided in NUREG-1800, "Standard Review

Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR), Revision 1, dated September 2005; and the guidance provided in the GALL Report.

In addition to its review of the LRA, the staff conducted onsite audits of selected AMPs to verify the applicant's claims of consistency with the GALL Report during the weeks of June 8, 2009, and October 20, 2009, as described in the "AMP Audit Report Regarding the Kewaunee Power Station, License Renewal Application," dated August 12, 2009, and in the "Work Control Process Aging Management Program Audit Report Regarding the Kewaunee Power Station, License Renewal Application," dated December 14, 2009, respectively. The onsite audits and reviews are designed to maximize the efficiency of the staff's LRA review. The applicant can respond to questions, the staff can readily evaluate the applicant's responses, the need for formal correspondence between the staff and the applicant is reduced, and the result is an improvement in review efficiency.

3.0.1 Format of the License Renewal Application

The applicant submitted an application that followed the standard LRA format, as agreed to by the staff and the Nuclear Energy Institute (NEI) by letter dated April 7, 2003. This LRA format incorporates lessons learned from the staff's reviews of previous LRAs, which used a format developed from information gained during a staff-NEI demonstration project conducted to evaluate the use of the GALL Report in the LRA review process.

The organization of LRA Section 3 parallels that of SRP-LR Chapter 3. The AMR results information in LRA Section 3 is presented in the following two table types:

(1) Table 3.x.1 (Table 1s) – where "3" indicates the LRA section number, "x" indicates the subsection number from the GALL Report, and "1" indicates that this is the first table type in LRA Section 3.

(2) Table 3.x.2-y (Table 2s) – where "3" indicates the LRA section number, "x" indicates the subsection number from the GALL Report, "2" indicates that this is the second table type in LRA Section 3, and "y" indicates the system table number.

The content of the GALL Report tables and the LRA tables are essentially the same. In its LRA, the applicant chose to modify the tables in Chapter 3 to provide additional information that would assist the staff in its review. In each Table 1, the applicant summarized the portions of the application with respect to consistency with the GALL Report. In each Table 2, the applicant identified the linkage between the scoping and screening results in Chapter 2 and the AMRs in Chapter 3.

3.0.1.1 Overview of Table 1s

Each of the Tables 3.x.1 (Table 1s) provides a summary comparison of how the facility aligns with the corresponding tables of the GALL Report. These tables are essentially the same as Tables 1 through 6 provided in the GALL Report, Volume 1, except that the "ID" column has been replaced by an "Item Number" column, the "Type" column is removed, and the "Related Generic Item" and "Unique Item" columns have been replaced by a "Discussion" column. The "Discussion" column is used by the applicant to provide clarifying and amplifying information.

The following are examples of information that the applicant placed within this column:

- statements indicating that further evaluation is documented in subsection x
- statements indicating that subsection x contains information or evaluations related to the item
- exceptions to the GALL Report assumptions
- discussion of how the item is consistent with the corresponding line item in the GALL Report when this consistency may not be intuitively obvious
- discussion of how the item is different from the corresponding line item in the GALL Report (e.g., when there is exception taken to a GALL Report AMP)

The format of the Table 1s allows the staff to align a specific Table 1 row with the corresponding GALL Report table row so that the consistency can be easily checked.

3.0.1.2 Overview of Table 2s

Each of the Tables 3.y.2-x (Table 2s) provides the detailed results of the AMRs for those components identified in LRA Section 2 as subject to an AMR. The LRA contains a Table 2 for each of the systems or components "x" within a system grouping "y" (e.g., reactor coolant systems, engineered safety features, auxiliary systems, etc.). For example, the engineered safety features group (3.2.2-x) contains tables specific to the containment vessel spray system, safety injection system, and residual heat removal system. Each Table 2 consists of the following nine columns:

(1) Component Type – The first column identifies the component types, commodity groups, structural members, or subcomponents from LRA Section 2 that are subject to an AMR. The component types are listed in alphabetical order.

(2) Intended Function – The second column contains the license renewal intended functions for the listed component types. Definitions of intended functions are contained in LRA Table 2.0-1.

(3) Material – The third column lists the particular materials of construction for the component type.

(4) Environment – The fourth column lists the environment to which the component types are exposed. Internal and external service environments are indicated and a list of these environments is provided in LRA Table 3.0-1.

(5) Aging Effect Requiring Management – The fifth column lists aging effects/aging mechanisms requiring management (AERMs). As part of the AMR process, the applicant determined any AERMs for each combination of material and environment.

(6) Aging Management Programs – The sixth column lists the AMPs that the applicant used to manage the identified aging effects.

(7) GALL Report Volume 2 Line Item – The seventh column lists the GALL Report item(s) that the applicant identified as corresponding to the AMR results in the LRA. The

applicant compared each combination of component type, material, environment, AERM, and AMP in LRA Table 2 to the items in the GALL Report. If there were no corresponding items in the GALL Report, the applicant left the column blank. In this way, the applicant identified the AMR results in the LRA tables that corresponded to the items in the GALL Report tables.

(8) Table 1 Item – The eighth column lists the corresponding summary item number from Table 1. If the applicant identified AMR results in Table 2 that are consistent with the GALL Report, then the associated Table 3.x.1 line summary item number should be listed in Table 2. If there is no corresponding item in the GALL Report, then column eight is left blank. That way, the information from the two tables can be correlated.

(9) Notes – The ninth column lists the corresponding notes that the applicant used to identify how the information in Table 2 aligns with the information in the GALL Report. The notes identified by letters were developed by an NEI working group to be used in LRAs. Any plant-specific notes are identified by a number and provide additional information concerning the consistency of the line item with the GALL Report or other clarifying information.

3.0.2 Staff's Review Process

The staff conducted the following three types of evaluations of the AMRs and associated AMPs:

(1) For items that the applicant stated were consistent with the GALL Report, the staff conducted either an audit or a technical review to determine consistency.

(2) For items that the applicant stated were consistent with the GALL Report with exceptions and/or enhancements, the staff conducted either an audit or a technical review of the item to determine consistency with the GALL Report. In addition, the staff conducted either an audit or a technical review of the applicant's technical justification for the exceptions and the adequacy of the enhancements.

(3) For other items, the staff conducted a technical review pursuant to 10 CFR 54.21(a)(3).

These audits and technical reviews determine whether the effects of aging on SCs can be adequately managed so that the intended functions can be maintained consistent with the plant's current licensing basis (CLB) for the period of extended operation, as required by 10 CFR Part 54.

3.0.2.1 Review of AMPs

For those AMPs for which the applicant had claimed consistency with the GALL Report AMPs, the staff conducted either an audit or a technical review to confirm that the applicant's AMPs were consistent with the GALL Report. For each AMP that had one or more deviations, the staff evaluated each deviation to determine whether the deviation was acceptable and whether the AMP, as modified, would adequately manage the aging effect(s) for which it was credited. For AMPs that were not addressed in the GALL Report, the staff performed a full review to determine their adequacy.

The staff evaluated the AMPs against the following 10 program elements defined in SRP-LR Appendix A:

(1) Scope of the Program: The scope of the program should include the specific SCs subject to an AMR for license renewal.

(2) Preventive Actions: Preventive actions should prevent or mitigate aging degradation.

(3) Parameters Monitored or Inspected: Parameters monitored or inspected should be linked to the degradation of the particular structure or component intended function(s).

(4) Detection of Aging Effects: Detection of aging effects including such aspects as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new/one-time inspections should occur before there is a loss of structure or component intended function(s).

(5) Monitoring and Trending: Monitoring and trending should provide predictability of the extent of degradation, as well as timely corrective or mitigative actions.

(6) Acceptance Criteria: Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or component intended function(s) are maintained under all CLB design conditions during the period of extended operation.

(7) Corrective Actions: Corrective actions, including root cause determination and prevention of recurrence, should be timely.

(8) Confirmation Process: Confirmation process should ensure that preventive actions are adequate and that appropriate and effective corrective actions have been completed.

(9) Administrative Controls: Administrative controls should provide a formal review and approval process.

(10) Operating Experience: Operating experience (OE) of the AMP, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support the conclusion that the effects of aging will be adequately managed so that the SC intended function(s) will be maintained during the period of extended operation.

Details of the staff's audit evaluation of program elements (1) through (6) and (10) are documented in the Aging Management Program Audit Report and summarized in SER Section 3.0.3.

The staff reviewed the applicant's corrective action program and documented its evaluations in SER Section 3.0.4. The staff's evaluation of the corrective action program included assessments of program elements (7), (8), and (9).

The staff reviewed the updated safety analysis report (USAR) supplement for each AMP to determine if it provided an adequate description of the program or activity, as required by 10 CFR 54.21(d).

3.0.2.2 Review of AMR Results

Table 2 contains information concerning whether the AMRs align with the AMRs identified in the GALL Report. For a given AMR in Table 2, the staff reviewed the intended function, material, environment, AERM, and AMP combination for a particular component type within a system. The AMRs that correlate between a combination in Table 2 and a combination in the GALL Report were identified by a referenced item number in column seven, "NUREG-1801 Volume 2 Reference." The staff also conducted onsite audits to verify the correlation. A blank column seven indicates that the applicant was unable to locate an appropriate corresponding combination in the GALL Report. The staff conducted a technical review of these combinations not consistent with the GALL Report. The eighth column, "Table 1 Item," provides a reference number that indicates the corresponding row in Table 1.

3.0.2.3 USAR Supplement

Consistent with the SRP-LR for the AMRs and associated AMPs that it reviewed, the staff also reviewed the USAR supplement that summarizes the applicant's programs and activities for managing the effects of aging for the period of extended operation, as required by 10 CFR 54.21(d).

3.0.2.4 Documentation and Documents Reviewed

In performing its review, the staff used the LRA, LRA supplements, SRP-LR, and the GALL Report. Also, during the onsite audits, the staff examined the applicant's justifications, as documented in the Audit Summary Report, to verify that the applicant's activities and programs will adequately manage the effects of aging on SCs. The staff also conducted detailed discussions and interviews with the applicant's license renewal project personnel and others with technical expertise relevant to aging management.

3.0.3 Aging Management Programs

SER Table 3.0.3-1 presents the AMPs credited by the applicant and described in LRA Appendix B. The table also indicates the GALL Report AMP that the applicant claimed its AMP was consistent with, if applicable, and the SSCs for managing or monitoring aging. The section of the SER, in which the staff's evaluation of the program is documented, is also provided.

Table 3.0.3-1 KPS Aging Management Programs

Applicant AMP	LRA Sections	New or Existing Program	Applicant Comparison to the GALL Report	GALL Report AMPs	SER Section
ASME Section XI Inservice Inspection (ISI), Subsections IWB, IWC, and IWD	A2.1.2, B2.1.2	Existing	Consistent with exceptions and enhancements	XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	3.0.3.2.1
ASME Section XI, Subsection IWE	A2.1.3, B2.1.3	Existing	Consistent	XI.S1, "ASME Section XI, Subsection IWE"	3.0.3.1.1
ASME Section XI, Subsection IWF	A2.1.4, B2.1.4	Existing	Consistent with exception	XI.S3, "ASME Section XI, Subsection IWF"	3.0.3.2.2
Bolting Integrity	A2.1.5, B2.1.5	Existing	Consistent with enhancements	XI.M18, "Bolting Integrity"	3.0.3.2.3
Boric Acid Corrosion	A2.1.6, B2.1.6	Existing	Consistent	XI.M10, "Boric Acid Corrosion"	3.0.3.1.2
Buried Piping and Tanks Inspection	A2.1.7, B2.1.7	Existing	Consistent with enhancement	XI.M34, "Buried Piping and Tanks Inspection"	3.0.3.2.4
Closed-Cycle Cooling Water System	A2.1.8, B2.1.8	Existing	Consistent with exceptions	XI.M21, "Closed-Cycle Cooling Water System"	3.0.3.2.5
Compressed Air Monitoring	A2.1.9, B2.1.9	Existing	Consistent with exceptions and enhancement	XI.M24, "Compressed Air Monitoring"	3.0.3.2.6
External Surfaces Monitoring	A2.1.10, B2.1.10	Existing	Consistent with enhancements	XI.M36, "External Surfaces Monitoring"	3.0.3.2.7
Fire Protection	A2.1.11, B2.1.11	Existing	Consistent with exception and enhancements	XI.M26, "Fire Protection," and XI.M27, "Fire Water System"	3.0.3.2.8
Flow-Accelerated Corrosion	A2.1.12, B2.1.12	Existing	Consistent with exception	XI.M17, "Flow-Accelerated Corrosion"	3.0.3.2.9
Flux Thimble Tube Inspection	A2.1.13, B2.1.13	Existing	Consistent	XI.M37, "Flux Thimble Tube Inspection"	3.0.3.1.3
Fuel Oil Chemistry	A2.1.14, B2.1.14	Existing	Consistent with exceptions	XI.M30, "Fuel Oil Chemistry"	3.0.3.2.10
Fuel Oil Tank Inspections	A2.1.15, B2.1.15	Existing	Consistent with enhancement	XI.M30, "Fuel Oil Chemistry"	3.0.3.2.11
Inspection of Overhead Heavy Load and Refueling Handling Systems	A2.1.16, B2.1.16	Existing	Consistent with enhancement	XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	3.0.3.2.12
Lubricating Oil Analysis	A2.1.17, B2.1.17	Existing	Consistent	XI.M39, "Lubricating Oil Analysis"	3.0.3.1.4
Metal-Enclosed Bus	A2.1.18, B2.1.18	Existing	Consistent with enhancement	XI.E4, "Metal-Enclosed Bus"	3.0.3.2.13

Applicant AMP	LRA Sections	New or Existing Program	Applicant Comparison to the GALL Report	GALL Report AMPs	SER Section
Non-Environmental Qualification (EQ) Electrical Cables and Connections	A2.1.19, B2.1.19	New	Consistent	XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	3.0.3.1.5
Non-EQ Electrical Cable Connections	A2.1.20, B2.1.20	New	Consistent	XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	3.0.3.1.6
Non-EQ Inaccessible Medium-Voltage Cables	A2.1.21, B2.1.21	New	Consistent	XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	3.0.3.1.7
Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals	A2.1.22, B2.1.22	New	Consistent	XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	3.0.3.1.8
Open-Cycle Cooling Water System	A2.1.23, B2.1.23	Existing	Consistent with exception and enhancement	XI.M20, "Open-Cycle Cooling Water System"	3.0.3.2.14
Primary Water Chemistry	A2.1.24, B2.1.24	Existing	Consistent	XI.M2, "Water Chemistry"	3.0.3.1.9
Reactor Containment Leakage Testing 10 CFR 50, Appendix J	A2.1.25, B2.1.25	Existing	Consistent	XI.S4, "10 CFR 50, Appendix J"	3.0.3.1.10
Secondary Water Chemistry	A2.1.28, B2.1.28	Existing	Consistent	XI.M2, "Water Chemistry"	3.0.3.1.11
Reactor Head Closure Studs	A2.1.26, B2.1.26	Existing	Consistent with exception	XI.M3, "Reactor Head Closure Studs"	3.0.3.2.15
Reactor Vessel Surveillance	A2.1.27, B2.1.27	Existing	Consistent with exception	XI.M31, "Reactor Vessel Surveillance"	3.0.3.2.16
Selective Leaching of Materials	A2.1.29, B2.1.29	New	Consistent	XI.M33, "Selective Leaching of Materials"	3.0.3.1.12
Steam Generator Tube Integrity	A2.1.30, B2.1.30	Existing	Consistent with exception	XI.M19, "Steam Generator Tube Integrity"	3.0.3.2.17

Applicant AMP	LRA Sections	New or Existing Program	Applicant Comparison to the GALL Report	GALL Report AMPs	SER Section
Structures Monitoring Program	A2.1.31, B2.1.31	Existing	Consistent with enhancements	XI.S5, "Masonry Wall Program"; XI.S6, "Structures Monitoring Program"; and XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Plant"	3.0.3.2.18
Environmental Qualification (EQ) of Electric Components	A4.1, B3.1	Existing	Consistent	X.E1, "Environmental Qualification (EQ) of Electric Components"	3.0.3.1.13
Metal Fatigue of Reactor Coolant Pressure Boundary	A4.2, B3.2	Existing	Consistent with enhancement	X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary"	3.0.3.2.20
Alloy 600 Inspections	A2.1.1, B2.1.1	Existing	Plant-Specific	N/A	3.0.3.3.1
Work Control Process (WCP)	A2.1.32, B2.1.32	New (Refer to DEK RAI response Letter Serial No. 09-597, September 25, 2009)	Consistent with the GALL Report with exceptions and enhancement	(1) GALL AMP XI.M32, "One-Time Inspection," when WCP is used as a one-time inspection program for programmatic verification of designated preventive or mitigative monitoring programs. (2) GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," when WCP is used as a periodic, condition monitoring program.	3.0.3.2.19 (Previous plant-specific version deleted, as discussed in 3.0.3.3.2)

3.0.3.1 AMPs That Are Consistent with the GALL Report

In LRA Appendix B, the applicant identified the following AMPs as being consistent with the GALL Report:

- ASME Section XI, Subsection IWE Program
- Boric Acid Corrosion Program
- Flux Thimble Tube Inspection Program
- Lubricating Oil Analysis Program
- Non-EQ Electrical Cables and Connections Program
- Non-EQ Electrical Cable Connections Program
- Non-EQ Inaccessible Medium-Voltage Cables Program
- Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program
- Primary Water Chemistry Program
- Reactor Containment Leakage Testing 10 CFR 50, Appendix J Program
- Secondary Water Chemistry Program
- Selective Leaching of Materials Program
- Environmental Qualification (EQ) of Electric Components Program

3.0.3.1.1 ASME Section XI, Subsection IWE Program

Summary of Technical Information in the Application. LRA Section B2.1.3 describes the existing ASME Section XI, Subsection IWE Program as consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE." The applicant stated that the program provides for condition monitoring, including periodic visual examinations of metal pressure boundary surfaces and welds, penetrations, integral attachments and their welds, moisture barriers, and pressure-retaining bolted connections. The applicant further stated that the program is implemented in accordance with the requirements of 10 CFR 50.55a and uses American Society of Mechanical Engineers (ASME) Code Section XI, Subsection IWE, 2001 Edition through the 2003 Addenda.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.S1. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.S1. Based on its audit and review, the staff finds that elements one through six of the applicant's ASME Section XI, Subsection IWE Program are consistent with the corresponding program elements of GALL AMP XI.S1 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.3 summarizes OE related to the ASME Section XI, Subsection IWE Program. In the LRA, the applicant stated that during an April 2003 walkdown, surface rust was noted on the exterior face of the reactor containment vessel (RCV), primarily at the vessel-concrete interface, which was subsequently corrected in accordance with the ASME Section XI, Subsection IWE Program. The LRA discusses surface rust that was discovered around the equipment hatch in October 2004. The rust was corrected via the work management system. The LRA further discusses caulk degradation at the joint between the personnel airlock and the concrete floor, which was subsequently repaired to its design condition.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff identified concerns regarding water leakage from the reactor cavity area, which could degrade the steel containment and associated coatings during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of requests for additional information (RAIs).

In RAI B2.1.3-2 dated July 13, 2009, the staff requested that the applicant identify any locations requiring augmented examinations per Subsection IWE, and the results of any required examinations.

By letter dated August 17, 2009, the applicant responded to RAI B2.1.3-2. The applicant stated that currently there are no RCV surface areas that are experiencing accelerated degradation, which would require augmented examinations based on the requirements of Subsection IWE-1241. The applicant's response is consistent with the staff's review of the OE database during the audit which found that, while the applicant had found local areas of concrete with leaching and cracks, no RCV areas were identified with accelerated corrosion or material loss in a local area exceeding 10 percent of the normal wall thickness that could not be accepted by engineering evaluation or repair. Therefore, the staff finds the applicant's response acceptable and the staff's concern described in RAI B2.1.3-2 is resolved.

During the audit, based on its review of OE, the staff asked the applicant why KPS did not have an AMP for coatings. The applicant explained that an AMP was not needed for coatings because the coatings are not credited for aging management. Although the coatings are not credited for aging management, the staff believed their failure could result in the failure of a safety system to perform its intended function. In RAI B2.1.3-3 dated July 13, 2009, the staff requested that the applicant justify not having an AMP for coatings. (The staff's evaluation of the applicant's protective coatings program, which the applicant has in lieu of an AMP, is documented in SER Section 3.0.3.3.3.)

By letter dated August 17, 2009, the applicant responded to RAI B2.1.3-3. In its response, the applicant stated that the protective coatings are not relied upon to manage the effects of aging of the RCV. The applicant stated that coatings provide protection for the underlying base metal but do not perform an intended function as defined in 10 CFR 54.4(a)(1), (2), and (3). The applicant stated further that the ASME Section XI, Subsection IWE Program manages the aging effect of loss of material due to corrosion for the RCV, and that the benefits of proper maintenance of the protective coatings on the RCV are being addressed by the action plan developed in response to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," and 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." The applicant also stated that the GL recommendations related to aging management will become part of the CLB and, therefore, will carry forward into the period of extended operation.

The staff reviewed the applicant's response to RAI B2.1.3-3 and found that additional information was needed regarding the proper maintenance of protective coatings at KPS. Therefore, in RAI XI.S8 dated August 28, 2009, the staff requested that the applicant describe, in detail, the coatings program at KPS. Specifically, the staff requested that the applicant: (1) explain how the coatings program will ensure that there will be proper maintenance of the protective coatings inside containment, and ensure operability of post-accident safety systems that rely on water recycled through the containment sump and drain system during the period of extended operation; and (2) describe the frequency and scope of the inspections, acceptance criteria, and the qualifications of the personnel who perform containment coatings inspections.

In its response to RAI XI.S8, dated September 28, 2009, the applicant stated that its protective coatings program conforms to the requirements identified in Regulatory Guide (RG) 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants." The applicant stated that the program, including inspections, incorporates guidance from American Society for Testing and Materials (ASTM) D5144, "Guide for the Use of Protective Coating Standards in Nuclear Power Plants," and ASTM D5163, "Standard Guide for Establishing Procedures to Monitor the Performance of Safety-Related Coatings in an Operating Nuclear Power Plant."

The applicant also stated that its protective coatings program requires that a containment coating condition assessment be performed during each refueling outage, and that a condition assessment report be prepared to document the inspection findings. The applicant also stated that the personnel responsible for performing containment coatings inspections are qualified in accordance with approved station procedures.

Based on a review of the applicant's responses to RAIs B2.1.3-3 and XI.S8, the staff determined that the applicant's protective coatings program implemented during the current licensing period ensures that coatings inside the RCV will be properly maintained during the period of extended operation because the protective coatings program conforms to the requirements identified in RG 1.54, Revision 0, and inspection procedures incorporate guidance from ASTM D5144 and ASTM D5163. (The staff's review of the applicant's Protective Coatings Monitoring and Maintenance Program is contained in SER Section 3.0.3.3.3.) The staff's concerns in RAIs B2.1.3-3 and XI.S8 are resolved.

During the audit, the staff noted that the applicant had observed indications of water leaking from the refueling cavity. In RAI B2.1.3-1 dated July 13, 2009, the staff requested that the applicant provide a discussion of how the ASME Section XI, Subsection IWE Program is addressing the possible aging effects associated with the refueling cavity leakage.

By letter dated August 17, 2009, the applicant responded to RAI B2.1.3-1. The applicant stated that the scope of the ASME Section XI, Subsection IWE Program is associated with the metal pressure-retaining boundary of the RCV. The applicant stated that moisture barriers that prevent intrusion of moisture into inaccessible areas of the containment shell at concrete-to-metal interfaces are also inspected as part of the ASME Section XI, Subsection IWE Program. The applicant also stated that, if moisture barrier degradation were observed, the condition would be documented in the corrective action program. The applicant also stated that, in the fall of 2006 and again in 2008, during inspections performed under the Boric Acid Corrosion Program and the Structures Monitoring Program, the reactor cavity/refueling pool was identified as a potential source of leakage. The applicant stated that it identified the area below the reactor cavity and the A-RCS loop vault as the two most likely locations. The applicant stated that it evaluated the amount of leakage and categorized it as minimal (e.g., streaking of the walls). The applicant also stated that it determined that the leakage had not come into contact with the RCV and, therefore, that the RCV was not required to be evaluated for this identified leakage by the ASME Section XI, Subsection IWE Program.

The staff reviewed the applicant's response to RAI B2.1.3-1 and determined that further clarification was needed concerning the leakage volume and path since the information provided in responses to RAI B2.1.3-1 and RAI B2.1.31-4 (discussed in SER Section 3.0.3.2.18) did not appear to be consistent. Therefore, the staff issued follow-up RAI B2.1.31-4a, dated November 20, 2009, requesting additional details about the reactor cavity/refueling pool leakage.

Specifically, the staff requested that the applicant provide the following:

(1) more details about the leakage volume and path observed in the 2003, 2004, 2006, and 2008 outages

(2) details of any remedial actions or repairs performed during 2003 and 2004 to stop the leakage

(3) plans to verify the structural integrity of the concrete and rebar at the cracked locations by core drills or other means

(4) plans for permanent remediation of reactor cavity/refueling pool leakage

By a letter dated December 28, 2009, the applicant responded to RAI B2.1.31-4a. The applicant stated that there are three sites within the reactor containment that have been identified as potential indications of leakage from the reactor cavity. The applicant also stated that none of the leakage from these three sites had the potential for moisture contact with the steel containment vessel. The applicant's response to the RAIs concerning the effect of leakage on the concrete structures inside containment and commitment for identification and remediation of the leakage is described in SER Section 3.0.3.2.18.

Based on its review, the staff finds the applicant's responses to RAIs B2.1.3-1, B2.1.31-4, and B2.1.31-4a acceptable because leakage from the reactor cavity at the three locations is unlikely to reach or come into contact with the RCV. The leakage observed was minimal and not quantifiable (a few drops of water), and water did not flow beyond the immediate vicinity of the three leakage locations. Therefore, the water from the leakage areas could not have travelled and come into contact with the steel containment vessel. The applicant inspected concrete surfaces inside containment, including the basement elevation, and did not find any moisture except for a minimal amount at the leakage locations. Furthermore, the applicant did not find any water or moisture in sump "B" (the sump nearest to the containment vessel), which would have been the primary source of water collection in case water comes into contact and flows along the steel containment vessel. The staff's evaluation concerning the effect of water leakage from the reactor cavity on the concrete structures inside containment is documented in SER Section 3.0.3.2.18.

Based on its audit and review of the application, and review of the applicant's responses to RAIs B2.1.3-1 through B2.1.3-3, XI.S8, and B2.1.31-4a, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. In LRA Section A2.1.3, the applicant provided the USAR supplement for the ASME Section XI, Subsection IWE Program. The staff notes that the USAR supplement description of the ASME Section XI, Subsection IWE Program conforms to the recommended USAR supplement for this type of program as described in SRP-LR Table 3.5-2.

The staff reviewed this section and determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's ASME Section XI, Subsection IWE Program, including the applicant's responses to RAIs, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.2 Boric Acid Corrosion Program

Summary of Technical Information in the Application. LRA Section B2.1.6 describes the existing Boric Acid Corrosion Program as consistent with GALL AMP XI.M10, "Boric Acid Corrosion."

The applicant stated that the program includes visual inspections to identify boric acid leakage and encompasses those systems and components which are the potential sources and targets of borated water leakage. The applicant also stated that the program includes requirements for ensuring that in-scope SSCs are properly monitored and that loss of material due to boric acid is consistently identified, documented, evaluated, trended, and effectively repaired. The applicant stated that the program also provides systematic measures for ensuring that corrosion caused by leaking borated water does not lead to the degradation of systems or components from which the boric acid leaked or the adjacent SCs upon which it might leak. The applicant further stated that the program uses GL 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Components in PWR Plants," and industry guidance for evaluating the severity of boric acid leakage and for determining the appropriate corrective actions.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared program elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M10. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M10.

Based on its review, the staff finds that program elements one through six of the applicant's Boric Acid Corrosion Program are consistent with the corresponding program elements of GALL AMP XI.M10 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.6 summarizes OE related to the Boric Acid Corrosion Program. The staff reviewed this information and interviewed the applicant's technical personnel to confirm that the applicable aging effects and industry and plant-specific OE have been reviewed by the applicant. During the audit, the staff independently verified that the applicant had adequately incorporated and evaluated OE related to this program. The staff also confirmed that the applicant has addressed OE identified after the issuance of the GALL Report.

The staff reviewed the OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. The staff reviewed the applicant's license renewal basis document and also a sample of condition reports, and confirmed that the applicant identified boric acid corrosion and implemented corrective actions. The staff noted several condition reports where adjacent SCs were also included in the evaluation of identified boric acid leakage. For the cases reviewed by the staff, actions were taken to stop the leakage, or monitoring activities were used to ensure no ongoing degradation until the leakage was stopped. The staff interviewed the applicant's technical personnel during the audit to confirm that plant-specific OE revealed no degradation not bounded by industry experience.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.6 provides the USAR supplement for the Boric Acid Corrosion Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.1-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Boric Acid Corrosion Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that the applicant has provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.3 Flux Thimble Tube Inspection Program

Summary of Technical Information in the Application. LRA Section B2.1.13 describes the existing Flux Thimble Tube Inspection Program as consistent with GALL AMP XI.M37, "Flux Thimble Tube Inspection." The applicant stated that the program manages the aging effect of loss of material due to wear of the flux thimble tube wall. The applicant stated that the flux thimble tubes provide a path for the in-core neutron flux monitoring system detectors and form part of the reactor coolant pressure boundary (RCPB). The applicant also stated that flux thimble tubes are subject to loss of material where flow-induced fretting causes wear at discontinuities in the path from the reactor vessel instrument nozzle to the fuel assembly guide tube. The applicant further stated that its response to NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors," established the program requirements, including inspection methodology, tube wear acceptance criterion, inspection frequency, corrective actions, and maintenance of program documents and test results. The applicant stated that program guidance was also developed from Westinghouse WCAP-12866, "Bottom Mounted Instrumentation Flux Thimble Tube Wear," (1991), and that beginning in 2004, a new acceptance/repair criterion was established and the calculation or prediction of future wall loss rates was implemented.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M37. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M37, with the exception of the "monitoring and trending" and "acceptance criteria" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff noted that the "monitoring and trending" program element of GALL AMP XI.M37 states that the wall thickness measurements should be trended and wear rates should be calculated. During its audit, the staff noted in the applicant's program basis document that it did not clearly address how the program manages discrepancies between projected wear rates and measured wear rates. By letter dated July 13, 2009, the staff issued RAI B2.1.13-1 requesting that the applicant explain how its program manages discrepancies between projected wear rates and measured wear rates, especially for cases where the discrepancies are large and unexpected.

In its response dated August 17, 2009, the applicant stated that the discrepancies between the projected wear rates and measurement-based wear rates are documented in the corrective action program. The applicant also confirmed that its corrective actions to manage the projection rate discrepancies from the measured wear rate include a review of nondestructive examination (NDE) data, a review of the causes of the unexpected wear, and a new projection of thimble tube thickness based on the current inspection frequency as well as potential isolation and repositioning of thimble tubes.

Based on its review, the staff finds the applicant's response to RAI B2.1.13-1 acceptable because: (1) the applicant's approach, using the engineering evaluation and corrective actions, is adequate to manage the wear rate discrepancies and aging effects of the flux thimble tubes; (2) the engineering review and corrective actions can identify the cause of the unexpected wear and perform corrective actions to eliminate or mitigate the cause of the unexpected wear; (3) the corrective actions, which include potential isolation and repositioning of thimble tubes, are adequate to manage the aging effects by isolating and repositioning the wear scar and to ensure the pressure boundary integrity of the thimble tubes; and (4) the applicant's actions are consistent with the recommendations of GALL AMP XI.M37. The staff's concern described in RAI B2.1.13-1 is resolved.

The staff noted that the "acceptance criteria" program element of GALL AMP XI.M37 states that acceptance criteria, such as percent through-wall wear, should be established and technically justified to provide an adequate margin of safety to maintain the integrity of the RCPB. This program element also states that acceptance criteria different from those previously documented in NRC acceptance letters for the applicant's response to Bulletin 88-09 and amendments thereto should be justified. During its audit, the staff noted that the applicant's program uses the acceptance criterion of 80 percent through-wall wear, above which repositioning and isolation of the thimble tube is required. By letter dated July 13, 2009, the staff issued RAI B2.1.13-3 requesting that the applicant justify how the current acceptance criterion provides an adequate margin of safety to ensure that the integrity of the RCPB is maintained.

In its response dated August 17, 2009, the applicant clarified that the eddy current testing in the program provides actual or conservative estimates of the depth of the wear scars and that its test data show that the tubes will retain their functional and structural integrity with up to an 85 percent wall loss for all plant operating modes.

Based on its review, the staff finds the applicant's response to RAI B2.1.13-3 acceptable because: (1) the applicant's evaluation concluded that the remaining 20 percent wall thickness will provide adequate structural integrity, (2) a thimble tube with a measured wall thickness of 80 percent or higher will be repositioned and isolated, and (3) the corrective action is initiated at a 60 percent through-wall measurement by repositioning the thimble tube if the plant-specific through-wall wear of the thimble tube at the next inspection period is projected to be equal to or greater than 80 percent. The staff's concern described in RAI B2.1.13-3 is resolved.

During its audit, the staff noted that the applicant's work order instructions for thimble tube eddy current inspection indicated that the best approach to calculating future wall loss is to use the exponential equation, with an exponent value calculated using two previous cycle inspection results for a specific plant; and for plants which do not have two prior inspection points, a conservative exponent value may be used. However, a report and attached information from the applicant's work order on the thimble tube degradation forecast suggests that the applicant's wear projection methodology may use a non-plant-specific exponent rather than an exponent based on the previous two inspection results. The staff also noted that the applicant's response to Bulletin 88-09, dated November 7, 1988, states that the examination frequency after 1998 will be dependent on the results of the previous two tests. It was not clear to the staff whether the applicant's approach to define the exponent considers plant-specific inspection results. By letter dated July 13, 2009, the staff issued RAI B2.1.13-4 requesting that the applicant: (1) clarify what exponent is used for the wear projections, and (2) if the previous inspection results are not used to determine the exponent, demonstrate why this methodology on the exponent determination is in agreement with or conservative compared to the exponent determination based on the actual plant-specific inspection results. The staff also requested that the applicant describe how its program considers and manages the potential effect of changes in flow rates and thimble or reactor hardware on the wear rates.

In its response dated August 17, 2009, the applicant clarified that the projection is based on plant-specific wear data obtained from the two previous inspection cycles. Additionally, the applicant stated that it performs analyses to confirm that the conservative projections bound the wear rate projections which are based on the plant-specific inspection data. The applicant also clarified that changes to the reactor coolant system (RCS) flow rate, thimble tube, or reactor hardware could only occur through a plant modification in accordance with the applicant's design control process. The applicant stated that this process is procedurally controlled, includes the requirements for safety review in accordance with 10 CFR 50.59, and is reviewed by affected plant organizations. The applicant also clarified that the design and hardware changes that can affect the thimble tube wear would be identified and addressed during the review process.

Based on its review, the staff finds the applicant's response to RAI B2.1.13-4 acceptable because: (1) the applicant's methodology uses the measured plant-specific wear data to perform the wear rate projections and is adequate to manage the aging effects of the thimble tubes, (2) the projections are based on actual plant-specific experience and data so that the projections represent and evaluate the plant-specific conditions adequately in terms of the thimble tube wear, and (3) the applicant's program evaluates and manages the potential effects of design and hardware modifications on the thimble tube integrity in accordance with 10 CFR 50.59 and with the applicant's controlled review procedures that will consider their impacts on the program and equipment. The staff's concern described in RAI B2.1.13-4 is resolved.

Based on its audit and review of the applicant's responses to RAIs B2.1.13-1, B2.1.13-3, and B2.1.13-4, the staff finds that elements one through six of the applicant's Flux Thimble Tube Inspection Program are consistent with the corresponding program elements of GALL AMP XI.M37 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.13 summarizes OE related to the Flux Thimble Tube Inspection Program.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. The staff also confirmed that the applicant has addressed OE identified after the issuance of the GALL Report. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff identified OE which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The applicant stated that inspections were performed in 2000 and 2004; however, the staff noted that the LRA did not clearly indicate the results of these inspections and whether they demonstrated the adequacy of the program-defined inspection frequency and wear projection methodology. By letter dated July 13, 2009, the staff issued RAI B2.1.13-2 requesting that the applicant provide relevant inspection results, including the actual wear of the two inspection periods which ended in 2000 and 2004, respectively, and to demonstrate that the applicant's inspection frequency and wear rate projection methodology are adequate to manage the aging effects of the thimble tubes.

In its response dated August 17, 2009, the applicant clarified that the eddy current testing of the flux thimble tubes repositioned in 1994 has confirmed that the wear scars are not actively wearing. The staff reviewed the 2000 and 2004 inspection results provided in the RAI response and found that: (1) the measured through-wall thickness data met the acceptance criteria of the applicant's program, and (2) the projected wall thickness values for the next inspection were within the acceptance criteria.

Based on its review, the staff finds the applicant's response to RAI B2.1.13-2 acceptable because: (1) the inspection frequency and associated wear rate projection methodology of the applicant's program are adequate to manage the wear of the flux thimble tubes, and (2) the applicant's OE demonstrates its program is effective to manage the aging effects of the flux thimble tubes. The staff's concern described in RAI B2.1.13-2 is resolved.

Based on its audit and review of the application, and review of the applicant's response to RAI B2.1.13-2, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.13 provides the USAR supplement for the Flux Thimble Tube Inspection Program. The staff reviewed this USAR supplement description of the program against the recommended description for this type of program as described in SRP-LR Table 3.1-2. The staff noted that the applicant's USAR supplement description did not include NRC Bulletin 88-09 as a reference. By letter dated July 13, 2009, the staff issued RAI B2.1.13-5 requesting the USAR summary description include NRC Bulletin 88-09 as a technical reference. The staff also requested that the applicant clarify whether the program implements the recommendations of NRC Bulletin 88-09.

In its response dated August 17, 2009, the applicant stated that it will revise LRA Section A2.1.13 to confirm NRC Bulletin 88-09 as a technical reference for its program. The applicant stated that it will add the following to the end of the last paragraph of LRA Section A2.1.13:

> The program implements the recommendations of NRC Bulletin 88-09, Thimble Tube Thinning in Westinghouse Reactors, as identified in WPSC letter, NRC-88-2 dated January 6, 1989.

Based on its review, the staff finds the applicant's response to RAI B2.1.13-5 acceptable because the applicant amended LRA Section A2.1.13 to conform to the recommended description for this type of program as described in SRP-LR Table 3.1-2. The staff's concern described in RAI B2.1.13-5 is resolved.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Flux Thimble Tube Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.4 Lubricating Oil Analysis Program

Summary of Technical Information in the Application. LRA Section B2.1.17 describes the existing Lubricating Oil Analysis Program as being consistent with GALL AMP XI.M39, "Lubricating Oil Analysis." The applicant stated that its program manages the aging effects of loss of material and reduction of heat transfer for aluminum, copper alloys, stainless steel, and steel mechanical system components when exposed to a lubricating oil environment. The applicant also stated that this is accomplished by maintaining oil system contaminants (i.e., primarily water and particulates) within acceptable limits, thus preserving an environment that is not conducive to loss of material or reduction of heat transfer. The applicant stated that the oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants, such as water, particulates, and metals. The applicant further stated that the effectiveness of this program is verified by the WCP Program.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff noted in the applicant's "acceptance criteria" program element that it is using the industry standard ISO 11500. The staff noted that this standard incorporates ISO 4406, which is a standard that GALL AMP XI.M39 recommends. The staff determined this to be acceptable because it is consistent with the recommendations of GALL AMP XI.M39 to use industry standards.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M39. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M39. Based on its audit, the staff finds that elements one through six of the applicant's Lubricating Oil Analysis Program are consistent with the corresponding program elements of GALL AMP XI.M39 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.17 summarizes OE related to the Lubricating Oil Analysis Program.

During its June 2009 audit, the staff reviewed the applicant's OE reports, including a sample of condition reports. In June 2001, the applicant noted that, based on an oil analysis, the 1B heater drain pump thrust stand bearing had water in the lube oil. The applicant noted that the level of water was 1,588 parts per million (ppm), which was still below the allowable concentration of 2,000 ppm of water. The applicant's report noted that a desiccant breather on the heater drain pump thrust stand would prevent reoccurrence of excess water. During its evaluation, the applicant noted that moisture from the air or moisture from packing leak-off spilling to the hot pump casing and flashing to steam may have entered the lube oil reservoir through the air breather. The staff noted that despite the applicant's corrective actions to prevent reoccurrence, in August 2005 there was excess water in the lube oil again. The applicant evaluated this excess water further and determined that the water in the lube oil was a result of packing gland leakage. The staff noted that the applicant took actions to remove the water in the lube oil reservoir and to correct the packing gland leakage. The applicant removed the source of water to the thrust stand oil reservoir. The staff finds that the applicant took corrective actions in both instances to prevent reoccurrence, ultimately determined the root cause for the water contamination, and corrected the packing gland leakage.

During its review of the applicant's condition reports, the staff noted that in January 2007, the applicant identified an adverse trend of sodium and boron in the technical support center (TSC) diesel generator lube oil. The applicant determined the baseline for sodium and boron in the lube oil from historical results and noted that there was a large increase in this sample compared to previous results. Based on its review, the applicant ultimately determined that the cause of the elevated sodium and boron was coolant leaking into the lubricating oil. The applicant located the leak to be between an injector tube and cylinder head. The staff finds that the applicant took corrective actions to identify the cause of the adverse trend and then replaced the cylinder head to prevent reoccurrence.

During May 2009, the applicant noted that the oil sample from the 1B control room A/C chiller pump contained suspended particles. The applicant noted that the particles were reddish in color, non-metallic and of low-density, and appeared to be some type of sealant. After the oil was sampled, the applicant flushed the bearing bracket with new oil to remove additional debris that remained. The applicant sent this oil sample to Insight Services for a laboratory analysis to determine the composition of the suspended particles and the quality of the oil. The results were obtained in June 2009, and the applicant noted that results indicated the oil was "normal" and within acceptance criteria. The applicant concluded that the suspended particles were sealant tape from the pipe plug. The staff noted that the applicant determined the presence of contaminants in the oil sample, took actions to remove any remaining debris, and obtained laboratory results to determine the composition of the particles and evaluate the need for further actions. The staff noted that the applicant intends to continue to obtain samples on a normal frequency and monitor for adverse trends.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.17 provides the USAR supplement for the Lubricating Oil Analysis Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Lubricating Oil Analysis Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.5 Non-EQ Electrical Cables and Connections Program

Summary of Technical Information in the Application. LRA Section B2.1.19 describes the new Non-EQ Electrical Cables and Connections Program as consistent with GALL AMP XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that this program will manage the aging effects of reduced insulation resistance and electrical failure of accessible non-EQ electrical cables and connections within the scope of license renewal that are subject to adverse localized environments. The applicant also stated that a representative sample of accessible insulated cables and connections within the scope of license renewal will be visually inspected for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking, or surface contamination.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.E1. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.E1, with the exception of the areas discussed below. For these areas, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During its audit, the staff reviewed the applicant's method for identifying adverse localized environments. The applicant stated in the LRA that an adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service condition for the cable and connections. The applicant stated that should an adverse localized environment be observed, a representative sample of electrical cables and connections installed within that environment will be visually inspected for aging. However, the applicant did not address how the adverse localized environment is identified. The staff noted that an adverse localized environment should be based on the most limiting service environment for cables (i.e., power, control, and instrumentation) and connections. By letter dated July 13, 2009, the staff issued RAI B2.1.19-1 requesting that the applicant explain how an adverse localized environment is identified.

In its response dated August 17, 2009, the applicant stated that for structures other than containment, the normal operating temperature ranges between 60 °F and 120 °F. The applicant further stated that one exception is the auxiliary feedwater (AFW) pump room in the turbine building that has a maximum operating temperature of 139 °F. The applicant stated that for cumulative radiation exposure, the plant's 40-year radiation dose ranges between less than 1E4 rads and 1.8E7 rads. The applicant also stated that the electrical cable and connection insulation material types installed in the plant have been reviewed based on the 60-year service limiting temperature range, which varies between 141 °F and 273 °F, and the 60-year service limiting radiation dose range, which varies between less than 1.5E4 rads and 2.7E7 rads (1.5 x 40-year value). The applicant stated that it considered the temperature rise due to ohmic heating in the review. Additionally, the applicant stated that there are no installed cables or connections with polyvinyl chloride (PVC) insulation, which has a 60-year service limiting temperature of 112 °F. The applicant also stated that the most common adverse localized environments are those created by elevated temperature and noted that steam generators, feedwater heater, main steam valves, uninsulated or unshielded hot process piping, steam or packing leaks, high-powered incandescent lighting, motor exhaust air vents, areas with equipment that operate at high temperature, areas with inadequate ventilation, etc., are sources of adverse localized environments. Furthermore, electrical cables and connections normally within 3 feet of these sources may be subjected to an adverse localized environment. The applicant further stated that it will identify adverse localized environments through plant OE reviews; communication with maintenance, operations, and radiation protection personnel; and the use of environmental surveys. Finally, the applicant stated that the identified adverse localized environment will be used as an input to the walkdown performed in support of the Non-EQ Electrical Cables and Connections Program.

Based on its review, the staff finds the applicant's response to RAI B2.1.19-1 acceptable because the applicant adequately described how adverse localized environments will be established and incorporated in the Non-EQ Electrical Cables and Connections Program. The staff's concern described in RAI B2.1.19-1 is resolved.

Based on its audit and review of the applicant's response to RAI B2.1.19-1, the staff finds that elements one through six of the applicant's Non-EQ Electrical Cables and Connections Program are consistent with the corresponding program elements of GALL AMP XI.E1 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.19 summarizes OE related to the Non-EQ Electrical Cables and Connections Program. The applicant stated that its program is a new program. The applicant performed a review of the corrective action program for representative examples of internal OE related to this program and found no cases of reduced insulation resistance or electrical failure of accessible non-EQ electrical cables and connections within the scope of license renewal that are subject to an adverse localized environment. The applicant also stated that as OE is obtained, lessons learned will be used to adjust this program as needed.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.19 provides the USAR supplement for the Non-EQ Electrical Cables and Connections Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.6-2.

The staff also notes that the applicant committed (Commitment No. 14) to implement the new Non-EQ Electrical Cables and Connections Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Non-EQ Electrical Cables and Connections Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.6 Non-EQ Electrical Cable Connections Program

Summary of Technical Information in the Application. LRA Section B2.1.20 describes the new Non-EQ Electrical Cable Connections Program as consistent with GALL AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that this program will manage the aging effect of loosening of bolted connections for non-EQ electrical cable connections within the scope of license renewal. The applicant stated that its program will perform a one-time inspection, on a sampling basis, to confirm the absence of loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. The applicant also stated that a representative sample of non-EQ electrical cable connections (e.g., metallic parts) associated with cables, within the scope of license renewal, will be tested at least once prior to the period of extended operation. The applicant further stated that the representative sample of non-EQ bolted electrical cable connections will be identified for testing based on voltage level (medium- and low-voltage), circuit loading (high loading), and location (high temperature, high humidity, vibration, etc.). The applicant also stated that the technical basis for the sample selections will be documented.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.E6. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL

AMP XI.E6, with the exception of the area discussed below. For this area, the staff determined a need for additional clarification, which resulted in the issuance of an RAI.

The staff noted that the applicant's "scope of the program," "parameters monitored or inspected," and "detection of aging effects" program elements are not consistent with GALL AMP XI.E6; SRP-LR Section 3.6.2.1, "AMR Results Consistent with the GALL Report"; and SRP-LR Table 3.6-2, "USAR Supplement for Aging Management of Electrical and Instrumentation and Control Systems." The staff noted that the applicant incorporated a one-time test, limited the voltage level testing criteria, limited connections to active or passive device external connections, and implemented program element changes that are inconsistent with GALL AMP XI.E6. The staff noted that the changes proposed by the applicant were, however, consistent with proposed Interim Staff Guidance (ISG) LR-ISG-2007-02: Changes to Generic Aging Lessons Learned (GALL) Report Aging Management Program (AMP) XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements."

During its audit, the staff also noted that although the applicant referenced the above ISG in its program basis document, the ISG is not referenced in LRA Section B2.1.20, nor is justification for its use provided in the program basis document or in LRA Section B2.1.20. By letter dated July 13, 2009, the staff issued RAI B2.1.20-1 requesting that the applicant provide justification, including an acceptable basis, for the proposed changes to its program and why these changes are not considered either exceptions to GALL AMP XI.E6 or a plant-specific program.

In its response dated August 17, 2009, the applicant stated that the description of the Non-EQ Electrical Cable Connections Program in LRA Appendix B, Section B2.1.20 is supplemented to include the following exceptions:

- The program will be a one-time inspection program which will be performed prior to the period of extended operation but not repeated every 10 years. The program element affected is "detection of aging effects."
- The program will not include high-voltage connections. The program elements affected are "scope of the program" and "parameters monitored or inspected."
- The program will not include connections that are on the internal side of an active component. The program element affected is "scope of the program."

Based on its review, the staff finds the applicant's response to RAI B2.1.20-1 acceptable because the applicant amended its LRA to identify an exception concerning the "scope of the program," "parameters monitored or inspected," and "detection of aging effects" program elements. The staff's review of this newly identified exception and its acceptability is discussed below. The staff's concern described in RAI B2.1.20-1 is resolved.

The staff also reviewed the portions of the "scope of the program," "parameters monitored or inspected," and "detection of aging effects" program elements associated with the exception, as amended by letter dated August 17, 2009, to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception. LRA Section B2.1.20 states an exception to the "scope of the program," "parameters monitored or inspected," and "detection of aging effects" program elements, as amended by letter dated August 17, 2009. The applicant stated that its program will be a one-time inspection program which will be performed prior to the period of extended operation but not repeated every 10 years. The applicant further stated that its program will not include high-voltage connections and connections that are on the internal side of an active component.

Based on its review, the staff finds the applicant's response to RAI B2.1.20-1 to be acceptable because the applicant amended its LRA to take exceptions to GALL AMP XI.E6, consistent with the staff guidance in LR-ISG-2007-02. The staff noted that LR-ISG-2007-02 addresses the applicant's proposed changes to GALL AMP XI.E6.

Based on its review, the staff finds this exception acceptable because the applicant's program is now consistent with GALL AMP XI.E6, as modified by LR-ISG-2007-02.

Subsequent to the audit, a notice of availability of the final LR-ISG-2007-02 was published in the *Federal Register* on December 23, 2009. The staff, therefore, re-evaluated the AMP, LRA Sections B2.1.20 and A2.1.20, and the exception based on the staff's aging management recommendations provided by LR-ISG-2007-02. Based on its review, the staff confirmed that elements one through six of the applicant's program remain consistent with the corresponding elements of GALL AMP XI.E6, as modified by the final LR-ISG-2007-02 dated December 23, 2009.

Based on its audit and review of the applicant's response to RAI B2.1.20-1, the staff finds that elements one through six of the applicant's Non-EQ Electrical Cable Connections Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL AMP XI.E6, as modified by the final LR-ISG-2007-02 dated December 23, 2009, and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.20 summarizes OE related to the Non-EQ Electrical Cable Connections Program. The applicant's review of its corrective action program did not reveal any specific corrective action program examples of loose bolt connections attributable to the aging mechanisms applicable to LRA Section B2.1.20 and GALL AMP XI.E6. The applicant stated that its program is a new program. As indicated above, the applicant performed a review of the corrective action program and stated that although cases of loose bolted connections were identified, there were no conclusive examples that the loosening of bolted connections was due to aging mechanisms associated with thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. The applicant further stated that as OE is obtained, lessons learned will be used to adjust this program as needed through the applicant's OE program.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.20 provides the USAR supplement for the Non-EQ Electrical Cable Connections Program, as amended by letter dated August 17, 2009. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in the staff guidance in LR-ISG-2007-02.

The staff also notes that the applicant committed (Commitment No. 15) to implement the new Non-EQ Electrical Cable Connections Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Non-EQ Electrical Cable Connections Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent with the GALL Report as modified by LR-ISG-2007-02 (December 23, 2009). The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.7 Non-EQ Inaccessible Medium-Voltage Cables Program

Summary of Technical Information in the Application. LRA Section B2.1.21 describes the new Non-EQ Inaccessible Medium-Voltage Cables Program as consistent with GALL AMP XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that this AMP will manage the aging effects of localized damage and breakdown of insulation leading to electrical failure of non-EQ inaccessible medium-voltage cables within the scope of license renewal that are subject to exposure to significant moisture simultaneously with significant voltage. The applicant also stated that the program will inspect the in-scope manhole for water collection and will remove water if required. The applicant further stated that testing will be performed to provide an indication of the condition of conductor insulation. The applicant stated that the specific test will be determined prior to the initial test, and the test will be a proven test for detecting deterioration of the insulation due to wetting. Additionally, the applicant stated that both inspection of the in-scope manhole and testing will be performed prior to the period of extended operation, with the inspections repeated every 2 years and testing repeated every 10 years thereafter.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.E3. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.E3, with the exception of the "detection of aging effects" program element. For this element, the staff determined a need for additional clarification, which resulted in the issuance of an RAI.

For the "detection of aging effects" program element, the applicant stated that inspection for water collection should be performed prior to the period of extended operation and every 2 years thereafter. GALL AMP XI.E3 states that the inspection for water collection should be based on actual plant experience with water accumulation in the manhole and an inspection frequency of at least every 2 years. The staff noted that the applicant did not reference its plant-specific OE to justify the fixed 2-year inspection frequency. In addition, the staff noted that the applicant's program does not provide for adjustment of the 2-year inspection frequency based on the possibility of subsequent significant water accumulation resulting in cable submergence. By letter dated July 13, 2009, the staff issued RAI B2.1.21-1 requesting that the applicant justify the difference between GALL AMP XI.E3 and its program, which does not specify that inspections for water collection be performed based on actual plant experience with water collection in the manhole.

In its response dated August 17, 2009, the applicant stated that LRA Section A2.1.21 will be revised to replace the fifth paragraph in the program description with the following:

> Inspection of the in-scope manhole east of the tertiary auxiliary transformer for water collection will be performed prior to the period of extended operation, and the inspection will be repeated at least every two years thereafter.

The applicant also stated that if significant water collection is observed during the inspections which may cause the in-scope cables to become submerged, the condition will be documented in the corrective action program. The applicant further stated that the corrective action program will evaluate the apparent cause and determine corrective actions, including adjustment of the 2-year inspection frequency, as necessary. However, the staff noted that the applicant's response did not include the specific guidance in GALL AMP XI.E3 which states, "In addition, inspection for water collection is performed based on actual plant experience with water accumulation in the manholes." By letter dated December 28, 2009, the applicant supplemented its response to RAI B2.1.21-1 by revising LRA Section A2.1.21 to replace the fifth paragraph in the program description with the following:

> Inspection of the in-scope manhole east of the tertiary auxiliary transformer for water collection will be performed based on actual plant experience with water accumulation in the manhole. However, the inspection will be performed at least every two years. The first inspection for license renewal will be performed prior to the period of extended operation.

Based on its review, the staff finds the applicant's response to RAI B2.1.21-1, supplemented by a letter dated December 28, 2009, acceptable because the applicant revised LRA Section A2.1.21 so that it is consistent with GALL AMP XI.E3 and SRP-LR Table 3.6-2. The staff noted that the applicant's revision to its LRA in conjunction with its corrective action program, which provides for the evaluation of the inspection frequency should subsequent inspections find significant water accumulation in the manhole, is now consistent with GALL AMP XI.E3 and SRP-LR Table 3.6-2. The staff, therefore, considers RAI B2.1.21-1 resolved.

Based on its audit and review of the applicant's response to RAI B2.1.21-1, as amended by letter dated December 28, 2009, the staff finds that elements one through six of the applicant's Non-EQ Inaccessible Medium-Voltage Cables Program are consistent with the corresponding program elements of GALL AMP XI.E3 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.21 summarizes OE related to the Non-EQ Inaccessible Medium-Voltage Cables Program. The applicant stated that its review of its corrective action program did not reveal any specific examples attributable to the aging mechanisms applicable to its program and GALL AMP XI.E3. The applicant's response to GL 2007-01 did not identify any failures of in-scope cables. In addition, the applicant's inspection and interviews with plant personnel concerning the in-scope manhole east of the tertiary auxiliary transformer did not identify water collection that would cause in-scope cables to be exposed to significant moisture.

During its audit, the staff walked down the in-scope manhole and confirmed the applicant's recent findings. The applicant further stated that as OE is obtained, lessons learned will be used to adjust this program as needed through the applicant's OE program. Therefore, the applicant has determined that its plant-specific OE did not reveal any degradation outside the bounds of industry experience.

Subsequent to the audit, by letter dated August 9, 2010, the applicant submitted a second annual update to the LRA. The annual update described modifications to the substation, switchyard, and associated LRA sections. As a result of the modifications that spliced a new 13.8-kilovolt (kV) feed to the existing 13.8-kV underground feeder cable to the in-scope tertiary auxiliary transformer at an underground pulling pit, the applicant added the pulling pit to the scope of license renewal. The pulling pit protects the new cable splice and is within the scope of license renewal because it supports inaccessible medium-voltage cables required for station blackout (SBO). The pulling pit is also within the program scope for the applicant's Non-EQ Inaccessible Medium-Voltage Cables Program and will be included as part of the program's manhole inspection activities. The staff, as referenced in its inspection report "Kewaunee Power Station NRC License Renewal Scoping, Screening, and Aging Management Inspection (Report 05000305/2009007)," performed a walkdown of the pulling pit and observed it to be free of water.

The GALL Report addresses inaccessible medium-voltage cables in GALL AMP XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The purpose of this program is to provide reasonable assurance that the intended functions of inaccessible medium-voltage cables (2 kV to 35 kV) that are not subject to the EQ requirements of 10 CFR 50.49 and are exposed to adverse localized environments caused by moisture while energized will be maintained consistent with the CLB. The application of GALL AMP XI.E3 to medium-voltage cables by the applicant was based on the OE available at the time Revision 1 of the GALL Report was developed. However, recently identified industry OE indicates that the presence of water or moisture can be a contributing factor in inaccessible power cable failures at lower operating voltages (480 volts (V) to 2 kV). Applicable OE was identified in licensee responses to GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," which included failures of power cables operating at service voltages of less than 2 kV where water was considered a contributing factor. The staff has concluded, based on recently identified industry OE concerning the failure of inaccessible low-voltage power cables (480 V to 2 kV) in the presence of significant moisture, that these cables can potentially experience aging-related degradation. The staff noted that the applicant's Non-EQ Inaccessible Medium-Voltage Cables Program did not address inaccessible low-voltage power cables.

By letter dated September 10, 2010, the staff issued RAI B2.1.21-1a requesting that the applicant:

(1) Provide a summary of its evaluation of recently identified industry OE and any plant-specific OE concerning inaccessible low-voltage power cable failures within the scope of license renewal (not subject to 10 CFR 50.49 EQ requirements), and how this OE applies to the need for additional aging management activities at KPS for such cables.

(2) Provide a discussion of how it will manage the effects of aging on KPS's inaccessible low-voltage power cables within the scope of license renewal and subject to an AMR, with consideration of recently identified industry OE and any plant-specific OE. The discussion should include assessment of its AMP description, program elements (i.e., "scope of the program," "parameters monitored or inspected," "detection of aging effects," and "corrective actions"), USAR, and updated summary description to demonstrate reasonable assurance that the intended functions of inaccessible low-voltage power cables subject to adverse localized environments will be maintained consistent with the CLB through the period of extended operation.

(3) Provide an evaluation showing that its Non-EQ Inaccessible Medium-Voltage Cables Program test and inspection frequencies, including event-driven inspections, incorporate recent industry and plant-specific OE for both inaccessible low- and medium-voltage cables. Discuss how its Non-EQ Inaccessible Medium-Voltage Cables Program will ensure that future industry and plant-specific OE will be incorporated into the program such that inspection and test frequencies may be increased based on test and inspection results.

The applicant responded by letter dated September 23, 2010, stating that, in response to GL 2007-01, "Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients," no failures of inaccessible, low-voltage power cables were identified at KPS. The applicant also stated that there have been no failures of inaccessible, low-voltage power cables at KPS since the GL 2007-01 review was completed. The applicant further stated that it will include the inaccessible, low-voltage power cables (i.e., cables with service voltages less than 2 kV) that are within the scope of license renewal and are not subject to 10 CFR 50.49 EQ (non-EQ) with the Non-EQ Inaccessible Medium-Voltage Cables Program.

The applicant stated that it performed a supplemental review and identified the additional in-scope, low-voltage cables to be included in the program. The cables identified include a power feed to the fire pump 1B control cabinet, a power feed to MCC 1-62D, and power to emergency diesel generator (EDG) fuel oil transfer pumps 1A and 1B. The addition of these cables also expanded the scope of underground duct banks and associated manholes to include EDG fuel oil storage tank access manholes.

In addition, the applicant also removed the "significant voltage" criterion in the Non-EQ Inaccessible Medium-Voltage Cables Program. The elimination of this criterion will no longer allow the program exclusion of inaccessible power cables that are energized less than 25 percent of the time.

The applicant stated that testing of the in-scope, low-voltage cables will be performed prior to the period of extended operation and at least every 10 years during the period of extended operation. The applicant also stated that the EDG fuel oil storage tank access manhole inspections will be performed based on actual plant experience with water accumulation in the manholes, but with the inspection performed at least every 2 years. The applicant further stated that the first inspection for license renewal will be performed prior to the period of extended operation, and that adverse conditions identified either through cable testing or manhole inspections will be evaluated through the applicant's corrective action program.

The applicant also stated that the electrical manhole, the two EDG fuel oil tank access manholes, and the cable pulling pit have been inspected for accumulation of water. The applicant stated that only minimal indications of water accumulation were identified, and that there were no indications of cable wetting or submergence. The applicant also stated that grading in the vicinity of the manholes is sloped to aid in directing surface water flow away from the manholes, which prevents surface runoff from entering the manhole in the event of significant rainfall or other flooding event. The applicant further stated that the grade around the pulling pit is not sloped, but that the pulling pit is provided with drains and is located in an area with minimal water ponding or runoff. In addition, the applicant stated that the manholes and pulling pit are located above the groundwater table such that groundwater accumulation does not occur. The applicant concluded that, therefore, water accumulation in the manholes and pulling pit was not expected.

The applicant revised LRA Section A2.1.21 and Section B2.1.21 (including the updated OE) to include in-scope inaccessible low-voltage power cables and associated in-scope manholes into its Non-EQ Inaccessible Medium-Voltage Cables Program.

Based on the information provided in the applicant's RAI response, the staff finds that:

(1) The applicant appropriately expanded the program scope to include inaccessible low-voltage power cables (480 V to 2 KV) and eliminated the criterion of "exposure to significant voltage" consistent with industry OE.

(2) For KPS, the proposed 10-year frequency for power cable insulation testing is acceptable because, as described in the applicant's RAI response: (a) review of plant-specific OE has not revealed any instance of inaccessible low- or medium-voltage power cable failures at KPS; and (b) the frequency of testing can increase based on testing and OE as evaluated through the applicant's 10 CFR 50, Appendix B corrective action program. The staff notes that this approach is consistent with the discussion of OE in SRP-LR Section A.1.2.3.10, which states that applicants should consider plant-specific and applicable industry OE for its AMPs.

(3) The applicant's inspection of manholes and pulling pit containing inaccessible in-scope power cables is acceptable for several reasons: (a) it takes into account the plant OE at KPS, (b) the applicant has performed inspections of the in-scope manholes and pulling pit and has found no indications of cable wetting or submergence, (c) the area around the manholes is graded to prevent surface water from entering the manholes due to flooding or heavy rain, (d) the pulling pit is equipped with drains and is located in an area that has limited exposure to runoff, and (e) the manholes and cable pit are located above the water table so groundwater intrusion should not occur. Because plant-specific OE has not shown significant water accumulation in the manholes and pulling pit, nor any indications of cable wetting or submergence within the scope of this AMP, a 2-year

inspection frequency is acceptable. In addition, the applicant's program supports more frequent inspections should adverse water accumulation be identified.

The staff finds that, with the enhancements discussed above, the Non-EQ Inaccessible Medium-Voltage Cables Program will adequately manage the aging effects of inaccessible power cables consistent with industry OE, such that there is reasonable assurance that inaccessible power cables subject to significant moisture will be adequately managed during the period of extended operation. The staff's concern described in RAI B2.1.21-1a is resolved.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During this review, the staff did not identify any OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.21 provides the USAR supplement for the Non-EQ Inaccessible Medium-Voltage Cables Program, as amended by the applicant's letters dated August 17, 2009, December 28, 2009, August 9, 2010, and September 23, 2010. The staff reviewed this revised USAR supplement description of the program and notes that, as revised, it conforms to the recommended description for this type of program as described in SRP-LR Table 3.6-2.

In its response to RAI B2.1.21-1, dated August 17, 2009, combined with its supplemental response to RAI B2.1.21-1 dated December 28, 2009, its letter dated August 9, 2010, and its response to RAI B2.1.21-1a dated September 23, 2010, the applicant stated that LRA Section A2.1.21 will be revised to replace the fifth and sixth paragraphs in the program description as discussed in the staff evaluation section above with the following:

> Inspection of the in-scope manhole east of the tertiary auxiliary transformer, the pulling pit, and the EDG fuel oil storage tank access manholes for water collection will be performed based on actual plant experience with water accumulation in the pulling pit and manholes. However, the inspection will be performed at least every two years. The first inspection for license renewal will be performed prior to the period of extended operation.
>
> Testing of the in-scope inaccessible low- and medium-voltage cables exposed to significant moisture will be performed prior to the period of extended operation, and the tests will be repeated at least every ten years thereafter.

The staff also notes that the applicant committed (Commitment No. 16) to implement the new Non-EQ Inaccessible Medium-Voltage Cables Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Non-EQ Inaccessible Medium-Voltage Cables Program, the staff finds that all program elements are consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.8 Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program

Summary of Technical Information in the Application. LRA Section B2.1.22 describes the new Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program as consistent with GALL AMP XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits." The applicant stated that this program will manage the aging effects of reduced insulation resistance and electrical failure for electrical cables and connections subject to sensitive, high-voltage, low-level signals installed in nuclear instrumentation and radiation monitoring circuits, within the scope of license renewal, that are subject to an adverse localized environment.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.E2. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.E2, with the exception of the area discussed below. For this area, the staff determined a need for additional clarification, which resulted in the issuance of an RAI.

LRA Section B2.1.22 states that this program will manage the aging effects of reduced insulation resistance and electrical failure for electrical cables and connections subject to sensitive, high-voltage, low-level signals installed in nuclear instrumentation and radiation monitoring circuits within the scope of license renewal that are subject to an adverse localized environment. The applicant further stated that an adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cables (power, control, and instrumentation) and connections. However, the applicant did not discuss how the adverse localized environments will be identified. The adverse localized environment should be based on the most limiting design environment of cables and connections. By letter dated July 13, 2009, the staff issued RAI B2.1.19-1 requesting that the applicant explain how an adverse localized environment is identified.

In its response dated August 17, 2009, the applicant stated that for structures other than containment, the normal operating temperature ranges between 60 °F and 120 °F. The applicant further stated that one exception is the AFW pump room in the turbine building that has a maximum operating temperature of 130 °F. The applicant stated that for cumulative radiation exposure, the plant's 40-year radiation dose ranges between 1E4 rads and

1.8E7 rads. The applicant also stated that the electrical cable and connection insulation material types installed in the plant have been reviewed based on the 60-year service limiting temperature range, which varies between 141 °F and 273 °F, and the 60-year service limiting radiation dose range, which varies between 1.5E4 rads and 2.7E7 rads (1.5 x 40-year value). The applicant stated that it considered the temperature rise due to ohmic heating in the review. Additionally, the applicant stated that there are no installed cables or connections with PVC insulation, which has a 60-year service limiting temperature of 112 °F. The applicant also stated that the most common adverse localized environments are those created by elevated temperature and noted that steam generators, feedwater heater, main steam valves, uninsulated or unshielded hot process piping, steam or packing leaks, high-powered incandescent lighting, motor exhaust air vents, areas with equipment that operate at high temperatures, areas with inadequate ventilation, etc., are sources of adverse localized environments. Furthermore, electrical cables and connections normally within 3 feet of these sources may be subjected to an adverse localized environment. The applicant further stated that it will identify adverse localized environments through plant OE reviews, communication with maintenance, operations, and radiation protection personnel, and the use of environmental surveys.

Based on its review, the staff finds the applicant's response to RAI B2.1.19-1 acceptable because the applicant adequately described how adverse localized environments will be established. The staff's concern described in RAI B2.1.19-1 is resolved.

Based on its audit and review of the applicant's response to RAI B2.1.19-1, the staff finds that elements one through six of the applicant's Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program are consistent with the corresponding program elements of GALL AMP XI.E2 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.22 summarizes OE related to the Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program. The applicant stated that its program is a new program. The applicant stated that it performed a review of the corrective action program for representative examples of internal OE related to this program and identified no cases of reduced insulation resistance and electrical failure for electrical cables and connections subject to sensitive, high-voltage, low-level signals installed in nuclear instrumentation and radiation monitoring circuits, within the scope of license renewal, that are subject to an adverse localized environment. The applicant also stated that as OE is obtained, lessons learned will be used to adjust this program as needed.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.22 provides the USAR supplement for the Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program in SRP-LR Table 3.6-2.

The staff also noted that the applicant committed (Commitment No. 17) to implement the new Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program, the staff finds that all program elements are consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.9 Primary Water Chemistry Program

Summary of Technical Information in the Application. LRA Section B2.1.24 describes the existing Primary Water Chemistry Program as consistent with GALL AMP XI.M2, "Water Chemistry." The applicant stated that this program relies on the periodic monitoring and control of known detrimental contaminants, such as chloride, fluoride, dissolved oxygen, and sulfate concentrations below the levels known to result in cracking, loss of material, and reduction of heat transfer, and that the program is based upon industry guidelines for primary water chemistry given in Electric Power Research Institute (EPRI) TR-1014986, "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volume 1, Revision 6. The applicant also stated that the program includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of the environment to which internal surfaces of systems and components are exposed. The applicant further stated that the program maintains water quality (i.e., pH and conductivity) in accordance with the EPRI guidance.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M2. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M2, with the exception of the "preventive actions" and "acceptance criteria" program elements. For these elements, the staff determined a need for additional clarification, which resulted in the issuance of RAIs.

During its audit, the staff reviewed the applicant's LRA and accompanying documentation, including relevant chemistry, system operating, and administrative procedures. The staff also reviewed condition reports related to the applicant's program. In its review, the staff noted a contradiction in the applicant's identification of the EPRI report that forms the basis for its program. LRA Section B2.1.24 states that this program is based on EPRI TR-1002884, which it identifies as "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volume 1, Revision 6. However, the staff noted that this report number actually refers to Revision 5 of the report, whereas Revision 6, which is the most recent edition of the report and the one currently in effect, is EPRI TR-1014986. By letter dated July 13, 2009, the staff issued RAI B2.1.24-1 requesting a clarification of this contradiction.

In its response dated August 17, 2009, the applicant stated that its LRA Section B2.1.24 should have referenced EPRI TR-1014986, "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volume 1, Revision 6 as the basis for its program.

Based on its review, the staff finds the applicant's response to RAI B2.1.24-1 acceptable because LRA Section B2.1.24 has been revised to properly identify the technical basis for its program, which is a later revision of the guidelines recommended in GALL AMP XI.M2, consistent with the recommendations of GALL AMP XI.M2. The staff's concern described in RAI B2.1.24-1 is resolved.

The staff also noted an inconsistency between two of the applicant's documents concerning action level limits for dissolved oxygen. The applicant's primary water chemistry directive defines action level limits for dissolved oxygen for reactor critical conditions that are identical to those in EPRI TR-1014986. However, the applicant's primary chemistry sample specifications procedure defines a different set of limits. By letter dated July 13, 2009, the staff issued RAI B2.1.24-2 requesting clarification of this inconsistency.

In its response dated August 17, 2009, the applicant stated that action level limits stated in its procedure require updating and that this condition has now been documented for action in its corrective action program.

Based on its review, the staff finds the applicant's response to RAI B2.1.24-2 acceptable because the applicant has entered this inconsistency into its corrective action program to resolve the contradiction between two of its procedures, and its procedures will have consistent action level limits in accordance with EPRI TR-1014986. The staff's concern described in RAI B2.1.24-2 is resolved.

The staff further noted a discrepancy between two of the applicant's documents concerning limits of reactive silica in the boric acid storage tank. The applicant's primary water chemistry directive states that the limit on reactive silica for the boric acid storage tank is 5,000 parts per billion (ppb), with no further explanation. However, the applicant's primary chemistry sample specifications procedure states that this limit is 10,000 ppb, and that the limit has been increased proportionally for the higher boric acid level of approximately 8 percent, in accordance with EPRI TR-1014986. By letter dated July 13, 2009, the staff issued RAI B2.1.24-3 requesting clarification of this discrepancy.

In its response dated August 17, 2009, the applicant stated that its primary water chemistry directive does not specifically address limits on reactive silica for the boric acid tank. The applicable limits are contained in its Nuclear Fleet Administrative Procedure, "Primary Water Chemistry," which identifies limits that are in agreement with EPRI TR-1014986. The applicant also stated that its site-specific primary chemistry sample specifications procedure identifies the same limits.

Based on its review, the staff finds the applicant's response to RAI B2.1.24-3 acceptable because the applicant clarified that the chemistry limit is in accordance with EPRI TR-1014986, which is consistent with the recommendations in GALL AMP XI.M2. The staff's concern described in RAI B2.1.24-3 is resolved.

Based on its audit and review of the applicant's responses to RAIs B2.1.24-1, B2.1.24-2, and B2.1.24-3, the staff finds that elements one through six of the applicant's Primary Water Chemistry Program are consistent with the corresponding program elements of GALL AMP XI.M2 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.24 summarizes OE related to the Primary Water Chemistry Program. In the LRA, the applicant cited several instances of transients in water chemistry conditions dating back to 2001 and summarized the relevant circumstances and corrective actions taken. These included modifications to the Primary Water Chemistry Program to control release of corrosion products during mid-cycle shutdowns, the detection of contaminants in the boric acid storage tank due to component degradation, modification of program procedures to include monitoring the levels of zeolite-forming elements, and changes in procedures associated with lithium additions. The applicant stated that, for all of these occurrences, the Primary Water Chemistry Program had been effective in managing aging effects by monitoring chemistry control parameters and establishing limits for corrective actions.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.24 provides the USAR supplement for the Primary Water Chemistry Program. The staff reviewed this USAR supplement description of the program and noted that it did not conform to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, and 3.5-2.

The staff noted that the LRA lists a number of SCs for which the operating environment is primary water. The GALL Report states that no further AMR is necessary for these and similar components if the applicant provides certain component-specific commitments in the USAR supplement. The staff reviewed the applicant's USAR supplement and found that these commitments were not present. By letter dated July 13, 2009, the staff issued RAI B2.1.24-4 requesting that this deficiency be addressed.

In its response dated August 17, 2009, the applicant stated that the two commitments identified in the GALL Report that are applicable are related to: (1) the management of cracking for nickel

(Ni)-alloy components, and (2) the management of degradation of reactor vessel internals (RVI) components. The applicant also stated that the required commitments are not contained in the USAR supplement for the Primary Water Chemistry Program, but are instead included in the USAR supplements for the plant-specific Alloy 600 Inspections Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

Based on its review, the staff finds the applicant's response to RAI B2.1.24-4 acceptable because it identifies where the required commitments are contained and that the USAR supplement now conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, and 3.5-2. The staff's concern described in RAI B2.1.24-4 is resolved.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Primary Water Chemistry Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.10 Reactor Containment Leakage Testing 10 CFR 50, Appendix J Program

Summary of Technical Information in the Application. LRA Section B2.1.25 describes the existing Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J Program as consistent with GALL AMP XI.S4, "10 CFR 50, Appendix J." The applicant stated that the program manages the aging effects of cracking, loss of leak tightness, loss of material, loss of sealing, and leakage through the RCV, including the systems penetrating the RCV, penetrations, isolation valves, fittings and access openings made of elastomers, stainless steel, and steel to detect degradation of the pressure boundary. The applicant also stated that the program uses Option B, the performance-based approach, to implement the requirement of containment leak rate monitoring and testing.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.S4. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.S4. Based on its audit, the staff finds that elements one through six of the applicant's Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J Program are consistent with the corresponding program elements of GALL AMP XI.S4 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.25 summarizes OE related to the Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J Program. The applicant stated that it has a history of valves exceeding the administrative leak rate limits during Type B and C local leak rate tests. The applicant explained that this issue has been addressed by installing O-ring flanges and removing the valves from the penetration boundary. During its audit, the staff reviewed samples of condition reports and interviewed the applicant's technical staff to verify that these conditions were properly corrected in a timely fashion. The staff's review confirmed that the plant-specific OE did not reveal an adverse trend in program performance or any unacceptable aging-related degradation.

The staff reviewed the OE in the application, and during the audit, to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant and are evaluated in accordance with the GALL Report. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.25 provides the USAR supplement for the Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.5-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.11 Secondary Water Chemistry Program

Summary of Technical Information in the Application. LRA Section B2.1.28 describes the existing Secondary Water Chemistry Program as consistent with GALL AMP XI.M2, "Water Chemistry." The applicant stated that this program relies on the periodic monitoring and control of known detrimental contaminants, such as chloride, dissolved oxygen, and sulfate concentrations below the levels known to result in cracking, loss of material, or reduction of heat transfer and that the program is based upon industry guidelines for secondary water chemistry given in EPRI TR-1008224, "Pressurized Water Reactor Secondary Water Chemistry Guidelines," Revision 6. The applicant also stated that the program includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of the environment to which internal surfaces of systems and components are exposed. The applicant further stated that the program maintains water quality (pH and conductivity) in accordance with the EPRI guidance. In addition, the applicant stated that the effectiveness of the Secondary

Water Chemistry Program is verified by its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program; Steam Generator Tube Integrity Program; and WCP Program.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M2. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M2. Based on its audit, the staff finds that elements one through six of the applicant's Secondary Water Chemistry Program are consistent with the corresponding program elements of GALL AMP XI.M2 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.28 summarizes OE related to the Secondary Water Chemistry Program. In the LRA, the applicant cited several instances of transients in water chemistry conditions dating back to 2002 and summarized the relevant circumstances and corrective actions taken. These included high dissolved oxygen levels in the condensate and feedwater systems and low feedwater hydrazine levels. In addition, changes were made in equipment operator logs to reflect EPRI guidelines, and enhancements were added to various secondary water chemistry procedures. The applicant stated that, for all of these occurrences, the Secondary Water Chemistry Program had been effective in managing aging effects by monitoring chemistry control parameters and establishing limits for corrective actions.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.28 provides the USAR supplement for the Secondary Water Chemistry Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, and 3.5-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Secondary Water Chemistry Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.12 Selective Leaching of Materials Program

Summary of Technical Information in the Application. LRA Section B2.1.29 describes the new Selective Leaching of Materials Program as consistent with GALL AMP XI.M33, "Selective Leaching of Materials." The applicant stated that the new Selective Leaching of Materials Program will manage the aging effects of loss of material on internal and external surfaces of in-scope components, such as piping, pumps, valves, heat exchanger components made of steel (cast iron), and copper alloys (brass, bronze, or aluminum-bronze). The applicant also stated that the program combines the use of a one-time visual inspection with a hardness test or qualitative examination, such as resonance when struck by another object, scraping, or chipping, as appropriate, on the external and internal surfaces of components made of materials susceptible to selective leaching, to determine whether the aging effect of loss of material due to selective leaching has occurred. The applicant further stated that the program will define a one-time examination methodology and acceptance criteria, will inspect a representative sample of selected components that may be susceptible to selective leaching, and if selective leaching is found, the program will provide for evaluation as to the effect leaching will have on the component's function as well as the need to expand the number and location of components in the inspection sample.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M33. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M33, with the exception of the "scope of the program" and "detection of aging effects" program elements. For these elements, the staff determined a need for additional clarification, which resulted in the issuance of RAIs, as discussed below.

GALL AMP XI.M33 states in the "scope of the program" program element that the program includes a one-time visual inspection and hardness measurement of a selected set of sample components to determine whether loss of material due to selective leaching is not occurring for the period of extended operation. However, the LRA did not state how the selected set of sample components would be determined or the size of the sample of components that would be inspected. The staff noted that due to the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations, large sample sizes may be required in order to adequately confirm that selective leaching is not occurring. By teleconference on November 17, 2010, the staff issued RAI B2.1.29-2 requesting that the applicant provide specific information regarding how the selected set of components to be sampled will be determined and the size of the sample of components that will be inspected.

In its response dated November 23, 2010, the applicant stated that inspection locations will be developed to ensure that a representative sample of material and environment combinations is selected with a focus on inspecting leading indicator components. The applicant also stated that a sample size of 20 percent of the population (up to a maximum of 25 components) will be established for each of the two material groups (gray cast iron and copper alloy) consistent with the methodology established in EPRI TR-107514, "Age-Related Degradation Inspection Method and Demonstration in Behalf of Calvert Cliffs Nuclear Power Plant License Renewal Application," Section 4, Sampling Program Description. The staff finds the applicant's response acceptable because the applicant's selected set of components to be sampled will be based on material and environment combinations, and the sample locations will focus on the leading indicator components and include a large sample size. The staff's concern described in RAI B2.1.29-2 is resolved.

GALL AMP XI.M33 recommends the use of a one-time visual inspection and hardness measurement of a selected set of sample components to determine whether loss of material due to selective leaching is occurring for the period of extended operation; however, during its review, the staff found that the applicant's Selective Leaching of Materials Program credits the use of qualitative examinations, such as resonance when struck by another object, scraping, or chipping, as appropriate. By letter dated March 11, 2010, the staff issued RAI B2.1.29-1 requesting that the applicant provide justification for why the qualitative examination methodologies credited in the LRA AMP are an acceptable alternative to performing a hardness measurement, as recommended by the GALL Report.

In its response dated March 26, 2010, the applicant stated that it would take an exception to the "detection of aging effects" program element to use qualitative examination methods, such as resonance when struck by another object, scraping, or chipping, where a hardness measurement may not be feasible due to the component's form, configuration, or location. The applicant also stated that visual inspection will be used in conjunction with the qualitative examination methods. The staff finds the applicant's response acceptable because visible inspection is an appropriate method for detecting loss of material, and the qualitative examination methods proposed are appropriate for detecting the effects of selective leaching by providing indication of degradation in the base material. The staff's concern described in RAI B2.1.29-1 is resolved.

The staff also reviewed the portions of the "detection of aging effects" program element associated with the exception taken in response to RAI B2.1.29-1 to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception. LRA Section B2.1.29 states an exception to the "detection of aging effects" program element as a result of the response to RAI B2.1.29-1 discussed above. The exception states that the applicant will use qualitative examination methods, such as resonance when struck by another object, scraping, or chipping, where a hardness measurement may not be feasible due to the component's form, configuration, or location, in conjunction with a visible inspection to determine if selective leaching is occurring. The staff finds the exception acceptable because the qualitative examination methods proposed are acceptable methods to determine if selective leaching is occurring.

Based on its audit and review of the applicant's responses to RAIs B2.1.29-1 and B2.1.29-2, the staff finds that elements one through six of the applicant's Selective Leaching of Materials Program are consistent with the corresponding program elements of GALL AMP XI.M33 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.29 summarizes OE related to the Selective Leaching of Materials Program. The applicant stated that the Selective Leaching of Materials Program is a new program for which there is no plant-specific OE. The applicant also stated that as the new program is implemented, OE will be evaluated and the actions, inspection, and testing will be modified accordingly. The applicant further stated that inspection methods will be consistent with accepted industry practices.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program. The staff confirmed that the "operating experience" program element satisfies the criterion defined in the GALL Report and in SRP-LR Section A.1.2.3.10. The staff finds this program acceptable.

USAR Supplement. LRA Section A2.1.29 provides the USAR supplement for the Selective Leaching of Materials Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, and 3.3-2.

The staff also notes that the applicant committed (Commitment No. 21) to implement the new Selective Leaching of Materials Program prior to entering the period of extended operation for managing aging of applicable components, including a one-time visual inspection and hardness measurement or qualitative examination of selected components.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Selective Leaching of Materials Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions of these components 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 this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.13 Environmental Qualification (EQ) of Electric Components Program

Summary of Technical Information in the Application. LRA Section B3.1 describes the existing EQ of Electric Components Program as consistent with GALL AMP X.E1, "Environmental Qualification (EQ) of Electrical Components." The applicant stated that its program manages the effects of thermal, radiation, and cyclic aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. The applicant also stated that, as required by 10 CFR 50.49, EQ components are refurbished, replaced, or their qualification extended prior to reaching the aging limits established in the evaluation. The applicant further stated that aging evaluations for EQ components that specify a qualification of at least 40 years are considered time-limited aging analyses (TLAAs) for license renewal. LRA Section B3.1 states that for the period of extended operation, the qualified life for equipment is an additional 20 years at the maximum normal plant service conditions to which the equipment is exposed. The applicant also stated that in cases where the component lifespan (for the period of extended operation or current operating term) may not be achieved due to aging limitations of the equipment, it is acceptable to determine the qualified life of less than the length necessary, as long as the equipment is replaced, refurbished, or requalified prior to the end of qualified life.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP X.E1. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP X.E1, with the exception of the "parameters monitored or inspected," "detection of aging effects," and "monitoring and trending" program elements. For these elements, the staff determined a need for additional clarification, which resulted in the issuance of an RAI.

During its audit, the staff noted that the applicant's program has a specific reference to the use of ambient temperature monitoring to modify qualified life through reanalysis. The staff noted that GALL AMP X.E1 states that per RG 1.89, Revision 1, a condition or performance monitoring program is an acceptable basis to modify a qualified life through reanalysis. However, the applicant did not describe whether ambient temperature monitoring is performed and controlled consistent with GALL AMP X.E1, such that component qualified life remains bounded with respect to ambient temperature or as a means to modify the qualified life. By letter dated July 13, 2009, the staff issued RAI B3.1-2 requesting that the applicant explain how ambient temperature monitoring is or will be performed and controlled under its EQ of Electric Components Program.

In its response dated August 17, 2009, the applicant stated that ambient temperature monitoring data used in its program is historical data obtained from a monitoring program that was performed during the 1991–1992 timeframe, but there is no ambient temperature monitoring currently being performed for its program. The applicant also stated that EQ component qualified life analyses generally uses plant design temperatures, which are higher, on average, than actual service temperatures. The applicant further stated that when service temperatures are used in the analyses, the historical temperature monitoring data is adjusted to account for plant modification or changes that could affect ambient temperatures since the temperature monitoring data was obtained. The applicant also stated that ambient temperature monitoring data from the warmest months of the year are typically used as inputs to the qualification analysis. The applicant concluded that component qualified life analyses are based on conservative bounding service temperature inputs with respect to ambient temperature.

Based on its review, the staff finds the applicant's response to RAI B3.1-2 acceptable because the applicant explained the use of the historical temperature monitoring data, and that it is adjusted based on plant modifications or changes affecting the ambient temperature data when used in EQ component qualified life analyses, which is consistent with GALL AMP X.E1. The staff's concern described in RAI B3.1-2 is resolved.

Based on its audit and review of the applicant's response to RAI B3.1-2, the staff finds that elements one through six of the applicant's EQ of Electric Components Program are consistent with the corresponding program elements of GALL AMP X.E1 and are, therefore, acceptable.

Operating Experience. LRA Section B3.1 summarizes OE related to the EQ of Electric Components Program. The applicant stated that OE indicates the EQ of Electric Components Program is effectively implemented and that, where appropriate, corrective actions are identified and implemented to ensure program effectiveness. The applicant referenced a 2005 condition report related to high-energy line break (HELB) adverse environmental conditions not considered in the EQ, and a 2004 condition report concerning shield building filter assembly inlet damper solenoid valves not in compliance with its program classification. The applicant entered the recommended actions into the corrective action program for resolution and completed them. Additionally, the applicant stated that industry and applicant self assessments of its program effectiveness and implementation were performed in 2004, 2006, and 2007. The applicant stated that, despite identifying needed improvements and a backlog of unfinished EQ documentation updates, the assessments found the applicant's EQ program adequate. The applicant implemented a program to address the areas where improvement was needed and eliminate the EQ documentation backlog.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A3.3 provides the USAR supplement for the EQ of Electric Components Program. The staff reviewed this USAR supplement description of the program and noted that it did not conform to the recommended description for this type of program as described in SRP-LR Table 4.4-2.

The staff noted that GALL AMP X.E1 states that reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism incorporated in the prior evaluation. Furthermore, important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). By letter dated July 13, 2009, the staff issued RAI B3.1-1 requesting that the applicant provide justification for not including the reanalysis attributes in the USAR supplement.

In its response dated August 17, 2009, the applicant stated that the following statement would be added to LRA Section A3.3:

> Re-analysis of aging evaluations to extend the qualifications of components is performed on a routine basis as part of the program. Important attributes for the re-analysis of aging evaluations include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria and corrective actions (if acceptance criteria are not met).

Based on its review, the staff finds the applicant's response to RAI B3.1-1 acceptable because the applicant revised LRA Section A3.3 to include reanalysis attributes and the USAR supplement now conforms to the recommended description for this type of program as described in SRP-LR Table 4.4-2. The staff's concern described in RAI B3.1-1 is resolved.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's EQ of Electric Components Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2 AMPS That Are Consistent with the GALL Report with Exceptions or Enhancements

In LRA Appendix B, the applicant identified the following AMPs that were, or will be, consistent with the GALL Report, with exceptions or enhancements:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- ASME Section XI, Subsection IWF Program
- Bolting Integrity Program
- Buried Piping and Tanks Inspection Program
- Closed-Cycle Cooling Water System Program
- Compressed Air Monitoring Program
- External Surfaces Monitoring Program
- Fire Protection Program
- Flow-Accelerated Corrosion Program
- Fuel Oil Chemistry Program
- Fuel Oil Tank Inspections Program
- Inspection of Overhead Heavy Load and Refueling Handling Systems Program
- Metal-Enclosed Bus Program
- Open-Cycle Cooling Water System Program
- Reactor Head Closure Studs Program
- Reactor Vessel Surveillance Program
- Steam Generator Tube Integrity Program
- Structures Monitoring Program

- Work Control Process Program
- Metal Fatigue of Reactor Coolant Pressure Boundary Program

3.0.3.2.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program

Summary of Technical Information in the Application. LRA Section B2.1.2 describes the existing ASME Section XI ISI, Subsections IWB, IWC, and IWD Program as consistent, with exception and enhancements, with GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD."

The applicant stated that its program manages the aging effects of changes in dimensions, cracking, loss of fracture toughness, loss of material, and loss of preload for the ASME Class 1, 2, and 3 piping, including piping less than 4 inches nominal pipe size (NPS), and components fabricated of Ni alloys, stainless steel, and steel. The applicant further stated that its program manages the aging effect of cracking for the steel reactor coolant pump (RCP) motor flywheels.

The applicant stated that its program performs visual, surface, ultrasonic, and eddy current examinations based on the inspection extent, schedule, and techniques specified in Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1. The applicant further stated that its program performs examinations of the RCP motor flywheels as augmented examinations. These augmented examinations are regulatory commitments outside the scope of the requirements of the ASME Boiler and Pressure Vessel (B&PV) Code Section XI.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M1. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M1, with the exception of program elements "parameters monitored or inspected" and "detection of aging effects." For these program elements, the staff determined a need for additional clarification, which resulted in the issuance of RAIs.

The staff noted that the applicant did not provide a specific program to manage aging effects in Class 1 small-bore piping. The program description of LRA Section B2.1.2 states that the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program includes "piping less than four inches nominal pipe size [NPS]." The SRP-LR recommends a specific program to address aging management of Class 1 small-bore piping up to 4 inches NPS. The staff noted that this program is provided in GALL AMP XI.M35, "One-Time Inspection of ASME Code Class 1 Small-Bore Piping." The applicant does not have a program consistent with GALL AMP XI.M35, but instead uses its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to manage aging for Class 1 small-bore piping. The staff noted that the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program does not fully address the recommendations of GALL AMP XI.M35.

By letter dated July 13, 2009, the staff issued RAI B2.1.2-1 requesting that the applicant provide program information on the aging management of Class 1 small-bore piping up to 4 inches NPS.

In its response dated August 17, 2009, the applicant stated that it will perform examinations in accordance with the staff-approved risk-informed ISI program. The applicant stated that welds are selected based on risk significance and the potential for aging or cracking, and that 8 of the 96 Class 1 small-bore welds are scheduled for volumetric and surface examinations.

During a conference call with the applicant on September 22, 2009, the staff stated that additional information was needed to address the adequacy of the sampling size of its Class 1 small-bore welds.

By letter dated February 2, 2010, the applicant supplemented its response to RAI B2.1.2-1. The applicant clarified that based on its risk-informed ISI program, a total of 24 welds will be examined prior to the end of the period of extended operation. The applicant further stated that weld selection is based on susceptibility, inspectability, dose considerations, OE, and limiting locations of the total population of welds.

Based on its review, the staff finds the applicant's response to RAI B2.1.2-1, as supplemented by letter dated February 2, 2010, acceptable because the information demonstrated that the applicant has selection criteria that are consistent with the recommendations of GALL AMP XI.M35. The staff's concern described in RAI B2.1.2-1 is resolved.

During the audit, the staff noted that no specific information was provided regarding examination of small-bore piping socket welds. The applicant indicated only that there were 450 Class 1 welds up to 4 inches NPS, some of which were socket welds. By letter dated July 13, 2009, the staff issued RAI B2.1.2-2 requesting that the applicant provide information regarding the examination of small-bore piping socket welds.

In its response dated August 17, 2009, the applicant stated that for Examination Category B-J, Item No. B9.40, there are 320 ASME Class 1 socket welds. The applicant further stated that during the fourth (current) 10-year inspection interval, the risk-informed ISI program selected 20 small-bore ASME Class 1 socket welds to receive surface examinations, based on risk significance and the potential for aging mechanisms. The applicant stated that 12 of the 20 examinations have been completed to date, and there have been no indications of cracking. The applicant also stated that visual inspections of the ASME Class 1 piping systems at nominal operating pressure are performed during each refueling outage. The applicant stated that the surface examination of selected small-bore socket welds and the visual inspection of the ASME Class 1 piping systems are consistent with the requirements of ASME Code Section XI. The applicant stated that the socket weld issue had been resolved and that the staff has accepted the use of visual testing (VT)-2 and surface examinations.

The staff noted that its position has been that which is recommended in GALL AMP XI.M35, which recommends a one-time volumetric examination. The staff noted that a VT-2 or surface examination is only for leakage detection and since cracking in most cases starts from the inside surface, by the time leakage indication is detected by VT-2, the subject component would have already failed and lost its intended function. The staff noted that this is the reason GALL AMP XI.M35 recommends volumetric examinations of small-bore piping, including socket welds.

During a conference call with the applicant on September 22, 2009, the staff stated that additional information was needed to address the adequacy of sampling size of its Class 1 small-bore welds. The staff discussed its concerns with the applicant regarding the limitations of VT-2 examinations, as described above. The applicant stated that there was no industry demonstrated means of performing volumetric examinations to detect cracking at the inside diameter of a socket weld. The staff noted that: (1) VT-2 or surface examination is not useful in detecting cracking initiated from the inside of a socket weld, and (2) although there is not yet a performance demonstration initiative (PDI)-qualified ultrasonic testing (UT) technique that would have the ability to size a crack in socket welds, the industry has developed UT techniques on socket welds which, although not qualified for sizing, do provide go/no-go results that are useful in detecting aging.

By letters dated February 2, 2010, and September 23, 2010, the applicant supplemented its response to RAI B2.1.2-2. The applicant committed (Commitment No. 43) to perform volumetric examinations on 5 Class 1 socket welds, "using a demonstrated, nuclear-industry endorsed inspection methodology that can detect cracking within the specified examination volume, if a methodology becomes available." Furthermore, the applicant committed (Commitment No. 43) to perform one destructive examination consisting of at least two socket welds will be performed in lieu of the volumetric examination if a demonstrated inspection methodology is not available prior to the period of extended operation. The staff noted that PDI has a set of very strict qualification standards and that a PDI-qualified UT technique would accurately size a flaw, but may be difficult to develop. The staff further noted that several demonstrated UT techniques have been developed and used by the nuclear industry. They provide a go/no-go result that would be adequate in the examination of socket welds. Nonetheless, the staff understands that the applicant has options of performing PDI-qualified UT, industry-demonstrated UT, or opportunistic destructive examinations on the subject socket welds.

Subsequent to the applicant's response to RAI B2.1.2-2 above, on November 5, 2010, the staff held a telephone conference with the applicant to discuss Commitment No. 43. The staff provided additional information regarding sample size guidance for a plant such as KPS, and indicated that an appropriate sample size for Class 1 small-bore piping socket welds could be as low as 3 percent for an applicant that has not experienced a failure in its Class 1 small-bore piping during an extensive operating history (e.g., over 36 years of operation).

By letter dated November 9, 2010, the applicant supplemented its response to RAI B2.1.2-2 and indicated that there are currently a total of 345 Class 1 socket welds. The applicant stated that 10 of the welds (about 3 percent) will be volumetrically examined by a demonstrated volumetric technique. In case such a technique is not available, the applicant stated that destructive examination will be substituted for volumetric NDEs. The applicant indicated that it has an option of performing destructive examination in lieu of volumetric examination on a two-for-one basis. Because more information can be obtained from destructive examinations than from nondestructive examinations, the staff finds the applicant's option to perform destructive examination in lieu of volumetric examination on a two-for-one basis, acceptable. The staff also finds that the number of welds to be inspected is consistent with the staff's position of a 3 percent sample size for plants with no operating experience of weld failures. Therefore, the staff finds the applicant's proposed inspection sample size acceptable. The staff determines that the sampling adequacy issue regarding socket weld inspection has been addressed. In addition, the applicant also provided information regarding its inspection schedule and stated the following:

> A minimum of four volumetric examinations or two destructive examinations (or an equivalent combination of examinations) will be performed prior to the period of extended operation. To allow for orderly planning and scheduling of plant resources and outage workload, the remaining examinations will be performed within three years of entering the period of extended operation.

Since the applicant will be entering the period of extended operation in December of 2013, the staff noted that the first inspections will be performed within 3 years, and all inspections will be completed within 6 years. The staff finds the applicant's proposal consistent with the recommendations of the GALL Report regarding timely implementation of the small-bore piping inspections and is, therefore, acceptable.

Based on its review, the staff finds the applicant's response to RAI B2.1.2-2, as supplemented by letters dated February 2, 2010, September 23, 2010, and November 9, 2010, acceptable because the applicant committed (Commitment No. 43) to volumetric examinations of socket welds, consistent with GALL AMP XI.M35. The staff's concern described in RAI B2.1.2-2 is resolved.

The staff noted that the examinations will be implemented by the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and, therefore, the ASME Code Section XI acceptance criteria and examination expansion criteria are both applicable. The staff finds the applicant's commitment (Commitment No. 43) addressing examination of Class 1 socket welds to be consistent with the recommendations in GALL AMP XI.M35.

The staff determined that aging management of Class 1 small-bore piping is adequately addressed because the number of welds to be inspected, the selection methodology, and the timely implementation of the small-bore piping inspection are consistent with the recommendations in the GALL Report.

The staff also reviewed the portions of the "scope of the program," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements associated with the exceptions and enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions and enhancements follows.

Exception. LRA Section B2.1.2 states an exception to the "scope of the program," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements. The applicant stated that the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program is based on the ASME Code Section XI, 1998 Edition through 2000 Addenda. The applicant stated that use of the 1998 Code Edition through 2000 Addenda is consistent with 10 CFR 50.55a, which requires use of the ASME Code Edition in effect 12 months prior to the start of the inspection interval, and that, for KPS, this is the 1998 Edition though the 2000 Addenda. The applicant further stated that this is a different code edition and addenda than recommended in GALL AMP XI.M1, which specifies the use of the ASME Code Section XI, 2001 Edition through the 2003 Addenda.

To justify this exception, the staff noted that the applicant has performed a comparison of the two code edition/addenda combinations and has concluded that there were no changes in the scope of components.

To ensure that the GALL Report conclusions will remain valid when future editions of the ASME Code are incorporated into NRC regulations by the 10 CFR 50.55a rulemaking, the staff will perform an evaluation of these later editions for their adequacy for license renewal using the 10-element program evaluation described in the GALL Report as part of the 10 CFR 50.55a rulemaking. The staff will document this evaluation in the statements of consideration (SOCs) accompanying future 10 CFR 50.55a amendments, which will be published in the *Federal Register* notice (FRN) for each code edition or addendum. The applicant needs to examine the

FRN paragraph for a specific code edition or addendum for use in license renewal when updating its code of record in subsequent inspection intervals.

Based on its review, the staff does not consider the applicant's use of code edition as an exception, and finds it acceptable for the applicant to use the ASME Code Section XI, 1998 Edition through 2000 Addenda.

Enhancement 1. LRA Section B2.1.2 states an enhancement to the "detection of aging effects" program element. The applicant stated that the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program will be enhanced to: (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the staff for review and approval to augment the current inspections.

The staff noted that this enhancement incorporates the recommendations of GALL AMP XI.M16, "PWR Vessel Internals," which refers to Chapter IV of the GALL Report that states:

> No further aging management review is necessary if the applicant provides a commitment in the FSAR [final safety analysis report] supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

The staff noted that the applicant committed (Commitment No. 1) in its USAR supplement to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to: (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the staff for review and approval to augment the current inspections.

Based on its review, the staff finds the applicant's enhancement acceptable because the applicant provided a commitment (Commitment No. 1) to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to manage the effects of aging for the RVIs consistent with the recommendations of the GALL Report and SRP-LR.

Enhancement 2. LRA Section B2.1.2 states an enhancement to the "detection of aging effects" program element. The applicant stated that the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program will be enhanced to include identification of the limiting susceptible cast austenitic stainless steel (CASS) RVI components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking. The applicant further stated that for each identified component, a plan will be developed that accomplishes aging management through either a supplemental examination or a component-specific evaluation. Furthermore, the plan will be submitted for staff review and approval, not less than 24 months before entering the period of extended operation. The applicant further stated that the enhancement will ensure that the inspections for the detection of aging effects on the CASS RVI components will implement the best industry practices.

In addition, the applicant stated in LRA Table 3.1.1, item 3.1.1-80 that the loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS RVI components is managed by this enhancement to the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to include the recommendations of GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)," following participation in the industry programs for investigating and managing aging effects on reactor internals.

The staff noted that the applicant did not describe a specific program to manage the effects of loss of fracture toughness due to thermal and neutron irradiation embrittlement of CASS RVI components. The staff further noted that in LRA Table 3.1.1, item 3.1.1-80, the applicant stated that, following participation in the industry programs for investigating and managing aging effects on reactor internals, the program to manage loss of fracture toughness of CASS RVI components would be consistent with the recommendations of GALL AMP XI.M13. The staff also noted that the LRA, on page B-7, states that the recommendations of GALL AMP XI.M13 will be an enhancement to the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

The applicant committed (Commitment No. 2) that its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program will be enhanced to include identification of the limiting susceptible CASS RVI components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking, and for each identified component to develop a plan which accomplishes aging management through either a supplemental examination or a component-specific evaluation. The plan will then be submitted for staff review and approval not less than 24 months before entering the period of extended operation. The staff finds this acceptable because the applicant has made a commitment to develop and submit for staff review and approval, a program to manage loss of fracture toughness of CASS RVI components that is consistent with the recommendations of GALL AMP XI.M13.

Based on its audit and review of the applicant's responses to RAIs B2.1.2-1 and B2.1.2-2, the staff finds that elements one through six of the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, with acceptable enhancements and an exception, are consistent with the corresponding program elements of GALL AMP XI.M1 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.2 summarizes OE related to the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The applicant provided examples of OE review related to the effectiveness of its ISI program. The applicant stated that, during the fall 2006 refueling outage, the NDE examiner identified a moderate amount of dry boric acid on the interface of the valve body to the bonnet in the residual heat removal (RHR) system. The applicant also stated that the valve was repaired and returned to service.

The applicant stated that, in April 2003, during a liquid penetrant examination of a 2-inch socket weld in the RCS, a linear indication was recorded that was unacceptable in accordance with ASME Code Section XI 1989 Edition, Table IWB-3514-2. The engineering evaluation of the condition determined that it was a fabrication indication. The applicant further stated that the weld was repaired by light filing.

In another example provided by the applicant, it stated that during the spring 2003 refueling outage, the applicant performed visual examinations of its reactor vessel head and all the head penetrations. The applicant stated that this inspection stemmed from NRC Order EA-03-0091, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors." The examinations performed by the applicant showed that there were no recordable indications and that the head was free of any evidence of corrosion, boric acid residue, or leakage.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.2 provides the USAR supplement for the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, as amended by letter dated February 2, 2010. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.1-2.

The staff also notes that the applicant committed (Commitment No. 1 and No. 2) to enhance the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program prior to entering the period of extended operation.

Specifically, Commitment No. 1 states the following:

> The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will be enhanced to: (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval to augment the current inspections.

Specifically, Commitment No. 2 states the following:

> The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will be enhanced to include identification of the limiting susceptible cast austenitic stainless steel reactor vessel internals components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking. For each identified component, a plan will be developed, which accomplishes aging management through either a supplemental examination or a component-specific evaluation.

> The plan will be submitted for NRC review and approval not less than 24 months before entering the period of extended operation.

The staff notes that the applicant committed (Commitment No. 42) by letter dated February 2, 2010, to the following:

> For Examination Category B-J, Item No. B9.21, eight ASME Class 1 small-bore circumferential welds will receive volumetric and surface examinations during each 10-year ISI interval the during the period of extended operation.

The staff also notes that the applicant committed (Commitment No. 43) by letters dated February 2, 2010, September 23, 2010, and November 9, 2010, to the following:

> Ten volumetric examinations of ASME Class 1 small-bore socket welds will be performed using a demonstrated, nuclear-industry endorsed, inspection methodology that can detect cracking within the specified examination volume, if a methodology becomes available. In the event that a demonstrated, nuclear-industry endorsed, inspection methodology is not available, destructive examinations of socket welds will be substituted for volumetric non-destructive examinations. Each destructive weld examination will be considered equivalent to performing two volumetric weld examinations, such that a maximum of five destructive examinations will be performed.

The staff noted that regarding the inspection schedule, Commitment No. 43 further states the following:

- Four volumetric examinations or two destructive examinations, (or an equivalent combination of examinations) [will be performed] prior to the period of extended operation.

- [The] [R]emaining examinations [will be performed] within three years of entering the period of extended operation.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and Commitment No. 43, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the two enhancements and confirmed that their implementation through Commitment Nos. 1 and 2, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.2 ASME Section XI, Subsection IWF Program

Summary of Technical Information in the Application. LRA Section B2.1.4 describes the existing ASME Section XI, Subsection IWF Program as consistent, with an exception, with GALL AMP XI.S3, "ASME Section XI, Subsection IWF." The applicant stated that the program performs visual examinations of Class 1, Class 2, and Class 3 component supports consistent with the examinations of "Support Types Examined" in Table IWF-2500-1. The applicant further stated that the program is implemented in accordance with the requirements of 10 CFR 50.55a and uses ASME Code Section XI, Subsection IWF, 1998 Edition through the 2000 Addenda for the current inspection interval.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.S3. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.S3, with the exception of the "scope of the program" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During its audit, the staff noted that the "scope of the program" program element in the applicant's program basis document mentioned an augmented program for Class 1, Class 2, and Class 3 supports and hangers. The staff noted that the augmented program was implemented by the applicant's site-specific procedure, as documented in its audit report. During its audit, the staff reviewed this procedure and determined that additional information was required. By letter dated July 13, 2009, the staff issued RAI B2.1.4-1 requesting that the applicant explain how the additional examination requirements of IWF-2430 are satisfied by the applicant's ASME Section XI, Subsection IWF Program.

In its response dated August 17, 2009, the applicant stated that the surveillance procedure examines essentially 100 percent of all required accessible supports and hangers over the 10-year interval, as compared to the ASME Code Section XI, Table IWF-2500-1 requirement to examine 25 percent of Class 1 piping supports, 15 percent of Class 2 piping supports, and 10 percent of Class 3 piping supports during inspection intervals (i.e., every 10 years). The applicant further stated that this practice of an expanded number of examinations provides the opportunity to envelop any additional examinations that may be required by IWF-2430 (a), (b), (c), and (d). However, the applicant stated that if the examinations performed in accordance with the surveillance procedure do not encompass the requirements of IWF-2430 (a), (b), (c), and (d), additional examinations are incorporated into the program to satisfy IWF-2430 requirements.

Based on its review, the staff finds the applicant's response to RAI B2.1.4-1 acceptable because the augmented program specified in the applicant's surveillance procedure does not supersede or modify the requirements to determine and perform additional examinations of supports required to satisfy ASME Code Section XI, IWF-2430. The staff's concern described in RAI B2.1.4-1 is resolved.

The staff also reviewed the portions of the "scope of the program" program element associated with an exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception. LRA Section B2.1.4 states an exception to the "scope of the program" program element. The applicant stated that its program is based on the ASME Code Section XI, 1998 Edition through 2000 Addenda. The applicant further stated that this code edition is different than the code edition identified in GALL AMP XI.S3, which specifies the use of the ASME Code Section XI, 2001 Edition through the 2003 Addenda. The applicant stated that the use of the ASME Code Section XI, 1998 Edition through 2000 Addenda is consistent with provisions in 10 CFR 50.55a to use the code that is in effect 12 months prior to the start of an inspection interval. Additionally, the applicant compared the 1998 Edition with the 2001 Edition and identified no technical differences.

The staff noted that the ASME Code Section XI edition referenced by the applicant was previously approved under 10 CFR 50.55a for the 10-year interval. The staff further noted that the use of the 1998 Edition through the 2000 Addenda of the ASME Code is consistent with the provisions in 10 CFR 50.55a to use the code in effect 12 months prior to the start of the inspection interval. Based on its review, the staff finds this exception acceptable because: (1) the applicant follows the provisions of 10 CFR 50.55a, (2) no technical differences were identified between the requirements of the 1998 and 2001 Code Editions, and (3) the applicant is following a staff-approved ASME Code Section XI code edition and will update the code prior to the start of the next inspection interval, in accordance with 10 CFR 50.55a.

Based on its audit and review of the applicant's response to RAI B2.1.4-1, the staff finds that elements one through six of the applicant's ASME Section XI, Subsection IWF Program, with an acceptable exception, are consistent with the corresponding program elements of GALL AMP XI.S3 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.4 summarizes OE related to the ASME Section XI, Subsection IWF Program. The applicant stated that minor conditions, such as improper spring can settings and degraded pipe hangers, have been identified and corrected. During its audit, the staff had a difficult time verifying that the required additional examinations per IWF-2430 were being conducted. By letter dated July 13, 2009, the staff issued RAI B2.1.4-1 in relation to this issue. The staff's review and acceptability of RAI B2.1.4-1 is documented above.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that the OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.4 provides the USAR supplement for the ASME Section XI, Subsection IWF Program. The staff reviewed this USAR supplement description of the program and finds that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.5-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's ASME Section XI, Subsection IWF Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.3 Bolting Integrity Program

Summary of Technical Information in the Application. LRA Section B2.1.5 describes the existing Bolting Integrity Program as consistent, with an enhancement, with GALL AMP XI.M18, "Bolting Integrity." The applicant stated that the Bolting Integrity Program manages the aging effects of cracking, loss of material, and loss of preload for bolting and fasteners by incorporating NRC and industry recommendations in NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants"; EPRI TR-104213, "Bolted Joint Maintenance & Applications Guide"; and EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants." The applicant also stated that the program addresses: (1) proper assembly of bolted joints; (2) procurement, receipt, and storage of bolting materials; and (3) training of plant personnel. The applicant further stated that the program addresses bolting associated with pressure boundary, mechanical, and high-strength applications for component supports.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M18. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding elements of GALL AMP XI.M18 with the exception of the "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, as discussed below.

GALL AMP XI.M18 recommends that high-strength bolting used in nuclear steam supply system (NSSS) component supports be monitored for stress-corrosion cracking (SCC) under the "parameters monitored or inspected" program element description; however, the applicant's Bolting Integrity Program is not clear in how it monitors high-strength bolts for SCC. By letter dated July 13, 2009, the staff issued RAI B2.1.5-4 requesting that the applicant provide further justification regarding the applicability of SCC for high-strength bolts, and why exclusion of the management of SCC for high-strength bolting is not identified as an exception to the GALL Report recommendation.

In its response dated August 17, 2009, the applicant stated that the high-strength bolting used in the RCP connections are hand tightened and, therefore, do not experience tensile stress required for SCC. The applicant also stated that the steam generator footbolts are manufactured with a material that is resistant to SCC, are not subject to a corrosive environment, and experience low tensile stress. The applicant concluded that these high-strength bolts are not susceptible to SCC and, therefore, do not require aging management. The staff reviewed the response to RAI B2.1.5-4 and determined that the applicant did not provide sufficient information for the staff to determine whether residual stresses existed from fabrication, installation, or operation that may contribute to the possibility for SCC. By letter dated August 28, 2009, the staff issued RAI B2.1.5-5 requesting that the applicant provide further justification regarding the residual and tensile stresses on the RCP connecting bolts.

In its response dated September 28, 2009, the applicant stated that the susceptibility for SCC in the RCP connecting bolts could not be definitively ruled out and, therefore, the applicant would take an exception to GALL AMP XI.M18. The staff's evaluation of the exception is included in the "exception" section below.

GALL AMP XI.M18 recommends selection of bolting material and the use of lubricants and sealants, as well as proper torquing of the bolts and checking for uniformity of the gasket compression after assembly, under the "preventive actions" program element. This degree of detail implies the need for proper training of service and maintenance personnel. The applicant's Bolting Integrity Program included a training program that is pertinent to proper bolting procedures; however, the applicant did not specifically state the frequency of such training. By letter dated July 13, 2009, the staff issued RAI B2.1.5-1 requesting that the applicant provide additional information on its training programs and frequency, pertinent to the Bolting Integrity Program.

In its response dated August 17, 2009, the applicant described the bolting related training for mechanical maintenance personnel. The applicant stated that all mechanical maintenance personnel receive specific instruction on proper bolting techniques as part of their initial qualification training, with continuing training on a quarterly basis and specific refresher training conducted on an as-needed basis when performance deficiencies are noted through job observations or the corrective action program. The applicant also stated that certain bolting issues, such as joint design, material, gasket, and lubricant selection, are completed by engineering personnel.

The staff finds the applicant's response acceptable because the applicant provided initial and continuing training, supplemented by its job observation program. The staff's concern described in RAI B2.1.5-1 is resolved.

GALL AMP XI.M18 recommends inspections be performed in accordance with the ASME Code Section XI, Tables IWB 2500-1, IWC 2500-1, and IWD 2500-1 editions endorsed in 10 CFR 50.55a(b)(2) and the recommendations of EPRI NP-5769 under the "detection of aging effects" program element. In LRA Section B2.1.5, the applicant did not include which portions of the ASME Code Section XI would be used to perform the additional inspections. By letter dated July 13, 2009, the staff issued RAI B2.1.5-2 requesting that the applicant provide the specific ASME Code section numbers that would be used to perform the additional inspections.

In its response dated August 17, 2009, the applicant stated that the inspections would be performed in accordance with ASME Code Section XI, Subsections IWB 2500-1, IWC 2500-1, IWD 2500-1, and IWF 2500-1 of the 1998 Edition. The staff finds the applicant's response acceptable because it is consistent with the GALL Report. The staff's concern described in RAI B2.1.5-2 is resolved.

The staff also reviewed the portions of the "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements associated with an exception and enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception and enhancement follows.

Exception. On September 28, 2009, in its response to RAI B2.1.5-5, the applicant stated that an exception to the Bolting Integrity Program would be taken. This exception affects the "parameters monitored or inspected" and "detection of aging effects" program elements. The applicant revised the LRA to use only visual inspections, whereas GALL AMP XI.M18 recommends volumetric and visual examinations to detect aging of high-strength bolts.

The staff noted that the GALL Report "detection of aging effects" program element states that high-strength structural bolts and fasteners (actual yield strength greater than or equal to 150 kilopounds per square inch (ksi)) for NSSS component supports may be subject to SCC, and recommends that a volumetric examination comparable to that of ASME Code Section XI Examination Category B-G-1 be performed in addition to a visual examination. However, the GALL Report further states that this requirement may be waived with adequate plant-specific justification.

The staff noted that the applicant justified this exception by stating that the bolting in question is used to provide a connection between the top of the RCP support columns and the pump support brackets. The applicant stated that these bolts are hand tightened at each end and are not torqued. The staff noted, however, that the applicant could not definitively support the conclusion that residual stresses did not exist from the fabrication process. The applicant also justified this exception by stating that visual examinations will detect corrosion and conditions indicative of a corrosive environment which is a requirement of SCC in high-strength bolting. The applicant further justified this exception by stating that detection of corrosion or a corrosive environment would result in implementation of the plant's corrective action program, which would lead to corrective actions potentially including volumetric examination, hammer testing, or other appropriate measures. The staff noted, however, that the applicant did not provide the type of material being used for the threaded bar and its manufacturing process, so that the staff could evaluate the plant-specific justification. By letter dated November 20, 2009, the staff issued RAI B2.1.5-6 requesting that the applicant provide the type of material being used for the threaded bar and how it was manufactured.

In its response dated December 28, 2009, the applicant stated that the material from which the fastener was manufactured is Vascomax 300 (CVM) maraging steel. The applicant also stated that specific processes were used to ensure minimization of residual stresses and defects including: (1) heat treatment by slow heating to 900 °F, holding at 3 hours and then air cooling; (2) stress equalizing and nitrogen baking after fabrication; (3) application and baking of first bonded coating; and (4) ultrasonic examination in the axial direction prior to machining.

The staff finds the applicant's response acceptable because it provided assurance that the material was manufactured in a manner which considered the potential for residual stresses and

SCC, and the materials used are moderately corrosion resistant and resist SCC. The staff's concerns described in RAIs B2.1.5-4, B2.1.5-5, and B2.1.5-6 are resolved.

However, the staff noted that the applicant's response to RAI B2.1.5-5 did not provide justification for why the steam generator footbolts are not susceptible to SCC. By letter dated March 11, 2010, the staff issued RAI B2.1.5-7 requesting that the applicant provide justification for why the steam generator footbolts are noted in LRA Table 3.5.2-15, footnote 4, as not subject to SCC, and why no AMP is credited to manage the effects of aging on the footbolts.

In its response dated March 26, 2010, the applicant stated that the steam generator footbolts are constructed of Carpenter Custom 455 stainless steel, which has good corrosion resistance to atmospheric conditions and has been tested in salt spray and chloride solution environments to maintain its resistance to SCC. The applicant also stated that the steam generator footbolts are located above the containment floor and exposed to containment atmosphere, which contains little or no corrosive contaminants. The applicant further stated that the steam generator footbolts have low preload because they are snug-tight and that it has no high-strength structural bolting with a diameter greater than 1 inch, other than the RCP support bolts and steam generator footbolts discussed above.

The staff finds the applicant's response acceptable because: (1) the construction material for the steam generator footbolts has been tested in adverse environments and shown to maintain good resistance to SCC, (2) the footbolts are not in a corrosive environment, and (3) the footbolts are subject to low tensile stress. The staff's concern described in RAI B2.1.5-7 is resolved.

With the information provided in the applicant's RAI responses, the staff finds the program exception acceptable because the applicant's inspection process is consistent with the GALL Report recommendations, and the applicant's justification is an adequate plant-specific justification for a waiver of this recommendation.

Enhancement. LRA Section B2.1.5 states an enhancement to the "preventive actions" program element to further incorporate applicable EPRI and industry bolting guidance, including proper joint assembly, torque values, gasket types, use of lubricants, and other bolting fundamentals.

The staff noted that the enhancement does not cite a specific EPRI document or the details of the specific changes that will be made. This raises the question of whether or not EPRI guidance relied upon by the applicant is consistent with the GALL Report. The staff determined that additional information was needed to complete its review. By letter dated July 13, 2009, the staff issued RAI B2.1.5-3 requesting that the applicant provide the specific EPRI document related to this enhancement so that the staff can complete its review.

In its response dated August 17, 2009, the applicant stated that information in EPRI NP-5067, "Good Bolting Practices Volume 1: Large Bolt Manual"; EPRI NP-5067, "Good Bolting Practices Volume 2: Small Bolt Manual"; EPRI TR-104213, "Bolted Joint Maintenance and Application Guide"; EPRI 1015336, "Bolted Joint Fundamentals"; and EPRI 1015337, "Assembling Gasketed, Flanged Bolted Joints," will be included in the Bolting Integrity Program.

The staff noted that although EPRI NP-5067 is not specifically listed as a technical reference in GALL AMP XI.M18, the GALL Report does include EPRI NP-5769 as a technical reference. EPRI NP-5769 states, "It is believed that the bolting reference manuals [EPRI NP-5067, Volumes 1 and 2] will satisfy the industry's need for guidance in this area [which is bolted joints]." Additionally, the staff evaluated a comparison of the two documents dated April 1, 2005 (Agencywide Document Access and Management System (ADAMS) Accession ML051020128), and finds that the two documents are very closely related and cross-reference one another, in addition to referencing NUREG-1339, with no contradictions. Furthermore, the staff noted that EPRI 1015336 and EPRI 1015337 are also not listed as technical references in the GALL Report AMP. These EPRI reports are consolidations of various bolting related EPRI reports including EPRI NP-5067, Volumes 1 and 2, which were previously evaluated for consistency, and EPRI TR-104213, which is specifically referenced in the GALL Report. The staff further compared EPRI 1015336 and EPRI 1015337 with the requirements of the GALL Report AMP and finds no contradictions.

The staff finds the applicant's response to RAI B2.1.5-3 and this enhancement acceptable because it is consistent with the recommendations of the GALL Report. The staff's concern described in RAI B2.1.5-3 is resolved.

Based on its audit and review of the applicant's responses to RAIs B2.1.5-1, B2.1.5-2, B2.1.5-3, B2.1.5-4, B2.1.5-5, B2.1.5-6, and B2.1.5-7, the staff finds that elements one through six of the applicant's Bolting Integrity Program, with an acceptable exception and enhancement, are consistent with the corresponding program elements of GALL AMP XI.M18 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.5 summarizes OE related to the Bolting Integrity Program. The applicant cited three examples where corroded bolts were discovered during inspections, evaluated, and appropriately dispositioned as part of the corrective action program. In two of the instances, the applicant stated that although the requirements of the AMP and plant procedures found these worn and damaged studs acceptable, they were replaced as an enhanced measure to assure structural integrity. During the audit, the staff noted that a condition report indicated that in April 2008, one of four bolts was found missing from the support stand for a portion of one steam generator's flow instrument tubing. The staff also noted that the problem was identified as a potential compromise to the structural integrity of the stand; however, the structural integrity was re-examined by structural design engineers, who determined that the joint still satisfied applicable design criteria. The staff further noted that these reports and others like them confirmed that the plant-specific OE did not reveal any degradation not bounded by industry experience and demonstrated that proper corrective actions are taken to address bolting issues.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion defined in the GALL Report and in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.5 provides the USAR supplement for the Bolting Integrity Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, and 3.5-2.

The staff also notes that the applicant committed (Commitment No. 3) to enhance the Bolting Integrity Program prior to the period of extended operation. Specifically, the applicant committed to further incorporate applicable EPRI and industry bolting guidance by including information on proper joint assembly, torque values, gasket types, use of lubricants, and other bolting fundamentals.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Bolting Integrity Program, including the applicant's response to the RAIs, the staff concludes that the applicant has demonstrated that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff has reviewed the enhancement and confirmed that the implementation of the enhancement through Commitment No. 3, prior to the period of extended operation, would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions of these components 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 this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.4 Buried Piping and Tanks Inspection Program

Summary of Technical Information in the Application. LRA Section B2.1.7 describes the existing Buried Piping and Tanks Inspection Program as consistent, with exceptions and an enhancement, with GALL AMP XI.M34, "Buried Piping and Tanks Inspection." The applicant stated that the program manages the aging effect of loss of material from the external surfaces of buried steel piping and tanks. The applicant also stated that it has expanded the program to include stainless steel piping and tanks. The applicant further stated that the program manages the aging effect through the use of preventive measures, such as coating and/or wrapping the buried material, and through the use of condition monitoring measures, including opportunistic and deliberate visual inspections.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated. The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M34. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M34, with the exception of the "scope of the program" and "parameters monitored or inspected" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The GALL AMP XI.M34 program description includes only buried steel piping and tanks; however, during its audit, the staff found that the applicant's Buried Piping and Tanks Inspection Program "scope of the program" program element includes both steel and stainless steel piping and tanks. By letter dated July 13, 2009, the staff issued RAI B2.1.7-1 requesting that the applicant revise the LRA AMP to reflect that the inclusion of stainless steel in the scope of the LRA AMP constitutes an exception to the GALL Report AMP. The applicant was also requested to clarify whether the stainless steel piping present at the plant was coated or uncoated.

In its response dated August 17, 2009, the applicant modified the LRA AMP "scope of the program" program element to show the inclusion of stainless steel piping as an exception to the GALL Report AMP. The applicant stated that the stainless steel piping under consideration is a vent line which was installed in 2003, consisting of approximately 30 feet of 2-inch nominal ASTM A-312 schedule 80 coated and wrapped pipe, all of which is buried except for about 3 feet. The applicant also stated its failure was highly unlikely due to the limited amount of buried piping, the design requirements of the piping (i.e., atmospheric service), the recent installation, and the planned inspections.

The staff finds this response acceptable because the applicant has: (1) appropriately modified the LRA to reflect the inclusion of stainless steel piping as an exception to the GALL Report AMP; and (2) demonstrated that, through the design of the piping and the planned inspections, the LRA AMP will provide aging management which is at least equivalent to that provided by the GALL Report AMP, and thus the applicant's program is consistent with GALL AMP XI.M34. The staff's concern described in RAI B2.1.7-1 is resolved.

GALL AMP XI.M34 recommends the use of coatings and wrappings under the "parameters monitored or inspected" program element description; however, during its audit, the staff found the program includes uncoated steel tank hold down straps. By letter dated July 13, 2009, the staff issued RAI B2.1.7-2 requesting that the applicant revise the LRA AMP to reflect that the inclusion of uncoated steel piping or tanks constitutes an exception to the GALL Report AMP.

In its response dated August 17, 2009, the applicant modified the LRA AMP "scope of the program," "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements to show the inclusion of uncoated steel. The applicant stated that the hold down straps for the EDG fuel oil tanks are the only uncoated steel material managed by this program. The applicant also stated that these straps are inspected when the exterior of the fuel tank is inspected. The applicant further stated that the straps will be inspected prior to entering the period of extended operation, and an engineering evaluation will be performed to determine whether additional periodic inspections will be required during the period of extended operation based on evidence of loss of material.

The staff finds the applicant's response to this RAI acceptable because: (1) the applicant has appropriately identified the use of uncoated steel as an exception to the GALL Report AMP, (2) the straps will be inspected prior to entering the period of extended operation, and (3) an engineering evaluation will be performed to determine appropriate inspection intervals based on loss of material.

The staff also reviewed the portions of the "scope of the program," "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements associated with exceptions and an enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions and enhancement follows.

Exception 1. LRA Section B2.1.7 states an exception to the "scope of the program" program element. This exception and staff evaluation are discussed above in RAI B2.1.7-1.

Exception 2. LRA Section B2.1.7 states an exception to the "scope of the program," "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements. This exception and staff evaluation are discussed above in RAI B2.1.7-2.

Enhancement. LRA Section B2.1.7 states an enhancement to the "parameters monitored or inspected" and the "detection of aging effects" program elements. The applicant stated that an inspection of a representative sample of in-scope buried material and protective measure combinations will be accomplished through the use of opportunistic and deliberate inspections during the 10 years preceding, and the 10 years following, the beginning of the period of extended operation.

The staff reviewed this enhancement against the corresponding program elements in GALL AMP XI.M34. On the basis of its review, the staff finds this enhancement acceptable because when it is implemented prior to the period of extended operation, the program inspection frequencies will be consistent with the recommendations in GALL AMP XI.M34.

Based on its audit and review of the applicant's responses to RAIs B2.1.7-1 and B2.1.7-2, the staff finds that elements one through six of the applicant's Buried Piping and Tanks Inspection Program, with acceptable exceptions and an enhancement, are consistent with the corresponding program elements of GALL AMP XI.M34 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.7 summarizes the OE related to the Buried Piping and Tanks Inspection Program. The applicant stated that it conducted an inspection of a fire water system header based on observed degradation in a potable water pipe that was of similar design and construction. The applicant also stated that it found the fire water system header was in generally good condition.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no plant OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation; however, the staff noted a number of recent industry events involving radioactive fluid leakage from buried and underground piping and tanks. In light of this recent industry OE, the staff is concerned about the continued susceptibility to failure of in-scope buried or underground piping. In reviewing the applicant's Buried Piping and Tanks Inspection and the External Surfaces Monitoring programs, along with the applicable AMR items associated with them, the staff is not clear whether: (1) the components addressed by these AMPs clearly include both buried and underground piping (piping which is below grade and contained in a vault or other structure where it is exposed to air and where access is limited), and (2) whether these programs are being updated to incorporate lessons learned from these recent events as well as any OE from the applicant's own history.

By letter dated May 27, 2010, the staff issued RAI B2.1.7-3 requesting that the applicant address these issues. The staff identified this as **Open Item 3.0.3.2.4-1.**

In its response dated July 22, 2010, the applicant stated that no leaks have been discovered in in-scope buried or underground piping during the past 5 years, although an area of degraded piping with surface degradation and irregularities was found in the transition zone between the buried and aboveground portions of the diesel fuel oil day tank vent piping during modification work in the area. The applicant stated that this was caused by approximately 2 feet of the pipe in this zone not being coated or wrapped. The applicant also stated that an extent of condition inspection of two similar locations demonstrated that coatings and wrappings were installed. The applicant further stated that: (1) components that are located below grade in a vault are inspected by the External Surfaces Monitoring Program; (2) cathodic protection is provided for buried portions of the circulating water system and 400 of the 500 feet of buried fuel oil piping, and National Association of Corrosion Engineers (NACE) surveys of the cathodic protection system are conducted; (3) with the exception of the one instance of the diesel fuel oil vent piping, coatings have been found to be in good condition; (4) during excavations, backfill in the vicinity of buried piping has been found to be a proper bedding of sand and gravel as specified; (5) direct visual inspections of at least 10 linear feet of excavated piping will be conducted for the steel portions of the circulating water system, stainless steel portions of the circulating water system, steel portions of the diesel fuel oil piping, and three inspections of at least 10 linear feet of piping each for the ductile iron fire protection system; and (6) one of three of the fuel oil storage tanks along with its hold down straps will be inspected in each 10-year period of inspections. Based on its review, the staff determined that it did not have sufficient information to find the applicant's response acceptable.

In a letter dated September 10, 2010, the staff issued follow-up RAI B2.1.7-3a requesting that the applicant: (1) provide a commitment to maintain the cathodic protection system available 90 percent of the time; (2) provide a commitment to perform annual NACE cathodic protection surveys; (3) discuss any enhancements that may be developed for the 100 feet of buried fuel oil piping that are not cathodically protected and clarify that a buried piping inspection will occur in this portion of the system; and (4) clarify the program commitment to also include buried piping inspections in the 50–60 year period of plant operation.

In its response dated September 23, 2010, the applicant stated that: (1) the goal for availability of the cathodic protection system is 100 percent and that a minimum of 90 percent will be met; (2) cathodic protection surveys will be conducted on at least an annual basis; (3) it has no current plans to cathodically protect the 100 feet of buried fuel oil piping; however, an inspection of the non-cathodically protected pipe will be performed; and (4) the buried pipe inspections will be repeated during the second 10-year period of extended operation.

Based on a review of plant-specific OE, the staff notes that there have been no failures in the applicant's buried, in-scope piping. The staff also notes that the circulating water, fire protection, and diesel fuel oil systems have buried piping. The staff finds the applicant's responses acceptable because: (1) components that are located below grade in a vault are inspected by the External Surfaces Monitoring Program; (2) the applicant's cathodic protection system will be available 90 percent of the time and annual NACE survey testing will be conducted during the period of extended operation; (3) coatings were applied on buried steel piping; (4) recently-conducted inspections of excavated fire protection and diesel generator fuel oil piping demonstrate that coatings are in very good condition; (5) during excavations, backfill has been found to be acceptable; (6) the applicant has committed to conduct direct visual inspections of at least 10 linear feet of excavated piping for the steel portions of the circulating water system, stainless steel portions of the circulating water system, steel portions of the diesel fuel oil piping, and three inspections of at least 10 linear feet of piping each for the ductile iron fire protection system each 10-year period starting 10 years prior to the period of extended operation; (7) the non-cathodically protected 100 feet of buried diesel fuel oil piping will be inspected; and (8) one of three of the fuel oil storage tanks along with its hold down straps will be inspected in each 10-year period of extended operation.

The staff notes that the applicant has no current plans to cathodically protect the 100 feet of buried in-scope diesel fuel oil piping; however, the staff finds this acceptable because, based on information provided in the response to RAI B2.1.7-3, site-specific conditions and planned inspections are adequate to be consistent with paragraph 3.2, "Determination of Need for External Corrosion Control," from NACE Standard SP-169-2007, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," for the following reasons:

(1) Based on inspections of portions of the fire protection piping and 17 percent of the cathodically-protected diesel fuel oil piping, the coatings were in good condition.

(2) Backfill in the vicinity of buried piping has been found to be a proper bedding of sand and gravel as specified.

(3) Only surface degradation and irregularities were detected in the uncoated fuel oil vent piping at the soil-to-air interface.

(4) The applicant has committed to inspect 10 percent of the non-cathodically protected piping.

(5) Based on staff walkdowns conducted during the audit, soil conditions are similar along the entire length (i.e., cathodically and non-cathodically protected) of the diesel fuel oil piping and, therefore, corrosion rates would be expected to be similar.

The staff's concerns described in RAIs B2.1.7-3 and B2.1.7-3a are resolved, and Open Item 3.0.3.2.4-1 is closed.

USAR Supplement. LRA Section A2.1.7 provides the USAR supplement for the Buried Piping and Tanks Inspection Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment Nos. 4 and 48) to enhance the Buried Piping and Tanks Inspection Program prior to entering the period of extended operation. Specifically, the applicant committed to enhance the program to: (a) maintain its cathodic protection system available 90 percent of the time and conduct annual NACE survey testing; (b) conduct direct visual inspections of at least 10 linear feet of the excavated steel portions of the circulating water system, stainless steel portions of the circulating water system, steel portions of the diesel fuel oil piping, and three inspections of at least 10 linear feet of piping each for the ductile iron fire protection system each 10-year period starting 10 years prior to the period of extended operation; (c) inspect the non-cathodically protected 100 feet of buried diesel fuel oil piping; and (d) inspect one of three of the fuel oil storage tanks along with its hold down straps in each 10-year period. The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Buried Piping and Tanks Inspection Program, the staff determines that the program elements for which the applicant claimed consistency with the GALL Report are consistent. The staff also reviewed the two exceptions associated with the "scope of the program," "preventive actions," "parameters monitored or inspected," and "detection of aging effects" program elements, and their justifications, and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. In addition, the staff reviewed the enhancement and confirmed that its implementation through Commitment Nos. 4 and 48, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.5 Closed-Cycle Cooling Water System Program

Summary of Technical Information in the Application. LRA Section B2.1.8 describes the existing Closed-Cycle Cooling Water System Program as consistent, with exceptions, with GALL AMP XI.M21, "Closed-Cycle Cooling Water System." The applicant stated that this program manages the aging effects of cracking, loss of material, and reduction of heat transfer for the steel, stainless steel, and copper alloys in the piping, heat exchangers, and other components in the component cooling system, EDG cooling water subsystems, and control room air conditioning system. The applicant stated that this program establishes appropriate corrosion strategies and chemistry specifications, including the use of inhibitors, for each of the closed-cycle cooling water systems in the plant, based on EPRI TR-1007820, "Closed Cooling Water Chemistry Guideline," Revision 1. The applicant also stated that performance monitoring, including system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing, is used to verify the effectiveness of the chemistry controls in this program. The applicant further stated that a plant-specific WCP Program is used to provide additional verification of the program's effectiveness.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M21. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M21, with the exception of the "parameters monitored or inspected" and "monitoring and trending" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During its audit, the staff reviewed the applicant's program basis document and accompanying documentation, including relevant chemistry, system operating, and administrative procedures. The staff noted that the "parameters monitored or inspected" and "monitoring and trending" program elements in the applicant's program did not specify a monitoring frequency for nitrate levels in the component cooling water system, which uses a nitrite-molybdate corrosion control program. The staff further noted that EPRI TR-1007820, "Closed Cooling Water Chemistry Guideline," Revision 1, specifies that nitrate levels for such systems be monitored on a monthly basis for both Tier 1 and Tier 2 systems. By letter dated July 13, 2009, the staff issued RAI B2.1.8-3 requesting that the applicant provide a justification for not performing monthly monitoring of the nitrate levels in the closed-cycle cooling water system.

In its response dated August 17, 2009, the applicant stated that as an alternative to the monthly monitoring of nitrate levels recommended by EPRI TR-1007820, the applicant monitors nitrite levels on a monthly basis and ammonia levels on a quarterly basis. The applicant also stated that these monitoring activities verify chemistry stability and verify that unacceptable levels of nitrites, which would be produced by nitrifying bacteria, are not present in the closed-cycle cooling water system. The staff noted that in nitrite-treated systems, nitrates are produced by nitrifying bacteria, while ammonia and nitrogen gas are produced by denitrifying bacteria. Furthermore, either or both of these bacteria types may be present in a closed water system, and the absence of one type does not necessarily indicate the absence of the other. The staff noted that the periodic sampling for ammonia may be used to verify the absence or control of denitrifying bacteria, but it provides no assurance that nitrifying bacteria are not present. For this reason, EPRI TR-1007820 recommends monitoring for both nitrates and ammonia on a monthly basis for Tier 1 and 2 systems.

Based on its review, the staff found the applicant's response to RAI B2.18-3 unacceptable. Therefore, by letter dated December 16, 2009, the staff issued follow-up RAI B2.1.8-3a requesting that the applicant justify how current monitoring procedures provide assurance that excessive levels of nitrifying bacteria are not present in the closed water system. In its response dated January 21, 2010, the applicant stated that, upon review of EPRI TR-1007820, it had determined that monitoring for nitrates through the Closed-Cycle Cooling Water System Program would provide improved ability to identify the presence of nitrifying bacteria in the component cooling system. The applicant stated that, as a result, nitrate monitoring will be implemented on a frequency consistent with the existing monitoring for ammonia. By letter dated January 21, 2010, the applicant committed (Commitment No. 40) to implement this change in its monitoring procedure.

Based on its review, the staff finds the applicant's responses to RAIs B2.1.8-3 and B2.1.8-3a acceptable because the applicant has committed (Commitment No. 40) to implement nitrate monitoring on a frequency consistent with the quarterly monitoring for ammonia. The staff finds that monthly monitoring for (decreases in) nitrites, along with quarterly monitoring for nitrates and ammonia, is acceptable in regards to EPRI TR-1007820 for the following reasons: (1) although the report recommends monthly samples for both nitrates and ammonia, Chapter 5 of the report allows deviating from these recommendations as long as there is a technical basis; (2) Table 5-3 of TR-1008720 states that nitrate and ammonia concentrations are not control parameters but rather parameters used for trending; and (3) the applicant has demonstrated the ability to identify biological activity as indicated by plant-specific OE cited in LRA Section B2.1.8, which describes an October 2006 example where possible biological activity was detected by sampling for adenosine triphosphate (ATP) levels. The staff's concerns described in RAIs B2.1.8-3 and B2.1.8-3a are resolved.

The staff also reviewed the portions of the "preventive actions" and "parameters monitored or inspected" program elements associated with the exceptions to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions follows.

Exception 1. LRA Section B2.1.8 states an exception to the "preventive actions" program element. The applicant stated that corrosion inhibitors are not used in the control room air conditioning system because this system interconnects with the service water system, which provides an alternate safety-related cooling mode. The applicant stated that periodic testing of this mode would release any inhibitors to the environment. The applicant also stated that, in lieu of the use of corrosion inhibitors, the system is periodically sampled to verify system integrity.

The applicant further stated that periodic visual inspections of system components are performed under the WCP Program.

The staff noted that EPRI TR-1007820 allows for the operation of closed cooling water systems without the addition of inhibitors, provided proper water chemistry is maintained. Specifically, the staff noted that EPRI TR-1007820 states that control of dissolved oxygen is particularly important for systems containing copper or copper alloys. The report recommends that dissolved oxygen either be maintained at less than 100 ppb to stabilize the cuprous oxide film on component surfaces or that it be maintained at greater than 2,000 ppb to stabilize the cupric oxide film. The staff also noted that operation at dissolved oxygen levels between these two limits is specifically warned against, since it results in alternate formation and breakdown of the two oxides, resulting in the loss of the protective film. The staff noted that the applicant does not state the limits on dissolved oxygen levels in the control room air conditioning system or in which of the two EPRI-recommended dissolved oxygen level regimes this system operates.

By letter dated December 3, 2009, the staff issued RAI B2.1.8-4 requesting that the applicant clarify the limits on dissolved oxygen levels in the control room air conditioning system and specify in which of the two EPRI-recommended dissolved oxygen level regimes this system operates. The staff also requested that if the limits on dissolved oxygen in the control room air conditioning system are not maintained within the levels that are recommended by EPRI TR-1007820, the applicant needs to provide further details on how inspection procedures under the applicant's WCP Program are used to verify that corrosion of copper alloy components does not occur. The staff also requested that the applicant include information on water sampling for the presence of dissolved and/or suspended copper indicative of copper alloy corrosion.

In its response dated January 21, 2010, the applicant stated that the dissolved oxygen level in the control room air conditioning system is not monitored. The applicant stated that the water chemistry parameters monitored for the system, in accordance with the Closed-Cycle Cooling Water System Program, include ATP, conductivity, copper, iron, pH, and suspended solids. The applicant stated that the acceptance criteria for these parameters are consistent with EPRI TR-1007820. The applicant stated that to verify that degradation of the copper alloy components is not occurring, the control room air conditioning system will be subject to inspection under the applicant's one-time inspections portion of its WCP Program as confirmation of the effectiveness of the Closed-Cycle Cooling Water System Program. The applicant also stated that this will include NDE techniques (e.g., visual and/or volumetric examinations) to detect the aging effects in the copper alloys in the system. The applicant further stated that this combination of routine monitoring for copper content in the control room air conditioning system cooling water and one-time inspection of the subject copper alloy components ensures that the system is not experiencing significant corrosion of copper alloy components.

Based on its review, the staff finds the applicant's response to RAI B2.1.8-4 acceptable because the water chemistry parameters monitored by its Closed-Cycle Cooling Water System Program and the one-time inspection performed under its WCP Program are capable of ensuring significant corrosion of copper alloy components in the control room air conditioning system is not occurring. The staff's concern described in RAI B2.1.8-4 is resolved.

Exception 2. LRA Section B2.1.8 states an exception to the "preventive actions" program element. The applicant stated that its program is implemented using EPRI TR-1007820, "Closed Cooling Water Chemistry Guideline," Revision 1 (2004), rather than the original revision of this report, EPRI TR-107396 (1997) as recommended by GALL AMP XI.M21. The applicant stated that the updated EPRI report provides for prescriptive guidance and has a more conservative monitoring approach. The applicant also stated that EPRI TR-1007820 meets the same requirements as EPRI TR-107396 with respect to maintaining corrosion and microbiological growth in closed cooling water systems for effectively mitigating many aging effects. The applicant further stated that the use of the updated edition of the EPRI report resulted in more restrictive chemistry action levels.

The staff noted that the "acceptance criteria" program element is also impacted by the chemistry action levels being more restrictive. By letter dated July 13, 2009, the staff issued RAI B2.1.8-1 requesting that this exception be revised to indicate that both the "preventive actions" and "acceptance criteria" program elements are impacted.

In its response dated August 17, 2009, the applicant stated that the "acceptance criteria" program element is also impacted by this exception. The applicant amended LRA Section B2.1.8, so that this exception states that the "acceptance criteria" program element is also impacted and that the implementation of EPRI TR-1007820 results in specific chemistry action levels that are more restrictive than those allowed in EPRI TR-107396.

Based on its review, the staff finds the applicant's response to RAI B2.1.8-1 acceptable because the LRA was amended to clearly and correctly identify the "acceptance criteria" program element being impacted by this exception. The staff's concern described in RAI B2.1.8-1 is resolved.

Based on its review, the staff finds this exception acceptable because the applicant has justified the use of the updated report, EPRI TR-1007820, as the basis for its Closed-Cycle Cooling Water System Program and has properly identified the program elements impacted by the use of this report.

Exception 3. LRA B2.1.8 states an exception to the "parameters monitored or inspected" program element. The applicant stated that differential pressure is not monitored as part of the thermal performance testing of the component cooling heat exchangers, as recommended by GALL AMP XI.M21. The applicant stated that periodic thermal performance and heat exchanger tube eddy current testing, and the frequent chemistry sampling of the closed-cycle cooling water systems, provide verification that the chemistry controls are preventing tube degradation that would affect differential pressure. The applicant further stated that monitoring shell-side inlet and outlet temperatures provide an indirect indication that heat exchanger differential pressure is not increasing.

Based on its review, the staff finds this exception acceptable because the alternative parameters monitored and inspected by the applicant provide satisfactory verification of heat exchanger performance.

Exception 4. LRA Section B2.1.8 states an exception to the "parameters monitored or inspected" program element. The applicant stated that thermal performance testing is not performed for the heat exchangers included in the component cooling water system cooling loop that are part of the EDG cooling water subsystem heat exchangers and lube oil coolers. The applicant stated that previous testing had shown that valid results cannot be obtained due to the configuration of the heat exchangers. The applicant also stated that corrosion inhibitors prevent gross degradation of the heat exchangers and frequent chemistry sampling provides verification that these chemistry controls are effective. The applicant further stated that the performance of the EDG cooling water subsystem is monitored during the periodic testing of the EDG, and this monitoring includes recording heat exchanger inlet and outlet temperature, engine water temperature, and cylinder temperatures. The applicant stated that these data provide adequate information to detect heat exchanger degradation. Finally, the applicant stated that the EDG cooling water subsystems are periodically drained and flushed, during which time the heat exchangers are visually inspected and the tubes cleaned. By letter dated July 13, 2009, the staff issued RAI B2.1.8-2 requesting that the applicant indicate the frequency for the periodic flushing and inspection and provide a basis for specifying this frequency. The staff also requested that the applicant provide information on OE to verify the effectiveness of its program.

In its response dated August 17, 2009, the applicant stated that only the EDG cooling water subsystem heat exchangers and lube oil coolers are periodically inspected and flushed, since the remaining heat exchangers in the component cooling system cooling loop that are part of other systems are in continuous operation. For these latter heat exchangers, system performance, including system flow rates and temperatures, is monitored. The applicant also stated that the EDG cooling water subsystem heat exchangers and lube oil coolers are drained and flushed every 18 months during refueling outages. The applicant further stated that the raw water side of the EDG heat exchangers is cleaned and inspected at that time, and eddy current inspection of the tubes is performed. The applicant further stated that no significant performance or material degradation in these components has been identified, and that their thermal performance is consistent with their required functions.

Based on its review, the staff finds the applicant's response to RAI B2.1.8-2 acceptable because the applicant provided the requested information, which describes an acceptable alternative to thermal performance testing of this portion of the component cooling water system and provides adequate assurance that potential component degradation in this portion of the component cooling water system is being adequately monitored. The staff's concern described in RAI B2.1.8-2 is resolved.

Based on its review, the staff finds this exception acceptable because the applicant has provided an acceptable alternative to thermal performance testing as a means of monitoring potential component degradation in this portion of the closed-cycle cooling water system.

Exception 5. LRA Section B2.1.8 states an exception to the "parameters monitored or inspected" program element. The applicant stated that air handling units and pumps in the control room air conditioning system are not performance tested as recommended in GALL AMP XI.M21. The applicant stated that the control room air conditioning system is in continuous operation and system performance is monitored and alarmed in the control room. The applicant also stated that the air handling units and pumps are cleaned on a 12-month frequency. The applicant further stated that visual inspections of piping, valves, heat exchangers, and other component internals under the WCP Program provide a representative sample of the material-environment combinations in the systems within the scope of the program.

Based on its review, the staff finds this exception acceptable because it provides assurance that potential component degradation in this portion of the component cooling water system is being adequately monitored.

Based on its audit and review of the applicant's responses to RAIs B2.1.8-1 and B2.1.8-2, the staff finds that elements one through six of the applicant's Closed-Cycle Cooling Water System Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL AMP XI.M21 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.8 summarizes OE related to the Closed-Cycle Cooling Water System Program. The staff reviewed this information and interviewed the applicant's technical personnel to confirm that the applicable aging effects and industry and plant-specific OE have been reviewed by the applicant. During the audit, the staff independently verified that the applicant had adequately incorporated and evaluated OE related to this program.

In the LRA, the applicant cited examples, dating back to 2003, of modifications to procedures and possible indications of corrosion in the component cooling water system and EDG cooling water subsystem. The applicant summarized the relevant circumstances and corrective actions taken for these events. The applicant stated that, for all of these occurrences, the Closed-Cycle Cooling Water Program had been effective in managing aging effects by monitoring chemistry control parameters and establishing limits for corrective actions.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.8 provides the USAR supplement for the Closed-Cycle Cooling Water System Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 40), by letter dated January 21, 2010, to implement nitrate monitoring for the component cooling system on a frequency consistent with the existing monitoring for ammonia.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Closed-Cycle Cooling Water System Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and their justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.6 Compressed Air Monitoring Program

Summary of Technical Information in the Application. LRA Section B2.1.9, as amended by the applicant's letter dated November 13, 2009, describes the existing Compressed Air Monitoring Program as consistent, with exceptions and an enhancement, with GALL AMP XI.M24, "Compressed Air Monitoring." The applicant stated that the program manages the aging effect of loss of material for the steel, stainless steel, and copper alloy components in the station and instrument air system and the air start subsystems for the EDGs. The program performs air quality sampling, visual inspections, and periodic testing to verify the adequacy of the air quality and to detect air leakage. The applicant also stated that the program addresses the requirements of GL 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment."

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M24. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M24, with the exception of the "scope of the program," "preventive actions," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

During its audit, the staff noted that the technical basis references of the applicant's program did not include NRC Information Notice (IN) 81-38, IN 87-28, IN 87-28 Supplement 1, or Institute of Nuclear Power Operations Significant Operating Experience Report (INPO SOER) 88-01. The staff also noted that the GALL Report recommends that GL 88-14 be augmented by the references that were not included in the applicant's program. In addition, the staff noted that IN 87-28 Supplement 1 transmitted to the applicant by NUREG-1275, Volume 2, "Operating Experience Feedback Report – Air Systems Problems," addresses the concerns related to instrument air system failures and recommendations for corrective actions, and INPO SOER 88-01 describes the recommendations for operations, training, maintenance, design, and analysis to prevent and mitigate instrument air system failures.

By letter dated July 13, 2009, the staff issued RAI B2.1.9-1 requesting that the applicant clarify whether or not IN 81-38; IN 87-28; IN 87-28 Supplement 1; NUREG-1275, Volume 2; and INPO SOER 88-01 documents are applicable as technical basis references for its program. For reference(s) not applicable, the applicant should justify why its approach without the reference is adequate for aging management.

In its response dated August 17, 2009, the applicant clarified that the aforementioned technical references are applicable to its program and an effort has been initiated to include the references in its program basis document as part of the next revision to the program.

Based on its review, the staff finds the applicant's response to RAI B2.1.9-1 acceptable because the applicant clarified that the technical references are applicable to the program and initiated actions to include the references in its program basis documents. The staff's concern described in RAI B2.1.9-1 is resolved.

The staff noted that the applicant's chemistry procedure for air quality control states an inspection frequency of one per year for pressure dew point, but the applicant's procedure did not specify any "Action Level" for hydrocarbon content or particulate size. In contrast, American National Standards Institute (ANSI)/ISA-7.0.01-1996, which is one of the applicant's technical references, recommends monitoring for pressure dew point each shift if a monitored alarm is not available. The staff also noted that the "Action Level" for the dew point was greater than or equal to 22 °F in the applicant's procedure. By letter dated July 13, 2009, the staff issued RAI B2.1.9-2 requesting that the applicant clarify why its inspection frequency for pressure dew point is not consistent with the recommendation of ANSI/ISA-7.0.01-1996, although the applicant claimed consistency with ANSI/ISA-7.0.01-1996. The staff also requested that the applicant clarify why no "Action Level" was specified for hydrocarbon content or particulate size in the chemistry procedure.

In its response dated August 17, 2009, the applicant clarified that the pressure dew point for the instrument air system is monitored and recorded each shift during plant operator rounds using the installed in-line dew point monitor. The applicant also clarified that a change has been initiated to add an action level specification for hydrocarbon and particulate content sample parameters in the chemistry procedure for compressed air quality control. The applicant also stated that the pressure dew point for the EDG air start subsystem is monitored annually. The applicant stated that the pressure dew point data have been within specification over the past several years and the air receivers have maintained a moisture-free condition. In its review of the RAI response, the staff noted that an air dryer is maintained in service on a continuous basis during compressor operation so as to remove moisture from the incoming compressed air, and the air receivers are checked daily for accumulation of condensation.

Based on its review, the staff finds the applicant's response to RAI B2.1.9-2 acceptable because: (1) the applicant's pressure dew point monitoring frequency for the instrument air system is consistent with the recommendation of ANSI/ISA-7.0.01-1996 and GALL AMP XI.M24; (2) a change has been initiated to add an action level specification to the hydrocarbon and particulate content sample parameters in the chemistry procedure for compressed air quality control, consistent with the recommendations of GALL AMP XI.M24; (3) an air dryer is in service during the compressor operation; and (4) the applicant's daily check for accumulation of condensation is adequate to manage adverse effects of moisture on the EDG air start subsystem. The staff also finds that the applicant's OE demonstrates that the pressure dew point of the air start subsystem is adequately maintained within specification, and the EDG air start subsystem has minimal demand flow, except when an EDG start signal is generated. The staff's concern described in RAI B2.1.9-2 is resolved.

In its review, the staff noted that the "parameters monitored or inspected" program element of GALL AMP XI.M24 recommends that ISI and testing be performed to confirm that maintenance practices, emergency procedures, and training are adequate to ensure that the intended function of the air system is maintained. The staff noted that in conjunction with GL 88-14, NUREG-1275, Volume 2 (Part I, Section 9.0) recommends that anticipated transient and system recovery procedures and related training for loss of air system events should be reviewed for adequacy and revised as necessary. NUREG-1275, Volume 2 recommends that plant personnel should be trained in the anticipated transient and system recovery procedures to respond to loss of air system events. The staff needed clarification as to whether the aforementioned recommendations for the emergency procedures and training are adequately implemented in the applicant's program. By letter dated July 13, 2009, the staff issued RAI B2.1.9-3 requesting that the applicant provide relevant references for the emergency procedures, training, and training schedules.

In its response dated August 17, 2009, the applicant confirmed that an abnormal operating procedure is implemented to manage and recover from events that result in decreasing instrument air pressure, and licensed operators are required to be trained on loss of instrument air events in accordance with the applicant's training program for the licensed operator requalification training program.

Based on its review, the staff finds the applicant's response to RAI B2.1.9-3 acceptable because the applicant's program implements an emergency procedure for loss of instrument air and training of licensed plant operators for loss of instrument air events consistent with GALL AMP XI.M24. The staff's concern described in RAI B2.1.9-3 is resolved.

In its review, the staff noted that the "acceptance criteria" program element of GALL AMP XI.M24 recommends that acceptance criteria be established for the system and for individual components that contain specific limits or acceptance ranges, based on design-basis conditions and/or component vendor specifications. The staff also found that the applicant's program documents did not clearly indicate that acceptance criteria were established for some parameters. Therefore, by letter dated July 13, 2009, the staff issued RAI B2.1.9-5 requesting that the applicant clarify whether relevant acceptance criteria are established and documented for the parameters described in the RAI. The staff requested that if any of the parameters do not have an acceptance criterion, then the applicant should justify why lack of the acceptance criterion for the parameter is acceptable for the aging management or describe the actions for the applicant to take in relation to the acceptance criterion. The parameters addressed in RAI B2.1.9-5 are: (1) the compressor load and unload times, (2) the inlet and outlet coolant temperatures of the compressor intercoolers and aftercoolers, (3) the set pressures of compressors' and receivers' pressure-relief valves, (4) the differential pressure through the dryers, and (5) the minimum operational time for each special service air accumulator and its associated check valves upon loss of the main air system.

In its response dated August 17, 2009, the applicant provided the response regarding the load and unload times for the compressors. The applicant clarified that periodic leakage testing is performed on the EDG air start subsystem, although it is not possible to monitor load and unload times of the air start subsystem compressors by design, and that the compressors are designed to automatically cycle based on the air start tank pressure. The staff found that the conduct of periodic leakage testing on the compressors is consistent with the GALL Report and, therefore, acceptable to manage the aging effects. The staff also found that the applicant confirmed that the program monitors the unload times of the inservice compressors in the station and instrument air system each shift in accordance with approved procedures; therefore, the staff finds that the monitoring of the unload times is adequate to detect and manage the degradation of the system due to aging effects.

However, the staff noted that the applicant did not provide technical information on the load time of the compressors in its response. By letter dated November 20, 2009, the staff issued RAI B2.1.9-6 requesting that the applicant clarify whether the program enhancement regarding the implementation of ASME OM-S/G-1998, Part 17 includes the acceptance criteria for the load time of the station and instrument air system compressors.

In its response dated December 28, 2009, the applicant stated that the establishment of specific acceptance criteria for load and unload time is not practical for the station and instrument air system compressors since the load and unload times vary based on the varying system air demand. The applicant also stated that as stated in the response to RAI B2.1.9-5, the unload times for the inservice compressors in the station and instrument air system are monitored each shift in accordance with approved procedure. The applicant further stated that the system engineer performs monitoring and trending of the system in accordance with the established system monitoring plan and, as part of the system monitoring plan, the system engineer records the load and unload times during compressor walkdowns performed at least once a month. The applicant stated that the system engineer uses the load and unload times, in conjunction with other system parameters, to monitor the system performance and to evaluate long term issues.

Based on its review, the staff finds the applicant's responses to RAIs B2.1.9-5 and B2.1.9-6 regarding the compressor load and unload times acceptable because: (1) the unload times of the inservice compressors in the station and instrument air system are monitored each shift in accordance with approved procedures; (2) the unload and load times of the station and instrument air system compressors are recorded according to the system monitoring plan, and analyzed to monitor the system performance and to evaluate long term issues; (3) the system engineer also performs the monitoring and trending of the station and air system in accordance with the established system monitoring plan; and (4) periodic leakage testing is performed on the EDG air start subsystem, although it is not possible to monitor load and unload times of the air start subsystem compressors by design, and the compressors are designed to automatically cycle based on the air start tank pressure. Therefore, the staff's concerns regarding the compressor load and unload times described in RAIs B2.1.9-5 and B2.1.9-6 are resolved.

In its response dated August 17, 2009, the applicant also provided the technical information regarding the inlet and outlet temperatures of the coolant in the compressor coolers. In its review, the staff noted that compressors F and G in the station and instrument air system, which are the normally-operating compressors, and the EDG air start subsystem compressors are air cooled. Therefore, the staff finds that the monitoring of coolant temperatures is not applicable to the air cooled compressors as addressed in the applicant's response to RAI B2.1.9-5. The staff also finds that the applicant's monitoring of the coolant temperatures of compressors A, B, and C during the routine testing is acceptable to ensure that the components are operating adequately on the basis that the compressors are not normally in operation, but are maintained and tested on a routine basis.

Based on its review, the staff finds the applicant's response to RAI B2.1.9-5 regarding the coolant temperatures acceptable because the AMP monitors the coolant temperatures in accordance with approved test procedures and the monitoring of the coolant temperatures can ensure that the components are operating adequately. The staff's concern regarding coolant inlet and outlet temperatures of the compressors described in RAI B2.1.9-5 is resolved.

In its response dated August 17, 2009, the applicant also provided the technical information regarding the set pressures of compressors' and receivers' pressure-relief valves. In its review of the response, the staff found that the set pressures for these compressed air system relief valves are routinely monitored, and that bench testing is performed to document the as-found set pressures. The staff also found that the applicant confirmed that if the acceptance criteria are not met, the relief valves are either adjusted or replaced.

Based on its review, the staff finds that the applicant's response to RAI B2.1.9-5 regarding the set pressures is acceptable because the monitoring and bench testing of the set pressures can ensure that the set pressure values are within the acceptance criteria through relevant corrective actions that are performed, as required. The staff's concern regarding the set pressures of compressors' and receivers' pressure-relief valves described in RAI B2.1.9-5 is resolved.

In its response dated August 17, 2009, the applicant also addressed its response to the concern described in RAI B2.1.9-5 regarding the differential pressure through the dryers. In its review of the RAI response, the staff noted that the differential pressure through the dryers is continuously monitored for the station and instrument air system, and the dryers are automatically bypassed in the event of high differential pressure across the dryer. The staff also noted that the applicant clarified that the setpoint at which dryer bypass occurs is established by approved procedures for the station and instrument air system. In an email exchange provided by the applicant (ADAMS Accession No. ML102700431), the applicant also indicated that a high differential pressure for the on-line drier is annunciated in the control room, procedures direct the applicant's staff to place a backup drier on line, and the expected time to have a backup drier in service is approximately 45 minutes. The staff finds that the applicant's procedure, including the establishment of the pressure setpoints to bypass the dryers, control room annunciation of the alarm, and actions directing the operators to place a backup drier on line, is adequate to manage the aging effects because the length of time the drier is bypassed due to high differential pressure is short and will not impact the overall quality of instrument air.

The staff also noted that although the differential pressure through the dryers of the EDG air start subsystem is not monitored (due to the intermittent operation of its compressors), the dryers are cleaned on an annual basis in accordance with approved procedures. Based on its review, the staff finds the applicant's response to RAI B2.1.9-5 regarding the differential pressure through the dryers acceptable because: (1) the setpoint at which dryer bypass occurs is established by approved procedures for the station and instrument air system with prompt placement of a backup dryer in service in the case of dryer bypass, (2) the compressors of the EDG air start subsystem operate intermittently, and (3) periodic cleaning and maintenance activities are performed for the dryers in accordance with approved procedures. The staff's concern regarding the differential pressure through the dryers described in RAI B2.1.9-5 is resolved.

In its response dated August 17, 2009, the applicant stated that the minimum operational time for each special service air accumulator and its associated check valves is a design consideration for the station and instrument air system and is not related to plant aging. However, the staff noted that the minimum operational time for each special air accumulator and its associated check valves, upon loss of the main air system, is part of the baseline data against which the periodic leak-rate test results are compared, in order to identify adverse trends or system and component degradation due to aging effects, as delineated in ASME OM-S/G-1998, Part 17, Section 5.3 and in the "monitoring and trending" program element of GALL AMP XI.M24. In addition, the staff noted that LRA Section B2.1.9 states that the Compressed Air Monitoring Program will be enhanced to incorporate the compressed air system testing and maintenance recommendations from ASME OM-S/G-1998, Part 17.

In LRA Section B2.1.9, the applicant also stated that ASME OM-S/G-1998, Part 17, Section 5.3, "Inservice Performance Tests," identifies periodic testing that should be performed for instrument air systems. In its review, the staff noted that ASME OM-S/G-1998, Part 17, Section 5.3 recommends leak tests of special service air accumulators and their associated check valves using pressure decay tests every refueling outage. The staff also noted that the concern regarding the minimum operational time for the air accumulators and their associated check valves is closely related to the conduct of leak tests.

Therefore, by letter dated November 20, 2009, the staff issued RAI B2.1.9-7 requesting that the applicant clarify its aging management methodology in terms of the leak tests of special service air accumulators and their associated check valves. RAI B2.1.9-7 is also described in the safety evaluation of Exception 1 because the safety evaluation is related to the concern regarding lack of the leak tests. In the RAI, the staff requested that the applicant clarify whether the applicant's program includes the leak tests for the special service accumulators and their associated check valves and whether the program compares the periodic leak test data with the minimum operational time for the accumulators and their associated check valves upon loss of the main air system. The staff also noted that lack of the leak tests and leak test data analysis affects the "scope of the program," "preventive actions," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements.

In its response dated December 28, 2009, the applicant stated that the safety-related special service air accumulators and their associated check valves are leak tested each refueling outage consistent with the requirements of ASME OM-S/G-1998, Part 17, to meet design-basis requirements. The applicant further stated that this testing is not included in or credited by the Compressed Air Monitoring Program, since the testing is not required in order to adequately manage the effects of aging for the service and instrument air system components within the scope of license renewal; furthermore, the AMR for the special service air accumulators and their associated check valves, as stated in LRA Table 3.3.2-8, concluded that there are no AERMs for these accumulators and check valves due to exposure to the dried compressed air environment. The applicant also stated that the AMR results are consistent with the GALL Report, Volume 2, Section VII, items VII.J-3, VII.J-18, and VII.J-22, which indicate that piping, piping components, and piping elements fabricated from copper alloys, stainless steel, or steel materials are not subject to aging effects in a dried air environment.

Based on its review, the staff finds the applicant's responses to RAIs B2.1.9-5 and B2.1.9-7 acceptable because: (1) the applicant stated that the environment for the components is dried air; (2) no aging effect is applicable to the components exposed to the dried air environment consistent with GALL Report items VII.J-3, VII.J-18, and VII.J-22; and (3) the monitoring and trending of the leak test results against the minimum operational time is not required for the aging management of the components. The staff's concern regarding the minimum operational time described in RAIs B2.1.9-5 and B2.1.9-7 is resolved.

Exception 1. LRA Section B2.1.9 states an exception to the "detection of aging effects" program element. The applicant stated that leak testing is not performed for the station and instrument air system distribution network as recommended in GALL AMP XI.M24. Instead, LRA Section B2.1.9 states Enhancement 1 to the same program element incorporates the compressed air system testing and maintenance recommendations from ASME OM-S/G-1998, Part 17 and EPRI TR-108147 and identifies these documents as part of the program basis. In contrast with this program exception, ASME OM-S/G-1998, Part 17 and EPRI TR-108147 recommend leak tests such as:

(1) pressure decay test on the distribution network as one of recommended tests for the case that compressor loading indicates an increase in system leakage (ASME OM-S/G-1998, Part 17, Section 5.3.3; EPRI TR-108147, Section 8.9.2)

(2) air leak test with a soap solution to piping joints and connections (EPRI TR-108147, Section 8.9.2)

In its review, the staff noted that the exception is directly related to Enhancement 1 and that a conflict exists between Exception 1 and Enhancement 1 in terms of the conduct of leak tests. By letter dated July 13, 2009, the staff issued RAI B2.1.9-4 requesting that the applicant clarify how its program can identify the locations of air leakage without leak testing for the distribution network, and clarify whether leak tests for the distribution network will be performed as the technical basis references recommend and to which the applicant committed in the program enhancement.

In its response dated August 17, 2009, the applicant stated that system walkdowns have been proven effective in identifying and locating air distribution system leakage, and that leak testing is used as a diagnostic tool when needed. The applicant further stated that although both ASME OM-S/G-1998, Part 17 and EPRI TR-108147 address leak testing, both documents advocate leak testing as part of a troubleshooting process when leakage is suspected and not as a periodic preventive maintenance activity, and that there is a technical difference between GALL AMP XI.M24 and the two industry documents. The applicant also stated that the exception regarding the leak testing does not imply that leak testing would not be performed when there are indications of leakage in the station and instrument air system, and the source of the leakage is not readily apparent. The applicant stated that this type of "as-needed" rather than "preventive" leak testing would be performed, when required, per ASME OM-S/G-1998, Part 17 and EPRI TR-108147.

In its review, the staff noted that Section 5.3.1(b)(1) and Table 1 of ASME OM-S/G-1998, Part 17 require that special service air accumulators and their associated check valves should be leak tested. Therefore, by letter dated November 20, 2009, the staff issued RAI B2.1.9-7 requesting that the applicant clarify whether the applicant's program includes leak tests for the special service air accumulators and their associated check valves, and whether the program compares periodic leak test data with the minimum operational time for the accumulators and their associated check valves upon loss of the main air system. This RAI and the applicant's response to the RAI are also described above as part of the safety evaluation regarding the acceptance criteria for the minimum operational time of the special service air accumulators and their associated check valves.

In its response dated December 28, 2009, the applicant stated that it performs leak tests on the safety-related special service air accumulators and their associated check valves to meet design-basis requirements, but not to manage the aging effects because no aging effects are applicable to the special service air accumulators and their associated check valves in the dried air condition as stated in LRA Table 3.3.2-8.

Based on its review, the staff finds the applicant's responses to RAIs B2.1.9-4 and B2.1.9-7 and this exception acceptable because: (1) the applicant's system walkdowns have been proven effective in identifying and locating air distribution system leakage; (2) when there are indications of leakage in the station and instrument air system and the source of the leakage is not readily apparent, leak testing would be performed, as needed, consistent with ASME OM-S/G-1998, Part 17 and EPRI TR-108147; and (3) the special service air accumulators and their associated check valves are exposed to dried air such that no aging effects are applicable to the components, although the applicant performs the leak tests of the accumulators and check vales to meet design-basis requirements. The staff's concerns described in RAIs B2.1.9-4 and B2.1.9-7 are resolved.

Exception 2. LRA Section B2.1.9 states an exception to the "scope of the program" program element, as amended by letter dated November 13, 2009. The applicant stated that the station and instrument air system and the EDG air start subsystems are not sampled at various locations as recommended by the "scope of the program" program element of GALL AMP XI.M24. The applicant also stated that the sample point for the station and instrument air system is downstream of the system dryer tower, and that the sample points for the EDG air start subsystems are downstream of the dryer for each subsystem.

The staff noted that the applicant's justification for the exception is that since the systems are normally pressurized, the only source for contaminants or moisture into the system would be via the respective compressors and, therefore, measuring the quality of the air as it enters the system provides an accurate representation of the quality of the air in the system.

In its review, the staff noted that the applicant correctly described the exception as the air quality sampling points in the applicant's program are downstream of the system dryer tower or downstream of the dryer, in contrast to the recommendation of the GALL Report that air quality be checked at various locations in the system. In comparison, the staff also noted that EPRI NP-7079, which is one of the technical references of GALL AMP XI.M24, states that the system should be sampled on the downstream side of the dryer as close to the outlet of the air filter as possible, and that this provides assurance of the quality of the air supplied to the system. The EPRI report also states that moisture content should be continuously monitored by the use of a permanent dew cell or moisture indicator installed on the downstream side of the dryer, and that this can be extremely useful in early detection of instrument air system problems.

Based on its review, the staff finds the applicant's exception acceptable because: (1) the locations of the air quality sampling in the applicant's program are consistent with the recommendation of EPRI NP-7079, which can assure the quality of the air supplied to the system; (2) the applicant's approach, which is consistent with one of the technical references of GALL AMP XI.M24, provides the assurance of the quality of the air supplied to the system and a reasonable representation of the quality of the air in the system based on the fact that the system is normally pressurized; and (3) in addition to the air quality control, the applicant performs inspections and testing as part of the AMP in order to ensure the integrity of the components and system.

Exception 3. LRA Section B2.1.9 states an exception to the "monitoring and trending" program element, as amended by letter dated November 13, 2009. The applicant stated that the sample data for the station and instrument air system and the EDG air start subsystems are not trended as recommended by GALL AMP XI.M24. In its justification, the applicant also stated that the sample data are related to air quality control parameters.

In its review, the staff noted that the applicant's justification is that specific chemistry parameter limits have been established for the station and instrument air system and the EDG air start subsystems in accordance with ANSI/ISA-7.0.01-1996. In addition, the measured chemistry parameters are compared to specific limits and an action is taken to restore the parameter within specification if an out-of-specification condition is identified. The staff also noted that the applicant stated that maintaining the compressed air system air quality in accordance with ANSI/ISA-7.0.01-1996 provides sufficient margins to ensure continued system functions, and that data trending of the [air quality] control parameter results would not provide information useful for aging management. In the applicant's letter, the applicant further clarified that chemistry procedures require that out-of-specification conditions are also documented in the corrective action program.

Based on its review, the staff finds the applicant's exception acceptable because: (1) the applicant takes adequate actions to restore the air quality parameters to the specific limits when parameters are identified as out-of-specification, and (2) the corrective actions can continue to control the air quality in accordance with ANSI/ISA-7.0.01-1996 and provide assurance of acceptable air quality control.

Enhancement. LRA Section B2.1.9 states an enhancement to incorporate the compressed air system testing and maintenance recommendations from ASME OM-S/G-1998, Part 17 and EPRI TR-108147, and to identify these documents as part of the program basis. The applicant also stated that the implementation of the enhanced testing and maintenance practices will ensure that the compressed air systems can perform their intended function.

Based on its review, the staff finds the applicant's enhancement acceptable because the enhancement is consistent with the recommendation of GALL AMP XI.M24.

Based on its audit and review of the applicant's responses to RAIs B2.1.9-1, B2.1.9-2, B2.1.9-3, B2.1.9-4, B2.1.9-5, B2.1.9-6, and B2.1.9-7, the staff finds that elements one through six of the applicant's Compressed Air Monitoring Program, with acceptable exceptions and an enhancement, are consistent with the corresponding program elements of GALL AMP XI.M24 and are, therefore, acceptable.

Operating Experience. The staff reviewed the OE described in LRA Section B2.1.9. In the LRA, the applicant stated that in July 2005, a station and instrument air system air compressor was started and tripped on "HP Air Outlet Temp High Trip." The applicant stated that the cause of the elevated temperature was determined to be a leaking "equalizing" line on the high pressure element, which involved a sufficient volume of leakage to cause elevated temperatures. The applicant also stated that the high pressure element was replaced as a unit. The staff found that the applicant took corrective action, identified the air leakage in the equalizing line as the root cause of the elevated temperatures, and replaced the high pressure element to manage the aging effect.

The applicant stated that in January 2007, during a plant tour, the intercooler pressure for one air compressor was outside the acceptance band, and the applicant cleaned the compressor intercooler to restore compressor performance. In the OE review, the staff found that the applicant responded to the situation with corrective action that restored system performance.

During its audit and review, the staff reviewed the onsite documents as well as the LRA. The staff also interviewed the applicant's technical staff. The staff confirmed that the plant-specific OE did not reveal any degradation not bounded by industry experience in relation to the Compressed Air Monitoring Program.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.9 provides the USAR supplement for the Compressed Air Monitoring Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.3-2.

The staff also notes that the applicant committed (Commitment No. 5) to enhance the Compressed Air Monitoring Program prior to entering the period of extended operation. Specifically, the applicant committed to incorporate the compressed air system testing and maintenance recommendations from ASME OM-S/G-1998, Part 17 and EPRI TR-108147, and to identify these documents as part of the program basis.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Compressed Air Monitoring Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and their justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancement and confirmed that its implementation through Commitment No. 5, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.7 External Surfaces Monitoring Program

Summary of Technical Information in the Application. LRA Section B2.1.10 describes the existing External Surfaces Monitoring Program as consistent, with enhancements, with GALL AMP XI.M36, "External Surfaces Monitoring." The applicant stated that through this program, during walkdowns, it visually inspects and monitors the external surfaces of piping, its components and supports, ducting, structural members and other components, materials, and commodities for loss of material and changes in material properties, including cracking, delamination, hardening, and loss of strength. The applicant stated that monitored materials and commodities include carbon steel, stainless steel, aluminum, copper and its alloys, and selected elastomers. The applicant also stated that this program provides support to the Bolting Integrity and Boric Acid Corrosion programs. The applicant further stated that the program takes an areas approach, where representative samples of materials in SSCs and in selected environments are monitored.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M36. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M36, with the exception of the "scope of the program" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The “program description” and “scope of the program” program elements of GALL AMP XI.M36 recommend the use of periodic visual inspections during walkdowns, to monitor and inspect external surfaces of steel components, such as piping, piping components, and ducting, for loss of material, leakage, discoloration, and coating degradations. In the LRA program description, the applicant included, in addition to monitoring steel components, visual monitoring of aluminum, copper alloys, stainless steel components, and selected elastomers. By letter dated July 13, 2009, the staff issued RAI B2.1.10-1 requesting that the applicant: (1) justify why the inclusion of other than carbon-steel based metal commodities and elastomers to the “scope of the program” program element does not constitute an exception, (2) provide details of how the inspecting personnel visually recognize corrosion in stainless steel and aluminum components during walkdowns, and (3) clarify how the aging effects of elastomers are identified, since visual observations are normally inadequate to identify aging of elastomer properties, such as hardness and flexibility.

In its response dated August 17, 2009, the applicant agreed with the staff for part one of the RAI, that the included metal commodities constitute an exception to GALL AMP XI.M36. The applicant responded to parts two and three of the RAI by providing details of how it will conduct visual inspections of the added metals during the walkdowns and assess the integrity of the selected elastomers. Since the applicant considered this an exception to the GALL Report, it is discussed below. The staff's evaluation of this exception concluded that the exception was acceptable, as stated below. The staff's concern described in RAI B2.1.10-1 is resolved.

The “program description,” “scope of the program,” “preventive actions,” “detection of aging effects,” and “monitoring and trending” program elements of GALL AMP XI.M36 articulate this program to be a visual inspection program. In the LRA “program description” program element, the applicant stated that this program will identify changes in material properties of piping, supports, structural members, and structural commodities, whether they are constructed of the included metals or elastomers. The applicant further stated that its External Surfaces Monitoring Program, after enhancements, is consistent with that of the GALL Report. By letter dated July 13, 2009, the staff, concerned with the inability of the applicant to visually identify changes in material properties during walkdowns, issued RAI B2.1.10-2 requesting that the applicant identify how it can visually detect changes in material properties, as these may require inspection techniques other than visual.

In its response dated August 17, 2009, the applicant referenced the portion of its response to RAI B2.1.10-1 regarding compliance to the recommendations of GALL AMP XI.M36 on elastomers. The applicant stated that this AMP manages aging effects related to changes in material properties for the flexible connections in the ventilation system ducting and the shield building penetration seals, by employing the “scratch, sniff, and stretch” technique as described in the EPRI “Aging Assessment Field Guide.” The staff reviewed the concept of “scratch, sniff, and stretch” and concluded that it is an acceptable technique promoting close physical inspection and manipulation of elastomers beyond the visual inspection recommended by the GALL Report. The staff reasoned that such close physical manipulation of elastomers is bound to reveal material degradation and changes in properties due to various aging mechanisms, be they physical, chemical, thermal, or weather related. The staff, therefore, accepts the applicant's approach in managing aging of elastomers because the EPRI approach and technique constitutes an acceptable industry practice. The staff's concern described in RAI B2.1.10-2 is resolved.

SRP-LR Section A.1.2.3.4, "detection of aging effects" program element, states that sampling is allowed for the inspection of a group of SCs, but that a rationale must be established for selection of the population and sampling size. The SRP-LR also states that samples should be biased toward locations most susceptible to the specific aging effect of concern during the period of extended operation, with provisions established to expand the size when degradation is detected in the initial sample. In LRA Section B.2.1.10, External Surfaces Monitoring Program "program description," the applicant stated that it takes an "areas approach" to monitoring the condition of plant equipment for loss of material. The applicant also stated that the plant is divided into areas that contain the equipment or structural commodities being evaluated, and that the inspectors look at a representative sample of the material and environment combinations in that area. The staff noted that the applicant did not include the basis for how it determines the population and size of the sampling of components inspected by the External Surfaces Monitoring Program. By letter dated July 13, 2009, the staff issued RAI B2.1.10-3 requesting that the applicant provide its sampling basis.

In its response dated August 17, 2009, the applicant stated that the phrase "representative sample" was used incorrectly in the "program description" of the LRA. The applicant also stated that its External Surfaces Monitoring Program is consistent with GALL AMP XI.M36, and that personnel performing the inspections inspect material and environment combinations in a designated area, looking for indications of aging, such as loss of material, loss of sealing, or leakage of components in that area. The applicant further stated that the inspections ensure that a sufficient number of commodities are examined such that an overall assessment of component aging can be determined. The staff also noted that the LRA states that system engineers perform comprehensive visual inspections at least once per refueling cycle, which is consistent with the recommendations in GALL AMP XI.M36.

Based on its review, the staff finds the applicant's response acceptable because: (1) the applicant's program is based on a combination of periodic system inspections and walkdowns conducted by operations, health physics, and engineering personnel; (2) the inspections and walkdowns in an area are based on material and environment combinations, looking for loss of material, loss of sealing, or leakage; and (3) comprehensive visual inspections are performed at least once per refueling cycle. The staff finds that this approach is consistent with GALL AMP XI.M36. The staff's concern described in RAI B2.1.10-3 is resolved.

The staff also reviewed the portions of the "scope of the program," "monitoring and trending," and "detection of aging effects" program elements associated with exceptions and enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions and enhancements follows.

Exception. In its response to RAI B2.1.10-1, the applicant recognized an exception to the program because its program includes aluminum, copper alloys, stainless steel, and selected elastomers. The applicant revised the LRA and took an exception to the "scope of the program" and "detection of aging effects" program elements. In the exception, the applicant stated that the program has been extended beyond the GALL Report's restriction to manage aging effects of just steel, to also manage the aging effects of stainless steel, aluminum, copper, and elastomers. The applicant further stated that the personnel performing inspections visually monitor external surface irregularities and localized discolorations for the included metal commodities. The inspectors also look for other relevant indicators, such as boric acid buildup, poor material conditions, coating degradations, accumulation of dirt and debris, and evidence of leakage. For aging management of elastomers, the inspectors use EPRI-developed techniques that include physical manipulation of elastomers and are identified as "scratch, sniff, and stretch."

The staff reviewed the applicant's revisions to the LRA and justification for the exception as presented in its response to RAI B2.1.10-1. The staff determined the exception to be acceptable because the applicant will use: (1) relevant indicators for timely identification of corrosion, and (2) the WCP Program to supplement the External Surfaces Monitoring Program to supplement aging management of SCs in environments and materials and commodities combinations. In addition the staff noted: (1) that aluminum, copper alloys, and stainless steel in an indoor-uncontrolled air environment do not exhibit aging effects (see Technical Bases for Revision to the License Renewal Guidance Documents, NUREG-1833); and (2) the location of the plant is in a colder climate which inhibits aggressive corrosion rates. The staff also finds the exception to use "scratch, sniff, and stretch" detection techniques, to assess the integrity of elastomers, acceptable because the technique includes physical manipulation and is recognized by EPRI and the industry.

Enhancement 1. LRA Section B2.1.10 states an enhancement to the "scope of the program" and "parameters monitored or inspected" program elements in that the applicant will enhance the External Surfaces Monitoring Program with inspections of infrequently accessed plant areas. The applicant stated that it will enhance and augment the "scope of the program" and "parameters monitored or inspected" program elements by having operators, engineers, and health physicists inspect the external surfaces of infrequently inspected commodities in SSCs, in accordance with GALL AMP XI.M36 recommendations. The staff finds this enhancement acceptable because: (1) it provides an increased surveillance of inaccessible plant areas' relevant commodities, (2) it is accompanied by a commitment (see Commitment No. 6, Table A6.0-1), and (3) it reinforces the "scope of the program" program element, supporting it with the "parameters monitored or inspected" program element, thus rendering it consistent with the GALL Report AMP recommendations.

Enhancement 2. LRA Section B2.1.10 also states an enhancement to the "monitoring and trending" program element. The applicant stated that it will enhance the External Surfaces Monitoring Program by providing training of the operations, engineering, and health physics plant personnel to better perform the program inspections and walkdowns. The applicant also stated that the enhancement will satisfy the need to document the identified material states or conditions with sufficient detail to support predictability of the extent of degradations, and provide background for timely corrective actions in accordance with the recommendation of GALL AMP XI.M36. The applicant's intent to adequately monitor material conditions was reinforced by its responses to RAIs B2.1.10-1 and B2.1.10-2. In the case of elastomers, during inspection, the applicant intends to physically manipulate the materials to ensure that they continue to maintain their functionality, assuring the operability of SSCs. For metallic materials other than (carbon) steel included in the scope of the program (i.e., stainless steel, copper, aluminum), the applicant plans to educate the inspectors to look for specific clues identifying corrosion and to pursue a comprehensive visual examination of these commodities (see also the staff's disposition of the RAIs, above). Following the additional input from the applicant, the staff finds this enhancement acceptable to reinforce the "monitoring and trending" program element, rendering it consistent with the GALL Report AMP recommendations.

Based on its audit and review of the applicant's responses to RAIs B.2.1.10-1, B.2.1.10-2, and B.2.1.10-3, the staff finds that elements one through six of the applicant's External Surfaces Monitoring Program, with acceptable exception and enhancements, are consistent with the program elements of GALL AMP XI.M36 and are, therefore, acceptable.

Operating Experience. LRA Section B.2.1.10 summarizes OE related to the External Surfaces Monitoring Program. Under OE, the applicant stated the External Surfaces Monitoring Program to be "...effective in identifying change in material properties, cracking, delamination, loss of material, and hardening and loss of strength, evaluating the degradation, and implementing corrective actions." The applicant further stated that when degradation was "...identified, corrective actions have been implemented to ensure that the intended functions of the affected SSCs are maintained." The staff also interviewed the applicant's technical personnel to confirm that the plant-specific OE did not reveal any aging effects not bounded by the GALL Report and confirmed that applicable aging effects and industry and plant-specific OE have been reviewed by the applicant. The staff also confirmed that the applicant has addressed the plant's OE identified after the issuance of the GALL Report.

The staff reviewed the OE information in the application during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Specifically, the staff, through an independent search of the applicant's condition report database and through an in-person interview of its onsite personnel, concluded that the applicant maintains a high awareness in visually identifying the presence of rust and corrosion in carbon steel SSCs. The staff extended the search to see if the applicant was capable of visually identifying corrosion for all metallic materials and elastomer degradations. The database search included both current and historical records. The staff was satisfied with the applicant's rust and corrosion tracking of carbon steel and copper material commodities. For example, in December of 2001, the applicant's inspection personnel found a leak at the shaft of a mixing pump. The plant assessed the situation, confirmed that the pump functionality in mixing and transferring contents remained, and advised timely repairs. After completion of the repairs, the pump was back at its design configuration. The staff, however, expressed concerns in the applicant's ability to visually monitor stainless steel and aluminum rust and loss of performance of elastomers; these concerns were evaluated and resolved in the subsection for Exception 1, as noted above.

The staff confirmed that the applicant repairs or replaces SSCs and commodities before they lose their capacity to perform their intended functions. Some work orders were completed well before loss of functionality with decisions based on cost/benefit analyses. If, however, a function of an SSC or commodity was lost, then the applicant took a contingency action. For example, in January 2002, the staff confirmed that the applicant's operations personnel identified a non-functional penetration seal located in the wall separating the two component cooling pumps. Since the penetration seal affected a fire barrier, the applicant took an immediate contingency action to establish a fire watch within one hour of this identification. Subsequently, the penetration seal was repaired and returned to its design configuration.

However, subsequent to the audit, the staff noted a number of recent industry events involving radioactive fluid leakage from buried and underground piping and tanks. In light of this recent industry OE, the staff is concerned about the continued susceptibility to failure of buried and/or underground piping that are within the scope of 10 CFR 54.4 and subject to aging management for license renewal. In reviewing the applicant's External Surfaces Monitoring and Buried Piping and Tanks Inspection programs, along with the applicable AMR items associated with them, the staff is not clear whether: (1) the components addressed by these AMPs clearly include both buried and underground piping (piping which is below grade and contained in a vault or other structure where it is exposed to air and where access is limited) and (2) these programs are being updated to incorporate lessons learned from these recent events as well as any OE from the applicant's own history.

In a letter dated May 27, 2010, the staff issued RAI B2.1.7-3 requesting that the applicant address these issues. The staff identified this as **Open Item 3.0.3.2.4-1.** The staff's evaluation and closure of RAI B2.1.7-3 and Open Item 3.0.3.2.4-1 is documented in LRA Section 3.0.3.2.4.

USAR Supplement. LRA Section A2.1.10 provides the USAR supplement for the External Surfaces Monitoring Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment Nos. 6 and 7) to enhance the program prior to entering the period of extended operation. Specifically, the applicant committed to: (1) inspect the accessible external surfaces of in-scope components, piping, supports, structural members, and structural commodities, in the infrequently accessed areas, consistent with the criteria used in other plant areas; and (2) provide training for operations, engineering, and health physics personnel performing the program inspections and walkdowns that will address the requirements of the External Surfaces Monitoring Program for license renewal, including the need to document the identified conditions with sufficient detail to support monitoring and trending the aging effects, and the aging effects monitored by the program and how to identify them.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's External Surfaces Monitoring Program, the staff determines those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determined that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff also reviewed the enhancements and confirmed that their implementation through Commitment Nos. 6 and 7, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared.

The staff reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

The staff concludes that the applicant 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).

3.0.3.2.8 Fire Protection Program

Summary of Technical Information in the Application. LRA Section B2.1.11 describes the existing Fire Protection Program as consistent, with an exception and enhancements, with GALL AMPs XI.M26, "Fire Protection," and XI.M27, "Fire Water System." The applicant stated that its Fire Protection Program manages the aging effects of change in material properties, cracking, delamination, increased hardness, loss of material, loss of sealing, loss of strength, shrinkage, and spalling for the fire protection components and features. The applicant also stated that its Fire Protection Program performs: (1) chemical treatment and periodic flushing of the water-based fire suppression system; (2) periodic inspection and testing of the water-based, carbon dioxide (CO_2), and Halon fire suppression systems; and (3) visual inspections of fire barriers, fire barrier penetrations and seals, fire barrier expansion joints, doors, fire wraps, and the RCP oil collection system to detect degradation.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M26. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M26. The staff noted that GALL AMP XI.M26 recommends that the diesel-driven fire pump be periodically tested to ensure the fuel supply line can perform its intended function. The staff also noted that the applicant does not have a diesel-driven fire pump and, therefore, has no fire protection pump fuel supply line which requires aging management. Hence, the staff further noted that this recommendation in GALL AMP XI.M26 is not applicable.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M27. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M27.

The staff also reviewed the portions of the "parameters monitored or inspected," "detection of aging effects," and "monitoring and trending" program elements associated with the exception and three enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of the exception and three enhancements follows.

Exception. LRA Section B2.1.11 states an exception to the "monitoring and trending" program element of GALL AMP XI.M26, "Fire Protection." In this exception, the applicant stated that the Halon system is functionally tested annually and Halon cylinder level measurements are taken on a 6-month frequency. The applicant further stated that the relay room and turbine bearing CO_2 fire suppression subsystems are inspected and tested every 18 months, during the refueling outage; while the remaining CO_2 systems are tested semi-annually.

The GALL Report recommends that a visual and functional test be performed on the Halon and CO_2 fire suppression systems at least once every 6 months. The staff noted that the applicant's CLB for the Halon and CO_2 systems is based on the 1973 editions of National Fire Protection Association (NFPA) Standard 12 A, "Standard on Halon 1301 Fire Extinguishing Systems," and Standard 12, "Standard on Carbon Dioxide Extinguishing Systems," respectively. The 1973 editions of NFPA Standards 12 A and 12 did not specify any testing frequency for the Halon and CO_2 fire suppression systems. The 6-month surveillance and testing frequency for the Halon and CO_2 fire suppression systems in the GALL Report is consistent with the current NFPA Standard 12 A (2009), but is more frequent than the current NFPA Standard 12 (2008), which stipulates an annual testing frequency for CO_2 systems.

By letter dated July 13, 2009, the staff issued RAI B2.1.11-1 requesting that the applicant provide operating history to justify why the longer timeframe is sufficient to protect the Halon and CO_2 fire suppression systems from the effects of aging. In its response dated August 17, 2009, the applicant stated the following:

> Based on the results of inspections and testing performed since 1973, there has been no significant aging-related degradation identified in these gaseous fire suppression systems. Therefore, the extended functional testing cycle provides adequate opportunity to observe system performance degradation prior to loss of intended function and the inspection and testing frequency is justified.

The staff reviewed the applicant's response and noted that the applicant's CLB is to functionally test the gaseous fire suppression system consistent with the NFPA standards. The staff noted that, with the exception of the relay room and turbine bearing subsystems, the applicant's CO_2 system is tested at a frequency consistent with the GALL Report recommendation and is tested more frequently than that of the current NFPA Standard 12 requirement. The staff also noted that the applicant's Halon systems are tested less frequently than both the GALL Report recommendation and the current NFPA Standard 12 A recommendation of a 6-month frequency. The applicant stated that the two CO_2 subsystems that are not consistent with the GALL Report are tested on an 18-month frequency. The staff's independent OE review indicated no aging-related effect that has adversely affected the operation of the Halon and CO_2 fire suppression systems. The staff further noted that the externals of the applicant's fire suppression systems and components are exposed to an inside air environment where corrosive agents (e.g., excessive salt or sulfur) are not expected to attack the fire suppression systems during the period of extended operation. The staff finds that the testing frequencies of the Halon and relay room and turbine bearing CO_2 subsystems, even though less frequent than the GALL Report recommendation, are sufficient to ensure that the systems will perform their intended functions, as evidenced by the operating history of the systems. The staff's concern described in RAI B2.1.11-1 is resolved.

Enhancement 1. LRA Section B2.1.11 states an enhancement to the "detection of aging effects" program element. The applicant committed (Commitment No. 8) to either test or replace a sample of sprinkler heads, in accordance with NFPA Standard 25. NFPA Standard 25 (2002), Section 5.3.1.1.1 states, in part, "Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested."

The GALL Report recommends replacing or testing the sprinkler heads after they have been in service for 50 years, in accordance with NFPA Standard 25 (1998, 2002). In reviewing this enhancement, the staff noted that the applicant's sprinkler heads had been in service since the start of the plant's operation. The staff finds the applicant's enhancement acceptable because it will make the applicant's program consistent with the GALL Report recommendation.

Enhancement 2. LRA Section B2.1.11 states an enhancement to the "parameters monitored or inspected" and the "detection of aging effects" program elements. The applicant committed (Commitment No. 9) to include the elastomer shield building fire boots in the fire barrier penetration seal inspection program.

The GALL Report recommends visually inspecting approximately 10 percent of the seals for signs of degradation at least once every refueling outage. The staff noted that the applicant regularly inspected these silicone-impregnated neoprene fire boots. However, the boot type seals are not specifically included in the plant fire barrier inspection procedure. The staff also noted that visual inspection of penetration seals is an integral part of the fire barrier inspection in GALL AMP XI.M26, "Fire Protection." The staff finds the applicant's enhancement acceptable because it will make the applicant's Fire Protection Program consistent with the GALL Report recommendation.

Enhancement 3. LRA Section B2.1.11 states an enhancement to the "parameters monitored or inspected" program element. The applicant committed (Commitment No. 10) to: (1) add one more criterion (i.e., inspecting for corrosion) to the current RCP oil collection system receiver inspection program and (2) perform a visual inspection of the internal surfaces of the oil collection tank prior to entering the period of extended operation.

The oil collection system collects any leaking lubricating oil from the RCPs, through the RCP oil collection system receiver, into a tank, as required by 10 CFR Part 50, Appendix R. To manage loss of material for steel in a lubricating oil environment, the GALL Report recommends using GALL AMPs XI.M39, "Lubricating Oil Analysis," and XI.M32, "One-Time Inspection." By letter dated July 7, 2009, the staff issued RAI B2.1.11-2 requesting that the applicant provide justification as to why the Lubricating Oil Analysis Program was not credited to protect the RCP oil collection system. In its response dated August 17, 2009, the applicant provided the following discussion:

> Since the lubricating oil environment for the tank is from oil leakage from reactor coolant pump bearings, it was determined that management of tank aging by the Lubricating Oil Analysis Program described in LRA Appendix B, Section B2.1.17 would not be effective. In addition, although the AMR conservatively concluded that loss of material due to corrosion is a potential aging effect, the internal air environment with the potential for minimal amounts of oil is not expected to be aggressive to the tank material and result in significant aging, Therefore, a specific visual inspection of the tank prior to the period of extended operation is provided as an enhancement to the Fire Protection Program, as described in LRA Appendix B, Section B2.1.11, "Fire Protection," Enhancement 3, in order to confirm that significant aging is not occurring. A visual inspection of the tank is adequate to identify signs of loss of material due to corrosion.

The staff finds the applicant's response acceptable because: (1) the applicant plans to enhance the program with additional inspection criteria for the RCP oil collection system and a one-time internal inspection of the oil collection tank prior to the period of extended operation, and (2) only minimal amounts of oil that leak from the RCP are expected to accumulate in the tank. The staff finds the one-time inspection of the internal surfaces affords the applicant an opportunity to assess internal material condition of the tank prior to the period of extended operation. The staff also finds the additional inspection criteria provide assurance that the effects of aging will be adequately managed.

Based on its audit and review of the applicant's responses to RAIs B2.1.11-1 and B2.1.11-2, the staff finds that elements one through six of the applicant's Fire Protection Program, with acceptable exception and enhancements, are consistent with the corresponding program elements of GALL AMPs XI.M26, "Fire Protection," and XI.M27, "Fire Water System," and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.11 summarizes OE related to the Fire Protection Program. The applicant stated that a degraded penetration seal was discovered during a preventive maintenance activity in 2002. The applicant also stated that a fire barrier impairment was issued, a work request was generated, and the fire barrier was repaired. The applicant further stated that use of a valve not designed to slowly bleed off fire system header pressure caused an unexpected auto start of the fire pumps during surveillance testing in 2005. The applicant revised the surveillance procedure to use a different valve more suitable for throttling to bleed off system header pressure.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no OE to indicate the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on fire protection system components within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.11 provides the USAR supplement for the Fire Protection Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.3-2.

The staff also notes that the applicant committed (Commitment Nos. 8, 9, and 10) to enhance the existing Fire Protection Program prior to entering the period of extended operation. Specifically, the applicant committed to: (1) either test or replace a sample of sprinkler heads, in accordance with NFPA Standard 25; (2) include the elastomer shield building fire boots in the fire barrier penetration seal inspection program; (3) include an additional criterion (inspecting for corrosion) to the current RCP oil collection system receiver inspection program; and (4) perform a one-time inspection of the internal surfaces of the RCP oil collection system tank.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fire Protection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancements and confirmed that their implementation through Commitment Nos. 8, 9, and 10, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.9 Flow-Accelerated Corrosion Program

Summary of Technical Information in the Application. LRA Section B2.1.12 describes the existing Flow-Accelerated Corrosion Program as consistent, with an exception, with GALL AMP XI.M17, "Flow-Accelerated Corrosion." The applicant stated that the program manages the aging effect of wall thinning for all carbon and low-alloy steel piping and components containing high-energy fluids for both safety-related and nonsafety-related applications. The applicant also stated that the program is based on EPRI Report 1011838, "Recommendations for an Effective Flow Accelerated Corrosion Program" (NSAC-202L, Revision 3), and predicts, detects, and monitors flow-accelerated corrosion in plant piping and other pressure-retaining components.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M17. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M17.

The staff also reviewed the portions of the "scope of the program" and "detection of aging effects" program elements associated with the exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of the exception follows.

Exception. LRA Section B2.1.12 states an exception to the "scope of the program" and "detection of aging effects" program elements. The applicant's Flow-Accelerated Corrosion Program is based on EPRI Report NSAC-202L, Revision 3, instead of Revision 2, as recommended in the GALL Report. The applicant stated that NSAC-202L, Revision 3 contains updated recommendations with recent developments in detection, modeling, and mitigation technology. The applicant also stated that NSAC-202L, Revision 3 is equivalent to NSAC-202L, Revision 2, since these recommendations refine and enhance the earlier versions, to ensure the continuity of existing flow-accelerated corrosion programs.

As discussed in the Audit Report, the staff determined that the differences between NSAC-202L, Revision 2 and Revision 3 include enhanced sample selection, inspection guidance, and additional guidance for use of OE. The staff finds the use of EPRI NSAC-202L, Revision 3 acceptable because the later revision provides enhancements and additional guidance that strengthens the Flow-Accelerated Corrosion Program.

Based on its review, the staff finds that program elements one through six of the applicant's Flow-Accelerated Corrosion Program, with an acceptable exception, are consistent with the corresponding program elements of GALL AMP XI.M10 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.12 summarizes OE related to the Flow-Accelerated Corrosion Program. The applicant stated that prior to the 2006 refueling outage, wall thickness inspections performed on the condensate supply to the 14B feedwater heater revealed wall thinning. The applicant also stated that the data was analyzed using the CHECWORKS computer code, and the projected wall thickness was determined to remain above the minimum required wall thickness over the next operating cycle. The applicant further stated that in 2006, wall thinning was identified in the shells of feedwater heaters 14A and 14B, evaluated using the

CHECWORKS computer code, and entered into the corrective action program for subsequent repair.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that the OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of this program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.12 provides the USAR supplement for the Flow-Accelerated Corrosion Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, and 3.4-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Flow-Accelerated Corrosion Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program as required by 10 CFR 54.21(d).

3.0.3.2.10 Fuel Oil Chemistry Program

Summary of Technical Information in the Application. LRA Section B2.1.14 describes the existing Fuel Oil Chemistry Program as being consistent, with exceptions, to the fuel oil chemistry portion of GALL AMP XI.M30, "Fuel Oil Chemistry." The staff noted that the remaining portion of GALL AMP XI.M30, fuel oil tank inspection, is documented in LRA Section B2.1.15. The applicant stated that this program is credited to manage the aging effect of loss of material for piping and components that supply fuel oil from storage tanks to the EDGs and to the TSC diesel generator by maintaining potentially harmful contaminants at low concentrations. The applicant further stated that the fuel oil quality is monitored and controlled in accordance with the guidelines from ASTM Standards D975, D4057, D2709, and D6217. Furthermore, the applicant stated that the effectiveness of this program will be verified by the Fuel Oil Tank Inspections Program and the WCP Program.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff noted that GALL AMP XI.M30 is comprised of a chemistry portion and a tank inspection portion. The staff further noted that the chemistry portion of GALL AMP XI.M30 includes periodic sampling and analysis of fuel oil to ensure that contaminants are maintained within acceptable levels. Furthermore, the tank inspection portion of GALL AMP XI.M30 includes periodic draining, cleaning, and inspection of fuel oil tanks to confirm the effectiveness of the chemistry control. The staff noted that the applicant has an individual program for each portion. The applicant's Fuel Oil Chemistry Program addresses only the chemistry portion of GALL AMP XI.M30. The applicant's Fuel Oil Tank Inspections Program addresses only the tank inspection portion of GALL AMP XI.M30. The staff's evaluation of the Fuel Oil Tank Inspections Program is documented in SER Section 3.0.3.2.11.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M30. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M30.

The staff also reviewed the portions of the "scope of the program," "preventive actions," "parameters monitored or inspected," "detection of aging effects," and "acceptance criteria" program elements associated with exceptions to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions follows.

Exception 1. LRA Section B2.1.14 states an exception to the "scope of the program" program element. The applicant stated that its technical specifications (TSs) do not include requirements for fuel purity as noted in GALL AMP XI.M30 and that the fuel oil purity and testing requirements are included in the applicable plant procedures.

The applicant stated that the recommendations in the GALL Report reference NUREG-1430 through NUREG-1433. The applicant further stated it is a Westinghouse design plant but has not adopted NUREG-1431, "Standard Technical Specifications Westinghouse Plants." The staff noted that LRA Section B2.1.14 states that the plant fuel oil specifications and procedures have requirements that are "similar" to NUREG-1431 for fuel oil purity and testing. By letter dated July 13, 2009, the staff issued RAI B2.1.14-1 requesting that the applicant provide a direct comparison between NUREG-1431 and its fuel oil specifications, along with a justification for any difference in fuel oil purity and testing parameters.

In its response dated August 17, 2009, the applicant compared its fuel oil sampling procedure with NUREG-1431. The applicant identified that the only difference is that the kinematic viscosity is not verified in new fuel oil deliveries prior to offloading the diesel fuel oil into the storage tanks. However, the applicant further stated that kinematic viscosity is included as part of the new fuel oil testing that is performed by an offsite laboratory. The applicant stated that the OE to-date has not revealed problems associated with the kinematic viscosity for fuel oil. The staff noted that if the results from the laboratory analysis indicate that the fuel oil parameters, including kinematic viscosity, were not within specifications, then corrective actions would be initiated. The applicant also stated that NUREG-1431 specifies a frequency of 31 days for determining the particulate concentration of fuel oil to be less than or equal to 10 milligrams per liter (mg/L). The applicant further stated that its fuel oil sampling procedure test for particulate concentration less than or equal to 10 mg/L is consistent with NUREG-1431; however, the test frequency is quarterly. The staff noted that this frequency is consistent with the "monitoring and trending" program element of GALL AMP XI.M30, which states that quarterly monitoring and analysis of fuel oil provides for timely detection of conditions conducive to corrosion.

Based on its review, the staff finds the applicant's response to RAI B2.1.14-1 and this exception acceptable because: (1) the applicant provided a direct comparison between its fuel oil sampling procedures with NUREG-1431; (2) the applicant's fuel oil sampling procedures are consistent with NUREG-1431 and the GALL Report, except for verification of kinematic viscosity prior to the new fuel oil being offloaded to the storage tanks; (3) the applicant provided an acceptable justification for not verifying the laboratory results for kinematic viscosity prior to the new fuel oil being offloaded into the storage tanks; (4) the applicant's OE through August 2009 (the date of its RAI response) has not indicated problems related to kinematic viscosity; and (5) the applicant will initiate corrective actions if the monitored fuel oil parameters, including kinematic viscosity, are not within the specified acceptance criteria in ASTM D975. The staff's concern described in RAI B2.1.14-1 is resolved.

Exception 2. LRA Section B2.1.14 states an exception to the "preventive actions" program element. The applicant stated that its program does not include the use of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, or corrosion inhibitors to mitigate corrosion.

The staff noted that the applicant does not use biocides. The applicant stated that new fuel oil is sampled before it is added into the storage tank to ensure that the fuel or the truck container does not contain excessive contaminants that would be introduced to the fuel oil storage tanks. The staff noted that the applicant performs periodic multilevel sampling, in which oil samples are taken from the top, middle, and bottom of the storage tanks, to ensure that there are no indications of deteriorating fuel oil, water, sediments, or biological growth. The staff further noted that the program is focused on limiting the potential for microbiologically-influenced corrosion (MIC) by minimizing the water concentration of the fuel, since microbiological growth would occur in the water/fuel interface. The applicant stated that results and operating history have not indicated microbiological growth in the fuel oil storage tanks. The staff noted that the applicant will consider the addition of biocides into its fuel oil if future plant OE provides indications of fuel oil degradation or corrosion.

Based on its review, the staff finds this portion of the exception acceptable because: (1) the applicant will be performing a multilevel sample of the fuel oil which will provide indications of contaminants including microbiological growth, (2) the applicant's operating history has not indicated that there is microbiological growth, and (3) if future plant-specific OE indicates microbiological growth, the applicant will consider the use of biocides as corrective actions.

The staff noted that the applicant does not use fuel stabilizers because of the frequent use of the diesel generators. The applicant stated that since the diesel generators are used so frequently, the fuel oil in the storage tank is mixed with new fuel being added in just as frequently. The applicant also stated that the day tanks, which are supplied by the storage tanks, experience a much higher turnover rate compared to the storage tanks because they are smaller in volume. The staff required additional information on the term "frequent basis," the volume of the fuel oil storage and day tanks, and the yearly fuel consumption of fuel oil from the tanks within the scope of license renewal. By letter dated July 13, 2009, the staff issued RAI B2.1.14-2 requesting that the applicant clarify what is meant by a "frequent basis" and to clarify the volume and fuel consumption of the fuel oil storage and day tanks within the scope of license renewal.

In its response dated August 17, 2009, the applicant described that each EDG is served by one fuel oil storage tank (35,000 gallons) and two fuel oil day tanks (850 gallons each), and the TSC diesel generator is served by one fuel oil storage tank (10,000 gallons) and one fuel oil day tank (275 gallons). The applicant described the frequency of operation of the EDGs and stated that the fuel consumption over an 18-month period is approximately 37 percent of the maximum capacity of the EDG fuel oil storage tank, and the fuel turnover for each day tank is over seven times the maximum capacity. The applicant described the frequency of operation of the TSC diesel generator and stated that the fuel consumption over an 18-month period is approximately 14 percent of the maximum capacity of the TSC fuel oil storage tank, and the fuel turnover for the day tank is over five times the maximum capacity. The staff noted that this information about fuel oil turnover supports this exception; however, it is not the sole basis and is also supported by the fuel oil analysis that is performed to ensure that the fuel oil quality is maintained and that biological breakdown and activity does not occur. The applicant stated that the frequency of sampling in the fuel oil storage tanks and fuel oil day tanks will be performed quarterly, consistent with GALL AMP XI.M30. The applicant further stated that the specific fuel oil parameters that will be monitored for fuel oil instability or breakdown are particulate contamination, kinematic viscosity, and distillation temperature. The staff noted that the applicant does not have OE to support fuel oil breakdown. The staff noted in LRA Section B2.1.14 that the applicant will consider the addition of fuel stabilizers if future plant OE provides indications of fuel oil instability or breakdown.

Based on its review, the staff finds the applicant's response to RAI B2.1.14-2 and this portion of the exception acceptable because: (1) quarterly fuel oil analysis of particulate contamination, kinematic viscosity, and distillation temperature will provide indications of fuel oil breakdown or instability that would support the use of fuel stabilizers; (2) the applicant's OE has not supported the need for fuel stabilizers; and (3) if future plant-specific OE indicates fuel oil breakdown or instability, the applicant will consider the use of fuel stabilizers as corrective actions. The staff's concern described in RAI B2.1.14-2 is resolved.

The applicant stated corrosion inhibitors are not added to the diesel fuel oil and that the fuel oil meets the ASTM D975, which includes specifications and acceptance criteria for a copper strip corrosion test. The staff noted that the copper strip corrosion test is used to evaluate the corrosive tendencies and corrosiveness of distillate fuel oils to copper. The staff reviewed ASTM D130, "Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test," which is the referenced test in ASTM D975, and noted that Section 10.3.1 is the test procedure for distillate fuel oil. The applicant stated that this test is performed as part of new fuel oil specifications and the fuel oil sample is tested as part of the receipt acceptance test by an outside laboratory. The staff noted that the applicant's plant-specific OE of this test for the last 10 years has shown that results meet the ASTM standard of the corrosiveness of distillate fuel oil to copper. The staff further noted that contaminants and particulates will settle to the bottom of the tank and will be detected during the periodic sampling of fuel oil or by periodic draining and inspection of the fuel oil storage tanks. The staff noted that the applicant will consider the addition of corrosion inhibitors into its fuel oil if future plant OE provides indications of fuel oil degradation or corrosion.

Based on its review, the staff finds this portion of the exception acceptable because: (1) the applicant's test results have indicated that fuel oil used by the applicant has met the standards of ASTM for corrosiveness of distillate fuel oil to copper; (2) contaminants will normally settle to the bottom of the tank, which will be removed and detected upon the periodic sampling and analysis of the fuel oil storage tanks and day tanks; and (3) the applicant will consider the use of corrosion inhibitors as part of corrective actions if future OE indicates a need for this additive.

Based on its review, the staff finds this exception acceptable in its entirety, as described above.

Exception 3. LRA Section B2.1.14 states an exception to the "parameters monitored or inspected" program element. The applicant stated its program uses ASTM D975, "Standard Specification for Diesel Fuel Oils," for determination of water and sediment levels in fuel oil in lieu of ASTM D1796, which is recommended by GALL AMP XI.M30.

The applicant stated that ASTM D975 references the test method included in ASTM D2709, which is appropriate specifically for Grade 2-D fuel oil, for measuring water and sediment in fuel oil. The staff noted that ASTM D2709 is a standard that is recommended by GALL AMP XI.M30. The applicant stated that the test method in ASTM D1796 is meant for higher viscosity fuel oils. The staff reviewed ASTM D975-06b and confirmed in Section 4.1.3 that the test method in ASTM D1796 is meant for Grade 4-D fuel oil. The staff compared ASTM D1796 and D2709 and noted that both test methods are performed by the centrifuge method.

Based on its review, the staff finds this exception acceptable because: (1) the applicant is using the appropriate test method, ASTM D2709, which is referenced in the GALL Report, for Grade 2-D fuel oil, and (2) both tests determine the water and sediment content by a centrifuge test method.

Exception 4. LRA Section B2.1.14 states an exception to the "parameters monitored or inspected" and "acceptance criteria" program elements. The applicant stated its program uses ASTM D6217, "Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration," for the determination of particulates in lieu of ASTM D2276, which is recommended by GALL AMP XI.M30.

The staff reviewed ASTM D6217 and D2276 and noted that these standards are meant for different types of fuel oil. More specifically, the staff noted that ASTM D6217 is meant for diesel fuel oil, while ASTM D2276 is meant for aviation fuel. The applicant stated that since ASTM D6217 is meant specifically for diesel fuel oil, its program uses this standard, which is also a standard that is recommended by the GALL Report. The staff also noted that GALL AMP XI.M30 recommends a modified ASTM D2276, Method A, in which the modification is the use of a filter with a pore size of 3.0 micrometers (μm). The staff reviewed ASTM D6217 and noted that this test method uses a filter with a pore size of 0.8μm, which is more conservative because the 0.8μm filter will be capable of capturing particulates that a 3.0μm filter cannot capture.

Based on its review, the staff finds this exception acceptable because: (1) the applicant is using ASTM D6217, which is meant for the type of fuel oil used by the applicant; (2) ASTM D6217 is a standard that is recommended by the GALL Report; and (3) ASTM D6217 uses a smaller filter size of 0.8μm compared to the GALL AMP XI.M30 recommendation of 3.0μm.

Exception 5. LRA Section B2.1.14 states an exception to the "detection of aging effects" program element. The applicant stated that its program drains and visually inspects a sample of the fuel oil obtained from the bottom of the day tanks on a monthly basis in lieu of taking multilevel samples of day tanks, as recommended by GALL AMP XI.M30.

The applicant stated that the EDG fuel oil day tanks and the TSC fuel oil day tank are supplied by their respective diesel fuel oil storage tanks. The applicant further stated that each day tank is sampled monthly by having approximately 1 gallon of fuel removed near the tank bottom and then visually inspected for water and sediments. By letter dated July 13, 2009, the staff issued

RAI B2.1.14-3 requesting that the applicant justify why multilevel sampling is not performed for the fuel oil day tanks and to justify why a visual inspection is sufficient compared to sending the fuel oil sample to a laboratory for testing, as stated in ASTM D4057.

In its response dated August 17, 2009, the applicant amended its LRA to remove Exception 5. By letter dated November 13, 2009, the applicant clarified its response to RAI B2.1.14-3 and amended its LRA to add Exception 5, which states the following:

> The Fuel Oil Chemistry program provides for monthly visual inspections and will be enhanced to provide quarterly laboratory analysis of fuel oil samples obtained from the bottom of the day tanks in lieu of taking multilevel samples of the day tanks as recommended by NUREG-1801, Section XI.M30.

The applicant stated that laboratory analysis of fuel oil for water, sediment, and particulates from the four EDG fuel oil day tanks and the one TSC fuel oil day tank will be performed consistent with the quarterly surveillance frequency for the respective fuel oil storage tanks. The applicant further stated that multilevel sampling is not warranted based on the relatively small volume of the day tanks (850 gallons for each EDG fuel oil day tank and 275 gallons for the TSC fuel oil day tank) and the relatively high turnover rate with respect to the capacity of the tanks (over seven times the capacity of each EDG fuel oil day tank and over five times the capacity of the TSC fuel oil day tank over an 18-month period). The staff noted that the sample points are tapped off the respective supply lines; therefore, the samples are representative of the fuel being drawn or used by the diesel generators. The applicant stated that the EDG fuel oil day tanks have a 3-inch riser from the tank bottom to the sample point, and the TSC fuel oil day tank has a true bottom sample. The staff noted that particulates, water, and contamination will settle toward the bottom of the tanks; therefore, the samples being drawn from the tanks in these configurations will represent a conservative sample. The applicant stated that it will perform a confirmatory one-time inspection of the fuel oil day tanks, as discussed in SER Section 3.0.3.2.11.

Based on its review, the staff finds the applicant's amended response to RAI B2.1.14-3 and exception acceptable because: (1) the applicant will be performing quarterly laboratory analyses of the fuel oil samples from the fuel oil day tanks, consistent with the recommendations in GALL AMP XI.M30; (2) the fuel oil samples that are being taken from the tanks provide the worst-case fuel oil sample, since contaminants and particulates will settle at the bottom of the tank, in comparison to a multilevel sample; and (3) the applicant will perform a confirmatory one-time inspection of the fuel oil day tanks to verify the condition of tank interiors. The staff's concern described in RAI B2.1.14-3 is resolved.

The applicant provided Commitment No. 30 to perform quarterly laboratory testing of the EDG and TSC diesel generator day tank fuel oil samples prior to the period of extended operation, which is consistent with the recommendations of GALL AMP XI.M30.

Based on its audit and review of the applicant's responses to RAIs B2.1.14-1, B2.1.14-2, and B2.1.14-3, as amended by November 13, 2009, the staff finds that elements one through six of the applicant's Fuel Oil Chemistry Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL AMP XI.M30 and are, therefore, acceptable. The staff's determination of consistency for the tank inspection portion of GALL AMP XI.M30 is documented in SER Section 3.0.3.2.11.

Operating Experience. LRA Section B2.1.14 summarizes OE related to the Fuel Oil Chemistry Program. The staff noted that in November 2006, during a tank sampling of the 1B EDG fuel oil storage tank, the applicant discovered an unusual amount of particulates. Although the applicant determined that the amount of particulates discovered was below the acceptable limits, the applicant chose to evaluate the condition to establish the source and cause of the unusual amount of particulates. The staff noted that the applicant concluded that the excess particulate was from maintenance work performed during the refueling outage to replace four flexible hoses. The staff noted that the applicant has planned for the corrosion to be removed from the inlet flange with a method to minimize or eliminate the potential for the corrosion products from falling into the tank during the cleaning process. During its audit, the staff noted that the applicant has completed the actions to remove the excess corrosion from the inlet flange and considered the potential that corrosion products may fall into the tank during the cleaning process. The staff noted that the applicant took corrective actions by: (1) identifying the source of the excess corrosion, (2) performing an evaluation to determine if the 1A fuel oil storage tank was also affected, and (3) removing the excess corrosion.

The staff noted that the applicant performed an evaluation in February 2007 on the acceptable use of ultra-low-sulfur diesel (ULSD) fuel oil in the EDGs and TSC diesel generator after the issuance of NRC IN 2006-22, "New Ultra-Low-Sulfur Diesel Fuel Oil Could Adversely Impact Diesel Engine Performance." The applicant stated that in June 2007, its evaluation concluded that there were no operability concerns with the use of ULSD in its EDGs. The applicant later performed a subsequent evaluation for the use of ULSD in the TSC diesel generator and concluded that the use of ULSD was appropriate. The applicant's condition report directed that the long-term issues (e.g., compatibility with lube oil, elastomers, storage tank interior surfaces, and long-term fuel storage) and short-term issues (e.g., heat content and lubricity) be evaluated. The staff reviewed the applicant's evaluation and noted that the conclusion was made that ULSD is acceptable for use in the EDG and TSC diesel generator after consideration of the long-term and short-term issues with using ULSD. The staff determined that after the issuance of IN 2006-22, the applicant took actions to evaluate the potential long and short-term issues with using ULSD and determined its acceptable use.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. The staff also confirmed that the applicant has addressed OE identified after the issuance of the GALL Report. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff identified OE which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The staff noted that after the issuance of Revision 1 of the GALL Report, the staff issued IN 2009-02, "Biodiesel in Fuel Oil Could Adversely Impact Diesel Engine Performance." The staff further noted this IN discusses potential issues that may occur with the use of B5 blend fuel oil, such as suspended water particles, biodegradation of B5, and material incompatibility. By letter dated July 13, 2009, the staff issued RAI B2.1.14-4 requesting that the applicant summarize the actions that were taken to determine the impact of IN 2009-02 and the use of biodiesel fuel oil, and if actions have not been taken yet, describe the actions that will be taken to determine the impact of IN 2009-02 and the acceptable or unacceptable use of biodiesel. The staff further requested that the applicant clarify any problems encountered with the use of biodiesel and the associated corrective actions to prevent reoccurrence in the future, if biodiesel is currently being used. Finally, the staff requested that the applicant clarify the actions that were taken and/or will be taken to prevent the addition of biodiesel into the fuel oil supply, and to describe actions that will be taken if it is determined that biodiesel has been added into the fuel oil supply, if biodiesel has been determined to be not acceptable for use.

In its response dated August 17, 2009, the applicant stated that the applicability of IN 2009-02 has been evaluated and the conclusion from this evaluation is introduction of B5 blend fuel oil is controlled by purchasing only Amoco Premier diesel fuel with a purchase order that specifically prohibits biodiesel. The applicant stated that the current purchase order was reviewed to confirm that this controlling provision is still in place. The staff noted that in addition to this purchase order, the applicant does verify the absence of B5 blend fuel oil as part of the laboratory analysis performed for the quarterly fuel oil samples. However, the applicant stated that the results of the laboratory analysis are not received prior to the addition and mixing of the new fuel oil into the storage tanks. The applicant indicated that if the presence of biodiesel fuel oil is identified by the laboratory analysis, this will be entered into their corrective action program which will include an operability evaluation of the diesel generators along with the implementation of appropriate corrective actions.

Based on its review, the staff finds the applicant's response to RAI B2.1.14-4 acceptable because the applicant: (1) has evaluated the applicability of recent OE, (2) has taken measures to prevent the addition of potentially harmful biodiesel fuel oil, (3) performs a laboratory analysis in order to verify that biodiesel fuel oil is absent, and (4) will implement corrective actions and perform an operability evaluation for the diesel generators if biodiesel is introduced to the fuel oil supply. The staff's concern described in RAI B2.1.14-4 is resolved.

Based on its audit and review of the application and review of the applicant's response to RAI B2.1.14-4, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.14 provides the USAR supplement for the Fuel Oil Chemistry Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.3-2. The staff's review of the tank inspection portion of the USAR supplement is documented in SER Section 3.0.3.2.11.

By letter dated August 17, 2009, the applicant committed (Commitment No. 30) to perform quarterly laboratory analyses of fuel oil samples from all fuel oil day tanks. In its commitment, the staff noted that the applicant referenced the incorrect ASTM standard (ASTM D4057). By letter dated November 13, 2009, the applicant amended Commitment No. 30 to state that the acceptance criteria of laboratory testing will be consistent with requirements in ASTM D975-06b, for water and sediment, and ASTM D6217, for particulates. The staff noted that the amended ASTM standards referenced in Commitment No. 30 are correct and consistent with the recommendations provided in GALL AMP XI.M30 and are, therefore, acceptable.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fuel Oil Chemistry Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent for the sampling and analysis for fuel oil to mitigate corrosion. The staff's evaluation and conclusion for the tank inspections is documented in SER Section 3.0.3.2.11. In addition, the staff reviewed the exceptions and their justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. The staff reviewed and confirmed that the implementation of Commitment No. 30 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.11 Fuel Oil Tank Inspections Program

Summary of Technical Information in the Application. LRA Section B2.1.15 describes the existing Fuel Oil Tank Inspections Program as being consistent, with an enhancement, to one component of GALL AMP XI.M30, "Fuel Oil Chemistry." The staff noted that the remaining component is documented in LRA Section B2.1.14. The applicant stated that this program is credited to manage the aging effect of loss of material for the internal surfaces of underground diesel generator fuel oil storage tanks. The applicant further stated that this program periodically drains, cleans, and inspects the internal surfaces of the tanks, and the schedule for cleaning and inspection is consistent with the recommendations of RG 1.137, Revision 1, "Fuel-Oil Systems for Standby Diesel Generators." Furthermore, the applicant stated that its program has provisions to perform an ultrasonic test of the fuel oil storage tank bottom plate to ensure that the minimum wall thickness requirements are satisfied and that degradation is not occurring.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff noted that GALL AMP XI.M30 is comprised of a chemistry portion and a tank inspection portion. The staff further noted that the chemistry portion of GALL AMP XI.M30 includes periodic sampling and analysis of fuel oil to ensure that contaminants are maintained within acceptable levels. Furthermore, the tank inspection portion of GALL AMP XI.M30 includes periodic draining, cleaning, and inspection of fuel oil tanks to confirm the effectiveness of the chemistry control. The staff noted that the applicant has an individual program for each portion. The applicant's Fuel Oil Chemistry Program addresses only the chemistry portion of GALL AMP XI.M30. The applicant's Fuel Oil Tank Inspections Program addresses only the tank inspection portion of GALL AMP XI.M30. The staff's evaluation of the Fuel Oil Chemistry Program is documented in SER Section 3.0.3.2.10.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M30. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M30, with the exception of the program description. For the program description, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During its review of the applicant's program description, the staff noted that the EDG day tanks and the TSC diesel generator day tank are not included in the scope of this program. The staff noted from LRA Table 3.3.2-19 that these day tanks credit the WCP Program. By letter dated July 13, 2009, the staff issued RAI B2.1.15-1 requesting that the applicant clarify if the WCP Program will periodically drain, clean, and visually inspect the interior of the tank and perform an ultrasonic test of the bottom plate to determine minimum wall thickness for the EDG day tanks and the TSC diesel generator day tank, consistent with the recommendations of GALL AMP XI.M30. Furthermore, the staff requested that if the WCP Program does not perform these activities, the applicant should justify the basis for not performing these activities for these tanks. Also, the staff requested that the applicant clarify how it will ensure that the internal surfaces of these day tanks are adequate if some type of inspection is not performed to assess the condition of the interior, including the tank bottom where contamination, water, and particulates are likely to settle and accumulate.

In its response dated August 17, 2009, the applicant stated that the WCP Program will perform a one-time inspection for all four EDG fuel oil day tanks and the one TSC diesel generator day tank to confirm the effectiveness of the Fuel Oil Chemistry Program on the internal surfaces of these tanks. The applicant further explained that this inspection will consist of an exterior surface ultrasonic inspection of all the fuel oil day tanks and then, based on the results, the EDG fuel oil day tank that has the most limiting results will be drained, cleaned, and visually inspected as the leading indicator for the remaining tanks. The staff noted that the ultrasonic inspection from the exterior surface will be capable of detecting material wastage that may be occurring on the internal surface of these tanks. The applicant stated that if ultrasonic inspection results indicate loss of material that may affect the intended function of the fuel oil day tanks, then those tanks will also be drained, cleaned, and inspected. The applicant stated that an internal visual inspection will be performed on an EDG fuel oil day tank because the sample points are not true-bottom, but rather, these tanks have a 3-inch riser above the tank bottom. The staff noted that because these tanks have a 3-inch riser and have been in service for approximately 10 years longer than the TSC diesel generator day tank, there is a potential that there is a build-up of contaminants in comparison to the one TSC diesel generator day tank. The staff also noted that the TSC diesel generator day tank has a true-bottom sample point so that fuel oil samples will provide indication of the worst case scenario for contaminants and build-up since they will settle toward the bottom of the tank. Furthermore, the applicant explained that the TSC diesel generator day tank design does not have a manway to allow access for internal cleaning and inspection.

Based on its review, the staff finds the applicant's response to RAI B2.1.15-1 and the applicant's use of a one-time inspection for the fuel oil day tanks acceptable because: (1) the applicant will perform exterior ultrasonic inspection of all fuel oil day tanks and internal cleaning and visual inspection of the most limiting EDG fuel oil day tank, (2) the applicant has included an inspection expansion based on the one-time inspection results, and (3) quarterly sampling and laboratory analysis from all fuel oil day tanks will determine the quality of the fuel oil. The staff's concern described in RAI B2.1.15-1 is resolved.

The staff also reviewed the portions of the "preventive actions" and "detection of aging effects" program elements associated with the enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement. LRA Section B.2.1.15 states an enhancement to the "preventive actions" and "detection of aging effects" program elements. The applicant stated its program will be enhanced to provide guidance for the periodic draining, cleaning, and inspection activities. The applicant described the details of this enhancement, which will include a visual inspection of the in-scope tanks for loss of material or other signs of degradation, such as coating degradation, abnormal rust, sludge, biological growth, and metal damage. Furthermore, thickness measurements for the EDG fuel oil storage tanks' bottoms and the TSC diesel generator fuel oil storage tank bottom will also be performed. The applicant stated that these inspections will be performed prior to entering the period of extended operation, and subsequent visual inspections and volumetric examinations will be performed on a frequency consistent with scheduled tank internals inspection activities.

The applicant stated in LRA Section B2.1.15 that this enhancement will proceduralize the requirements to drain, clean, and inspect the in-scope fuel oil storage tanks, and the requirement to visually inspect the internal surfaces and to measure the thickness of tank bottom surfaces of the in-scope tanks. During its audit, the staff noted that the applicant only has a preventive maintenance work order to inspect and clean the EDG fuel oil storage tanks and the TSC diesel generator fuel oil storage tank. The staff determined that since there currently are no formalized procedures to clean and inspect the fuel oil storage tanks, this enhancement is required to proceduralize the current preventive maintenance work order, the requirement to visually inspect the internal surfaces, and the measurement of the thickness of tank bottom surfaces of the in-scope fuel oil storage tanks.

Based on its review, the staff finds this enhancement acceptable because the applicant will be formalizing procedures for the activities to periodically drain, clean, and perform inspection activities, which include thickness measurements of the bottom plate to determine wall thickness, consistent with the recommendations of GALL AMP XI.M30.

Based on its audit and review of the applicant's response to RAI B2.1.15-1, the staff finds that elements one through six of the applicant's Fuel Oil Tank Inspections Program, with an acceptable enhancement, are consistent with the corresponding program elements of GALL AMP XI.M30 and are, therefore, acceptable. The staff's determination of consistency for the chemistry portion of GALL AMP XI.M30 is documented in SER Section 3.0.3.2.10.

Operating Experience. LRA Section B2.1.15 summarizes OE related to the Fuel Oil Tank Inspections Program. During its audit, the staff noted that in October 2001, the applicant performed a cleaning and inspection of the EDG fuel oil storage tanks. The staff reviewed the results of these inspections and noted that the "A" EDG fuel oil storage tank had seven gouge locations on the shell and that eight gouge locations were on the shell of the "B" EDG fuel oil storage tank. The applicant entered the discovery of these gouges in its corrective action program. The results of the inspection noted that these gouges were left during original construction. The applicant evaluated the gouges in the shells of the EDG fuel oil storage tanks and concluded that the maximum increased stress from the gouges does not exceed the allowable stress limit; therefore, these tanks are acceptable for continued operation. The staff noted that the applicant initiated corrective actions and determined that these tanks were suitable for continued use. The staff noted these tanks will be inspected on a 10-year frequency, consistent with RG 1.137.

The staff noted that the applicant also performed a tank inspection of the TSC diesel generator fuel oil storage tank. The results of this inspection concluded that the tank was in "excellent condition" and that it was suitable for continued operation. During its inspection, the applicant noted one area of coating discoloration but the base metal was still protected. The applicant determined that the tank was acceptable for continued service. The staff noted that the applicant will perform a tank inspection of the TSC diesel generator fuel oil storage tank on a 10-year frequency, consistent with RG 1.137.

The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.15 provides the USAR supplement for the Fuel Oil Tank Inspections Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.3-2. The staff's review of the chemistry analysis portion of the USAR supplement is documented in SER Section 3.0.3.2.10.

The staff also notes that the applicant committed (Commitment No. 11) to enhance the Fuel Oil Tank Inspections Program prior to entering the period of extended operation. Specifically, the applicant committed to formalize guidance for the periodic draining, cleaning, and inspection activities for the fuel oil storage tanks prior to the period of extended operation. By letter dated August 17, 2009, the applicant committed (Commitment No. 31) to enhance the WCP Program prior to entering the period of extended operation. Specifically, the applicant committed to perform ultrasonic inspections of the fuel oil day tanks prior to the period of extended operation.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fuel Oil Tank Inspections Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent for the tank inspections that confirm the effectiveness of the fuel oil chemistry. The staff's evaluation and conclusion for the sampling and analysis for fuel oil is documented in SER Section 3.0.3.2.10. Also, the staff reviewed the enhancement and confirmed that its implementation through Commitment No. 11, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.12 Inspection of Overhead Heavy Load and Refueling Handling Systems Program

Summary of Technical Information in the Application. LRA Section B2.1.16 describes the existing Inspection of Overhead Heavy Load and Refueling Handling Systems Program as consistent, with an enhancement, with GALL AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems." The applicant stated that this program manages the aging effect of loss of material due to general corrosion and rail wear for steel heavy load and refueling handling cranes, trolleys, bridges, and rails within the scope of license renewal by performing periodic visual inspections of the heavy load and refueling handling crane, trolley, bridge, and rail structural members. The applicant also stated that this program visually inspects structural bolting that is associated with structural members for general corrosion and tightness. The applicant further stated that overhead heavy load cranes are controlled in accordance with the guidance provided in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M23. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M23 with the exception of the "scope of the program" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI, as discussed below.

GALL AMP XI.M23 recommends that the program manage the effects of general corrosion on the crane and structural components and the effects of wear on the rails in the rail system under the "scope of the program" program element description; however, during its review, the staff found that the applicant's Overhead Heavy Load and Refueling Handling Systems Program includes visual inspection of the structural bolting associated with structural members for general corrosion and tightness. By letter dated March 11, 2010, the staff issued RAI B2.1.16-1 requesting that the applicant justify how a visual inspection will verify tightness of bolting. Additionally, the staff requested that the applicant verify if this bolting is also managed by the Bolting Integrity Program, and if not, whether it conducts volumetric examinations on bolting larger than 1 inch with a yield strength greater than or equal to 150 ksi.

In its response dated March 26, 2010, the applicant stated that visual inspection of bolting for tightness is performed by observation of cracks in coatings, visible gaps between bolts and structural members, lack of full thread engagement of nuts, and excessive flexing of structural members. The applicant also stated that the two plant-specific OE examples included in LRA Section B2.1.16 were examples of loose bolting that were identified by visual inspection. The applicant further stated that it has no high-strength structural bolting greater than 1 inch in diameter associated with the structural members of cranes, and that bolting associated with crane structural members is not managed by the Bolting Integrity Program.

The staff finds this response acceptable because: (1) the methods used to perform the visual inspection for tightness of bolting are appropriate for and have been effective at identifying loosened bolting, and (2) the applicant has no high-strength bolting with a diameter greater than 1 inch associated with crane structural members that would require management in accordance with the Bolting Integrity Program. The staff's concern described in RAI B2.1.16-1 is resolved.

The staff also reviewed the portions of the "parameters monitored or inspected" program element associated with the enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement. LRA Section B.2.1.16 states an enhancement to the "parameters monitored or inspected" program element. The applicant stated that the inspection criteria of the Inspection of Overhead Heavy Load and Refueling Handling Systems Program will be enhanced to clarify the requirements of visual inspection of structural members, including structural bolting, of the in-scope heavy load and refueling handling cranes and associated equipment.

The staff noted that the "parameters monitored or inspected" program element of GALL AMP XI.M23 states the program evaluates the effectiveness of the maintenance monitoring program and the effects of past and future usage on the structural reliability of cranes. The applicant stated in LRA Section B2.1.16 that this enhancement will clarify the requirements of visual inspection of structural members, including structural bolting, of the in-scope heavy load and refueling handling cranes and associated equipment. The staff noted that the applicant considered plant-specific OE, as described in the "operating experience" program element, when evaluating the effectiveness of this program. The staff also noted that the applicant will appropriately incorporate its plant-specific OE when enhancing its program to clarify the requirements of visual inspection of structural members, including structural bolting, of in-scope components. The staff further noted that the applicant committed (Commitment No. 12) to implement this enhancement prior to the period of extended operation. On the basis of its review, the staff finds this enhancement acceptable because the applicant's actions associated with this enhancement considered plant-specific OE and evaluated the effectiveness of its program consistent with the recommendations of the GALL Report.

Based on its audit, the staff finds that elements one through six of the applicant's Inspection of Overhead Heavy Load and Refueling Handling Systems Program, with an acceptable enhancement, are consistent with the corresponding program elements of GALL AMP XI.M23 and are, therefore, acceptable.

Operating Experience. LRA Section B.2.1.16 summarizes OE related to the Inspection of Overhead Heavy Load and Refueling Handling Systems Program. The applicant included two instances of applicable OE in the LRA. The applicant stated that in June 2001, it observed excessive flexing of an I-beam that supports the trolley drive system for the auxiliary building crane. The applicant also stated that it performed an inspection of the beam support system and discovered that the bolts in the cross-plate support at the center of the I-beam had loosened. The applicant further stated that these bolts were inspected and then re-torqued. In order to prevent a reoccurrence of loosened bolts from structural members, the applicant took corrective actions to periodically inspect bolts for all structural members of the crane. The staff noted that the applicant identified the loosened bolts, initiated corrective actions to re-torque the bolts, and performed inspections to ensure the components were in satisfactory condition, and then considered this OE for enhancing this program.

The applicant stated a similar incident occurred in August 2002, when the applicant identified a loose bolted connection on a cross plate connection for the trolley drive system of the auxiliary building crane. The applicant took corrective actions to replace and re-torque the fastener and to revise the procedures to include cross-plate bolt inspections, as well as an increase in the frequency of the inspections. The staff noted that the applicant identified the loosened bolts, initiated corrective actions to replace and re-torque the fastener, and then considered this OE for enhancing this program.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.16 provides the applicant's USAR supplement for the Inspection of Overhead Heavy Load and Refueling Handling Systems Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.3-2.

The staff also notes that the applicant committed (Commitment No. 12) to enhance the Inspection of Overhead Heavy Load and Refueling Handling Systems Program prior to entering the period of extended operation. Specifically, the applicant committed to clarify the requirements of visual inspection of structural members, including structural bolting, of the in-scope heavy load and refueling handling cranes and associated equipment.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review and audit of the applicant's Inspection of Overhead Heavy Load and Refueling Handling Systems Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancement and confirmed that its implementation, through Commitment No. 12 prior to the period of extended operation, would make the existing program consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.13 Metal-Enclosed Bus Program

Summary of Technical Information in the Application. LRA Section B2.1.18 describes the existing Metal-Enclosed Bus Program as consistent, with an enhancement, with GALL AMP XI.E4, "Metal-Enclosed Bus." The applicant stated that its program manages the aging effects of reduced insulation resistance, electrical failure, and loosening of bolted connections for non-segregated metal-enclosed bus and internal components within the scope of license renewal. The applicant stated the program: (1) performs visual inspections, using a sampling methodology, of sections of the in-scope metal-enclosed bus looking for cracks, corrosion, foreign debris, excessive dust build up, and evidence of water intrusion; and (2) performs a visual inspection of component insulation surface anomalies, such as discoloration, cracking, chipping, or surface contamination. The applicant also stated that its program is supported by the Structures Monitoring Program, which performs visual inspection of portions of the metal-enclosed bus enclosure assemblies. The applicant further stated that the inspection of the metal-enclosed bus will be completed prior to the period of extended operation and performed every 5 years thereafter.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.E4. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.E4, with the exception of the area discussed below. For this area, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During its audit, the staff noted that LRA Sections B2.1.18 and A2.1.18, and the applicant's program basis document state that the program performs visual inspections, using a sampling methodology of sections of the in-scope metal-enclosed bus. The staff further noted that the program description of GALL AMP XI.E4 states that the purpose of the program is to provide an inspection of the metal-enclosed bus. GALL AMP XI.E4 recommends inspecting all internal portions of metal-enclosed bus and limits the application of sampling to accessible metal-enclosed bus bolted connections only. By letter dated July 13, 2009, the staff issued RAI B2.1.18-1 requesting that the applicant provide justification for specifying that selected sections of metal-enclosed bus will be sampled for visual inspections.

In its response dated August 17, 2009, the applicant stated that consistent with GALL AMP XI.E4, its program, described in LRA Section B2.1.18, includes the inspection of all in-scope metal-enclosed buses. In addition, the applicant revised the scope of the metal-enclosed bus inspection, as stated in LRA Section A2.1.18, by replacing the third paragraph with:

> The program performs visual inspections of the in-scope MEB [metal-enclosed bus] for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion, and performs visual inspections of the component insulation for surface anomalies, such as discoloration, cracking, chipping, or surface contamination.
>
> The program performs visual inspections of a sample of accessible MEB bolted connections that are covered with heat shrink tape, sleeving, insulated boots, etc., for surface anomalies, such as discoloration, cracking, chipping, or surface contamination.

The applicant also stated that it will also clarify the frequency of the metal-enclosed bus and bolted connection inspections in LRA Section A2.1.18 by replacing the fourth paragraph of the program description, as shown below:

> The inspection of all metal enclosed bus will be completed prior to the period of extended operation and will be repeated every 10 years thereafter.
>
> The inspection of the sample of bolted connections will be completed prior to the period of extended operation and will be repeated every 5 years thereafter.

Furthermore, the applicant stated that it will revise the frequency of the metal-enclosed bus and bolted connection inspections in Commitment No. 13, as described below:

> Thereafter, the inspection of all metal enclosed bus will not exceed a 10-year interval and the inspection of the sample of bolted connections will not exceed a 5-year interval.

Based on its review, the staff finds the applicant's response to RAI B2.1.18-1 acceptable because: (1) the applicant revised LRA Section A2.1.18 to clarify that the applicant's sampling methodology will visually inspect all in-scope metal-enclosed bus, consistent with GALL AMP XI.E4, and (2) the applicant also revised the metal-enclosed bus and bolted connection inspection frequencies, consistent with GALL AMP XI.E4. The staff, therefore, considers RAI B2.1.18-1 resolved.

The applicant's metal-enclosed bus bolted connection sampling methodology is referenced in its program basis document which states that a sample of metal-enclosed bus connections will be inspected. Furthermore, the staff noted the applicant has procedures that implement the metal-enclosed bus bolted connection sampling methodology based on a joint selection matrix that uses completed inspection information to determine the next set of connections for inspection and in conjunction with the inspection frequency of the Metal-Enclosed Bus Program, which is consistent with GALL AMP XI.E4.

The program description of LRA Section B2.1.18 states that the program is supported by the Structures Monitoring Program, which performs a visual inspection of portions of the metal-enclosed bus enclosure assemblies. The staff reviewed the applicant's Structures Monitoring Program and noted that it does not specify visual inspection for the metal-enclosed bus enclosure assemblies. By letter dated July 13, 2009, the staff issued RAI B2.1.18-2 requesting the applicant confirm that the Structures Monitoring Program visually inspects the exterior portions of the metal-enclosed bus, consistent with GALL Report Table VI, items VI.A-12 and VI.A-13.

In its response dated August 17, 2009, the applicant stated that Commitment No. 22, associated with the Structures Monitoring Program, will be enhanced to clearly define structures, structural elements, and miscellaneous structural commodities that are in-scope. The applicant also stated that the defined scope includes the metal-enclosed bus enclosure assemblies, structural supports, and enclosure seals. The applicant further stated that as enhanced, the Structures Monitoring Program supports inspections of the metal-enclosed bus consistent with GALL Report Table VI, items VI.A-12 and VI.A-13 by requiring visual inspection of portions of the metal-enclosed bus enclosure assemblies.

Based on its review, the staff finds the applicant's response to RAI B2.1.18-2 acceptable because: (1) the applicant will enhance the Structures Monitoring Program to include visual inspections of the metal-enclosed bus consistent with GALL Report Table VI, items VI.A-12 and VI.A-13, and (2) the applicant's program is consistent with GALL AMP XI.E4 with respect to visual inspection of metal-enclosed bus enclosure assemblies. The staff, therefore, considers RAI B2.1.18-2 resolved.

The staff also reviewed the portions of the "parameters monitored or inspected," "detection of aging effects," "acceptance criteria," and "corrective actions" program elements associated with enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement. LRA Section B2.1.18 states an enhancement to the "parameters monitored or inspected," "detection of aging effects," "acceptance criteria," and "corrective actions" program elements. The applicant stated that the existing program will be augmented to include periodic visual inspections of the metal-enclosed bus internal surfaces, bus supports, bus insulation, taped joints, and boots (e.g., bus connections) for signs of degradation or aging. The applicant stated that the Metal-Enclosed Bus Program will visually inspect internal surfaces for cracks, corrosion, aging degradation of insulation material, foreign debris, excessive dust build up, and evidence of moisture intrusion. The applicant also stated that bus insulation, taped joints, and boots will be visually inspected for signs of embrittlement, chipping, cracking, melting, swelling surface contamination, or discoloration, which may indicate overheating or aging degradation. The applicant stated that the internal bus supports will be visually inspected for structural integrity and signs of cracks. Finally, the applicant stated that corrective actions will be initiated for any observed aging degradation.

The applicant stated the enhancement will require the use of visual inspection of internal portions of the metal-enclosed bus, bus insulation, and internal bus supports, which impacts the "parameters monitored or inspected" program element. The applicant stated the enhancement will require the inspection of the metal-enclosed bus internal surfaces, accessible covered bolted connections, bus insulation, and internal bus supports, which impacts the "detection of aging effects" program element. In addition, the applicant's program basis document clarifies that it has only accessible bolted connections covered with heat shrink tape, sleeving, insulated boots, etc. Based on this, the staff noted that the inspections will be completed prior to the period of extended operation and every 5 years thereafter, consistent with GALL AMP XI.E4. In addition, the applicant stated in its program basis document that should degradation be observed and further evaluation required, the program allows for removal of the bus bolted connection insulation, inspection of the connection, and a resistance measurement to be performed. The applicant further stated that the resistance value will be specified in its implementing procedure. The applicant stated the enhancement will require further investigation and evaluation should unacceptable visual inspection of the metal-enclosed bus internal surfaces, bus supports, or internal component insulation be observed, which impacts the "acceptance criteria" program element. The applicant stated that this enhancement will require that aging degradation that is observed during visual inspections, including that which requires corrective action, will be entered into the applicant's corrective action program, which impacts the "corrective actions" program element.

Based on its review, the staff finds this enhancement acceptable because: (1) the actions that will be taken prior to the period of extended operation will make the applicant's existing program consistent with the recommendations in GALL AMP XI.E4, and (2) the applicant has committed (Commitment No. 13) to implementing these actions prior to the period of extended operation.

Based on its audit and review of the applicant's responses to RAIs B2.1.18-1 and B2.1.18-2, the staff finds that elements one through six of the applicant's Metal-Enclosed Bus Program, with an acceptable enhancement, are consistent with the corresponding program elements of GALL AMP XI.E4 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.18 summarizes OE related to the Metal-Enclosed Bus Program. The applicant stated that metal-enclosed bus failures due to degradation of bus insulation and accumulation of dust and debris occurred in the late 1980s. The applicant stated that the existing Metal-Enclosed Bus Program was created to manage non-segregated metal-enclosed bus joint connections. The applicant further stated that its program considered NRC INs 89-64, 98-36, and 2000-14. These INs document industry metal-enclosed bus failures, including those failures at the applicant's site that involved insulation failure and accumulation of water and debris. The applicant stated that its existing program was created to address the above failures and has been updated to include additional maintenance activities, testing, and program elements since original issue.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff identified OE which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The "operating experience" program element of the applicant's program states that the existing inspection program is designed to maintain the tightness of metal-enclosed bus joints and that joints were torque-checked for proper tightness. The staff noted that re-torquing is not recommended in EPRI TR-104213 (Sections 7.2.1 and 8.2) for electrical bolted connection maintenance. The EPRI document states the following:

> [T]he bolts should not be re-torqued unless the joint requires service or the bolts are clearly loose. Verifying the torque is not recommended. The torque required to turn the fastener in the tightening direction (restart torque) is not a good indicator of the preload once the fastener is in service. Due to relaxation of the parts of the joint, the final loads are likely to be lower than the installed loads.

By letter dated July 13, 2009, the staff issued RAI B2.1.18-3 requesting the applicant provide justification for not following the EPRI guidance for bus connection re-torquing.

In its response dated August 17, 2009, the applicant stated that when bolted connections are made accessible, current plant procedures incorrectly specify performance of a torque check on the bolted joints and re-torque of the joint if the as-found torque value is less than the manufacturers required torque value. The applicant also stated that the discrepancy was documented in the corrective action program to determine the necessary revisions to the procedures to provide consistency with the EPRI guidance.

Based on its review, the staff finds the applicant's response to RAI B2.1.18-3 acceptable because the applicant has entered the condition in its corrective action program to determine the procedure changes needed to be consistent with the EPRI guidance. The staff, therefore, considers RAI B2.1.18-3 resolved.

LRA Section B2.1.18 states that OE indicates that the Metal-Enclosed Bus Program is effective in identifying degradation, evaluating the degradation, and implementing corrective actions. The staff noted that corrective action examples included the discovery during preventive maintenance of foreign material on top of the bus insulation. The staff further noted that the bus insulation was cleaned and the applicant determined that the insulation remained intact with no sign of degradation. The applicant provided a second example that involved cracked insulation discovered during maintenance. The staff noted that the bus bars were removed, reinsulated and re-torqued. LRA Section B2.1.18 also states that no age-related metal-enclosed bus failures have occurred since the program was revised to include bus cleaning and enhanced visual inspection.

Based on its audit and review of the application, and review of the applicant's response to RAI B2.1.18-3, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.18 provides the USAR supplement for the Metal-Enclosed Bus Program, as amended by letter dated August 17, 2009. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.6-2.

In its response to RAI B2.1.18-1, dated August 17, 2009, the applicant amended LRA Section A2.1.18 to replace the third paragraph in the program description with the following:

> The program performs visual inspections of the in-scope MEB for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion, and performs visual inspections of the component insulation for surface anomalies, such as discoloration, cracking, chipping or surface contamination.
>
> The program performs visual inspections of a sample of accessible MEB bolted connections that are covered with heat shrink tape, sleeving, insulated boots, etc., for surface anomalies, such as discoloration, cracking, chipping or surface contamination.

The applicant also stated that it will clarify the frequency of the metal-enclosed bus and bolted connection inspections in LRA Section A2.1.18 by replacing the fourth paragraph of the program description as shown below:

> The inspection of all metal enclosed bus will be completed prior to the period of extended operation and will be repeated every 10 years thereafter.
>
> The inspection of the sample of bolted connections will be completed prior to the period of extended operation and will be repeated every 5 years thereafter.

Thereafter, the inspection of all metal enclosed bus will not exceed a 10-year interval and the inspection of the sample of bolted connections will not exceed a 5-year interval.

The staff also notes that the applicant committed (Commitment No. 13), as amended by letter dated August 17, 2009, to enhance the Metal-Enclosed Bus Program prior to entering the period of extended operation and thereafter, the inspection of all metal-enclosed buses will not exceed a 10-year interval and the inspection of the sample of bolted connections will not exceed a 5-year interval. Specifically, the applicant committed to include augmented periodic visual inspections of the metal-enclosed bus internal surfaces, bus supports, bus insulation, taped joints, and boots for signs of degradation or aging.

The staff determines that the information in the USAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Metal-Enclosed Bus Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancement and confirmed that its implementation through Commitment No. 13, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.14 Open-Cycle Cooling Water System Program

Summary of Technical Information in the Application. LRA Section B2.1.23 describes the existing Open-Cycle Cooling Water System Program as consistent, with an exception and an enhancement, with GALL AMP XI.M20, "Open-Cycle Cooling Water System." The applicant stated that the program addresses loss of material and reduction in heat transfer of the open-cycle cooling water system, which includes service water piping and portions of the circulating water piping system that support the operation of the service water system, including its alternate source of service water. The applicant also stated that the system components are constructed from copper alloys, stainless steel, and steel. The applicant further stated that the program proposes to manage this aging effect through the use of preventive measures, such as chemical treatment and monitoring measures (e.g., visual inspections, NDEs, heat exchanger thermal performance testing, and other maintenance activities).

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated. The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M20. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M20, with the exception of the "preventive actions" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

GALL AMP XI.M20 recommends that the system components be lined or coated to protect the underlying metal surfaces from being exposed to aggressive cooling water environments under the "preventive actions" program element description; however, during its audit, the staff found that much of the service water piping is not lined. By letter dated July 13, 2009, the staff issued RAI B2.1.23-1 requesting that the applicant demonstrate that the proposed program is sufficiently robust to adequately manage aging in the absence of pipe linings.

In its response dated August 17, 2009, the applicant stated that its source of open-cycle cooling water is Lake Michigan and that it is fresh water, relatively free of chemicals and minerals, and, therefore, not considered to be an aggressive cooling water environment. The applicant also stated that its program includes internal visual inspections whenever the piping is open for maintenance or repair, routine UT which is performed on select piping segments, and periodic replacement of susceptible dead leg piping. While the staff does not agree with the applicant's assertion that the open-cycle cooling water from Lake Michigan is not aggressive, the staff does consider this water to be less corrosive to carbon steel piping than most water sources. It is the staff's position that any aerated water source is corrosive to carbon steel and, therefore, aggressive. The staff noted that the applicant's program includes routine UT and periodic replacement of dead leg piping. The staff also noted that UT is effective in detecting loss of material in piping and that dead legs are the type of piping generally considered most susceptible to loss of material by corrosion. The staff finds this program acceptable because even in the absence of internal coatings, the low corrosivity of the water, as well as the increased inspection and routine piping replacement included in the applicant's program, provides a reasonable level of assurance that the LRA AMP will provide aging management which is at least equivalent to that provided by the GALL Report AMP.

The staff also reviewed the portions of the "detection of aging effects" and "parameters monitored or inspected" program elements associated with exceptions and enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of the exception and enhancement follows.

Exception. LRA Section B2.1.23 states an exception to the "detection of aging effects" program element. The applicant stated that the containment fan coil units and EDG cooling water subsystem heat exchangers will not be thermal performance tested. The applicant also stated that it will periodically inspect and flush these heat exchangers as an alternative to thermal testing, and additionally flow test the containment fan coil units and perform eddy current tube inspections on the EDG cooling water subsystem heat exchangers. The applicant further stated that the basis for this exception is its inability to obtain valid heat transfer results for these heat exchangers due to their configuration.

The staff reviewed this exception to the GALL Report in conjunction with GL 89-13. The staff noted that these heat exchangers constitute a small subset of the heat exchangers tested under this AMP. GL 89-13 indicates that there are heat exchangers for which obtaining valid heat transfer data is very difficult. GL 89-13 proposes that adequate heat transfer for these heat exchangers can be maintained through a combination of flushing and inspection. The staff finds the program exception acceptable because GL 89-13 specifically authorizes this technique for maintaining the heat transfer capabilities of heat exchangers. Despite the exception, the staff finds the "detection of aging effects" program element consistent with the one described in GALL AMP XI.M20.

Enhancement. LRA Section B2.1.23 states an enhancement to the "parameters monitored or inspected" program element. The applicant stated that the program will be enhanced to add piping corrosion and erosion inspection criteria to the circulating water underwater visual inspections. The applicant also stated that the inspection criteria includes buildup of silt and zebra mussels.

The staff reviewed this enhancement against the corresponding program element in GALL AMP XI.M20. On the basis of its review, the staff finds this enhancement acceptable because when it is implemented prior to the period of extended operation, the program inspection procedures and frequencies will be consistent with the recommendations in GALL AMP XI.M20.

Based on its audit and review of the applicant's response to RAI B2.1.23-1, the staff finds that elements one through six of the applicant's Open-Cycle Cooling Water System Program, with an acceptable exception and enhancement, are consistent with the corresponding program elements of GALL AMP XI.M20 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.23 summarizes OE related to the Open-Cycle Cooling Water System Program. The applicant stated that OE has been effective in detecting loss of material and loss of heat transfer, citing examples related to silting in elbows and eddy current testing of heat exchanger tubes.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program. During its review, the staff identified OE which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAIs.

In LRA Section B2.1.23, the applicant stated that it had addressed OE related to open-cycle cooling water systems. However, the staff found that the applicant had not addressed OE related to the biocide injection system functioning less than fully reliable. Plant OE also indicates that zebra mussels are commonly found in various parts of the open-cycle cooling water system. By letter dated July 13, 2009, the staff issued RAI B2.1.23-2 requesting that the applicant demonstrate the sufficiency of the proposed program to address biofouling.

In its response dated August 17, 2009, the applicant stated that the poor availability of the biocide injection equipment had been identified by the Open-Cycle Cooling Water Program and entered into the corrective action program. The applicant also stated that as a result of actions initiated by these programs, the availability of the biocide injection equipment has increased from 40 percent in 2007 to approximately 93 percent in 2009. The applicant further stated that although mussel fragments have been found in the open-cycle cooling water system, no live mussels were routinely found, even during the period when the availability of biocide injection equipment was poor.

Based on its review, the staff finds the applicant's response to RAI B2.1.23-2 acceptable because the program was: (1) sufficiently robust so as to be able to control zebra mussels even when the performance of the biocide injection was poor, (2) capable of identifying a weakness in the program and correcting it over a reasonably short period of time, and (3) capable of preventing loss of function of the system under conditions of poor operating reliability of the biocide injection equipment. The staff's concern described in RAI B2.1.23-2 is resolved.

In LRA Section B2.1.23, the applicant stated that it had addressed OE related to open-cycle cooling water systems. However, the staff found that the applicant had not addressed OE related to several instances where small heat exchangers fouled under low flow conditions. In all instances, it was apparent that the LRA program was sufficient to initiate corrective action for the compromised exchanger. In some, but not all instances, it was apparent that lessons learned were extended to other heat exchangers or other components. By letter dated July 13, 2009, the staff issued RAI B2.1.23-3 requesting that the applicant provide additional examples, particularly associated with low flow heat exchangers, demonstrating that OE from one component is used to modify the inspection program for other, similar components.

In its response dated August 17, 2009, the applicant provided two examples demonstrating the manner in which lessons learned were utilized on other components. The applicant's first example dealt with low flow fouling of safety injection pump lube oil coolers. These coolers fouled in January 2004 due to lake weeds and low flow conditions. These heat exchangers were subsequently replaced by a different type of heat exchanger which is less prone to fouling. Additionally, the applicant inspected three other heat exchangers which were potentially subject to the same fouling method. Inspection results indicated that these heat exchangers were not subject to this type of fouling and that no further action was required. The applicant's second example addressed eddy current test results for heat exchanger tube pitting. In 2006, the applicant performed eddy current testing to determine loss of material from heat exchanger tubes and removed two tubes to confirm the eddy current analysis. The destructive analysis of the tubes indicated a shortcoming in the eddy current analysis. This data was used to correct the eddy current analysis for this heat exchanger, as well as all other heat exchangers subject to eddy current testing.

Based on its review, the staff finds the applicant's response to RAI B2.1.23-3 acceptable because it demonstrates the ability of the program to appropriately apply lessons learned to other components. The staff's concern described in RAI B.2.1.23-3 is resolved.

Based on its audit and review of the application, and review of the applicant's responses to RAIs B2.2.23-2 and B2.1.23-3, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.23 provides the USAR supplement for the Open-Cycle Cooling Water System Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 18) to enhance the Open-Cycle Cooling Water System Program prior to entering the period of extended operation. Specifically, the applicant committed to enhance the program to add applicable aging effects as inspection criteria for the circulating water system underwater visual inspections. The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Open-Cycle Cooling Water System Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancement and confirmed that its implementation through Commitment No. 18, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.15 Reactor Head Closure Studs Program

Summary of Technical Information in the Application. LRA Section B2.1.26 describes the existing Reactor Head Closure Studs Program as consistent, with an exception, with GALL AMP XI.M3, "Reactor Head Closure Studs." The applicant stated that this program manages the effects of cracking and loss of material for the reactor head closure stud assembly, including nuts, washers, and the threads in the reactor vessel flange. The applicant further stated that the program includes preventive measures identified in RG 1.65, and visual or volumetric examinations in compliance with the ASME Code Section XI, 1998 Edition through 2000 Addenda to monitor the aging degradation. The preventive measures of RG 1.65 include the use of appropriate fabrication materials, coatings, and lubricants, and operating practices to reduce the potential for corrosion and contamination of the reactor head closure stud assembly (including nuts, washers, and reactor pressure vessel (RPV) flange threads).

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff reviewed the material specification sheet and confirmed that the closure studs and nuts meet the material limitations of RG 1.65: the maximum tensile strength is less than 1,172 megapascal (MPa) (170 ksi) and to avoid material property degradation, the studs are not metal-plated. In addition, the staff confirmed that: (1) the studs have a manganese phosphate surface treatment to prevent SCC; (2) the lubricant does not include any unstable compounds identified in RG 1.65; and (3) when the head is removed, to avoid corrosion and contamination, the water level of the reactor cavity is 6 inches below the flange and the stud bolts and bolt holes are protected. The staff noted that these actions by the applicant are consistent with the "preventive actions" program element in GALL AMP XI.M3.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M3. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.M3.

The staff also reviewed the portions of the "scope of the program" program element associated with its exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception. LRA Section B2.1.26 states an exception to the "scope of the program" program element. The applicant stated its program is implemented using the guidance of the ASME Code Section XI, 1998 Edition through 2000 Addenda, instead of the ASME Code Section XI, 2001 Edition through 2003 Addenda recommended by the GALL Report. The applicant stated that use of the ASME Code Section XI, 1998 Edition through 2000 Addenda is consistent with the provisions in 10 CFR 50.55a, which requires licensees to use the ASME Code Section XI in effect 12 months prior to the start of the inspection interval. The applicant further stated that the 1998 Code Edition allows surface or volumetric examinations of the reactor head closure studs when they are removed, whereas the 2001 Code Edition provided for a volumetric examination when the studs are in place or removed. Consequently, the staff noted that the change in examination provisions has no impact on the program because volumetric examination of the studs is performed when the studs are removed.

Based on its review, the staff finds this exception acceptable because the applicant is complying with the inspection requirements of the ASME Code Section XI Edition 1998 through 2000 Addenda and is consistent with the recommendations of GALL AMP XI.M3.

Based on its audit, the staff finds that elements one through six of the applicant's Reactor Head Closure Studs Program, with an acceptable exception, are consistent with the corresponding program elements of GALL AMP XI.M3 and are, therefore, acceptable.

Operating Experience. LRA Section B2.1.26 summarizes OE related to the Reactor Head Closure Studs Program. The staff reviewed the OE in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During the audit, the staff reviewed the OE described in the applicant's program basis document and interviewed the applicant's technical staff to confirm that the plant-specific OE did not reveal any degradation not bounded by industry experience. The applicant stated that a review of its condition reports did not identify any reported cracking or loss of material for the closure studs. A review of the applicant's corrective action reports indicated two minor incidents: (1) exceeding elongation limit of one stud by 0.001 inch (2003) and (2) removal of a stud blemish (2006). The staff concluded that by complying with the guidelines identified in the RG 1.65 and by complying with the requirements of the ASME Code Section XI, the applicant demonstrated that it is capable of effectively managing the aging degradation of the reactor head closure stud assembly during the period of extended operation.

The staff found no OE to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.26 provides the USAR supplement for the Reactor Head Closure Studs Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.2-2.

The staff noted the preventive measures implemented by its program are consistent with the measures identified in RG 1.65. The staff also noted that a volumetric examination of the studs is performed when the studs are removed, which is consistent with the requirements of the ASME Code Section XI, 2001 Edition through 2003 Addenda.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Reactor Head Closure Studs Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.16 Reactor Vessel Surveillance Program

Summary of Technical Information in the Application. In LRA Section B2.1.27, the applicant described its Reactor Vessel Surveillance Program, stating that this existing program is consistent with GALL AMP XI.M31, "Reactor Vessel Surveillance," with the exception to keep the last RPV surveillance capsule in the vessel beyond 60 years of operation. The applicant also stated that this existing program will be enhanced to include: (1) the applicable limitations on operating conditions to which the surveillance capsules were exposed, and (2) requirements for storing, and possible recovery, of tested and untested capsules.

The Reactor Vessel Surveillance Program manages the aging effect of loss of fracture toughness due to irradiation embrittlement of the RPV low-alloy steel material. Monitoring methods are in accordance with 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements." This program includes surveillance capsule removal and specimen mechanical testing and evaluation, radiation analysis, development of pressure-temperature (P-T) limits, and determination of low-temperature overpressure protection (LTOP) set points. The program ensures the RPV materials meet the fracture toughness requirements of 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements," and meet pressurized thermal shock (PTS) and upper-shelf energy (USE) requirements in 10 CFR 50.60, "Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation," and 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," as modified by the exemption granted to utilize the Master Curve methodology throughout the period of extended operation.

Staff Evaluation. The staff reviewed the applicant's proposed Reactor Vessel Surveillance Program and confirmed the applicant's claim of consistency with the GALL Report with one exception and two enhancements.

Appendix H of 10 CFR Part 50 specifies surveillance program criteria for 40 years of operation. GALL AMP XI.M31 specifies additional criteria for 60 years of operation. The staff determined that compliance with 10 CFR Part 50, Appendix H criteria for capsule design, location, specimens, test procedures, and reporting remains appropriate for this AMP because these items, which satisfy 10 CFR Part 50, Appendix H, will stay the same throughout the period of extended operation. LRA Section B2.1.27 proposed an exception to keep the last RPV surveillance capsule in the vessel beyond 60 years of operation. However, to ensure that the last capsule, if removed and tested during the period of extended operation for any reason, still meets the test procedures and reporting requirements of ASTM E 185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," the staff plans to impose conditions to address this specific concern:

> All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of ASTM E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. All capsules placed in storage must be maintained for future insertion. Any changes to storage requirements must be approved by the NRC.

The 10 CFR 50, Appendix H capsule withdrawal schedule during the period of extended operation is addressed according to the GALL Report's consideration of eight criteria for an acceptable reactor vessel surveillance program for 60 years of operation.

The staff reviewed the exception and enhancements and the associated justifications to determine whether this AMP remains adequate to manage the aging effects for which it is credited.

Exception. The exception is to keep the last RPV surveillance capsule in the RPV beyond 60 years of operation, as opposed to a capsule withdrawal at 60-years of operation recommended by Criterion 6 of GALL AMP XI.M31. This exception to GALL AMP XI.M31 is acceptable to the staff because it is consistent with the current position of the Division of Component Integrity (DCI) of the Office of Nuclear Reactor Regulation (NRR) regarding RPV capsule withdrawal schedules during the period of extended operation. The current position, which has been conveyed to industry through the ASME Code meetings and other occasions, was prompted by the need to have a set of evenly-distributed, instead of clustered, high fluence surveillance data for the entire fleet of pressurized water reactors (PWRs) when there is a steady increase of plants joining integrated surveillance programs sponsored by the industry. The staff is in the process of revising GALL AMP XI.M31 to reflect this current DCI position of modifying Criterion 6.

Enhancement 1. The first enhancement is to include in the AMP the applicable limitations on operating conditions to which the surveillance capsules were exposed. However, since LRA Section B2.1.27 does not specify these limitations, the staff could not verify that this enhancement will satisfy Criteria 2, 3, and 6 of GALL AMP XI.M31, as stated in the LRA. Hence, the staff issued RAI B2.1.27-1 by letter dated Oct. 13, 2009.

> RAI B2.1.27-1:
>
> LRA Section B2.1.27, "Reactor Vessel Surveillance," states under Enhancement 1: "The Reactor Vessel Surveillance Program will be enhanced to include the

applicable limitations on operating conditions to which the surveillance capsules were exposed (e.g., neutron flux, spectrum, irradiation temperature, etc.)." Please provide details regarding these applicable limitations. Further, demonstrate that with this Enhancement the Reactor Vessel Surveillance Program meet[s] the acceptance criteria 2, 3, and 6 that were listed in GALL Aging Management Program (AMP) XI.M31, "Reactor Vessel Surveillance."

The applicant responded to RAI B2.1.27-1 in its letter dated November 13, 2009, that Enhancement 1 will ensure that:

(1) Changes in plant parameters (e.g., operating temperature, neutron fluence) to which reactor vessel materials are exposed, are evaluated for the effect on the applicability of RG 1.99, Revision 2, Radiation Embrittlement of Reactor Vessel Materials, Regulatory Position 1, as discussed in the GALL Report, Section XI.M31, item 2.

(2) Plant parameters (e.g., cold leg temperature, neutron fluence) remain within the bounds defined for the surveillance data used as input to the embrittlement evaluations, as discussed in the GALL Report, Section XI.M31, item 3.

(3) Reactor vessel exposure conditions (e.g., neutron flux, spectrum, irradiation temperature, etc.) are monitored to ensure that the actual exposure conditions remain consistent with those used to project the effects of embrittlement to the end of the period of extended operation, as discussed in the GALL Report, Section XI.M31, item 6.

The staff noted that the additional information clearly indicates Enhancement 1 is designed to address acceptance criteria 2, 3, and 6 in GALL AMP XI.M31. Hence, RAI B2.1.27-1 is resolved. Since Enhancement 1 is to upgrade the current Reactor Vessel Surveillance Program to meet the GALL AMP XI.M31 requirements, the staff considers Enhancement 1 acceptable.

Enhancement 2. The second enhancement is to include requirements for storing, and possible recovery, of tested and untested capsules. Criterion 4 of GALL AMP XI.M31 recommends, "[a]ll pulled and tested capsules, unless discarded before August 31, 2000, are placed in storage. (Note: These specimens are saved for future reconstitution use, in case the surveillance program is reestablished.)" The emphasis of Criterion 4 of GALL AMP XI.M31 is tested specimens, not capsules. The staff, therefore, concludes that Enhancement 2 is acceptable because it expands the scope of Criterion 4 of GALL AMP XI.M31 to include requirements for storing tested and untested capsules. Through capsule retention, the overall task of irradiating archival or reconstituted specimens becomes easier to manage.

Hence, the exception and enhancements represent modifications to GALL AMP XI.M31, which are considered acceptable and credible as discussed above. The staff's review of the AMP addressing the remaining acceptable criteria in GALL AMP XI.M31 is presented below.

Criterion 1 is automatically satisfied when RG 1.99, Revision 2 is appropriately used in the applicant's evaluation of USE, PTS, and P-T limits. Criterion 5 is for plants having a surveillance program that consists of capsules with a projected fluence of less than the 60-year fluence at the end of 40 years, and Criterion 6 is for plants having a surveillance program that consists of capsules with a projected fluence exceeding the 60-year fluence at the end of 40 years. LRA Section B2.1.27 states, "Capsule N, the last remaining surveillance capsule, has currently accumulated a neutron fluence greater than that projected for 60 years of operation." Therefore, instead of Criterion 5, Criterion 6 is applicable to the AMP. However, as discussed in the staff's evaluation of the exception proposed in LRA Section B2.1.27, the current DCI position will modify Criterion 6. Hence, meeting the entire Criterion 6 is no longer needed.

Criterion 7 provides guidelines for applicants without surveillance capsules. The applicant has a capsule in the RPV to monitor neutron fluence during the period of extended operation. Therefore, Criterion 7 does not apply to the AMP. Criterion 8 relates to the need to include the RPV nozzle materials in the AMP. Based on the staff's evaluations and conclusions of SER Section 4.2.2 on Charpy USE and SER Section 4.2.3 on PTS, it is clear that the RPV nozzle materials are not controlling. Therefore, Criterion 8 is satisfied.

For the CLB and the period of extended operation, the applicant's Reactor Vessel Surveillance Program is different from other plants' surveillance programs in one aspect: the irradiated specimens for the circumferential weld metal are tested to obtain directly measured fracture toughness data in accordance with the Master Curve method as defined in an NRC safety evaluation dated May 1, 2001, which supported granting the applicant an exemption from the requirements of 10 CFR 50, Appendix G, Appendix H, and 10 CFR 50.61 (ADAMS Accession No. ML011210180). However, since the applicant's 2006 Master Curve test results support the period of extended operation, the applicant will not perform any additional surveillance specimen testing during the period of extended operation. The 2006 Master Curve test results are evaluated in SER Section 4.2.3.

Operating Experience. In LRA Section B2.1.27, the applicant stated that its Reactor Vessel Surveillance Program has provided material embrittlement and dosimetry data since plant startup and the test results have been reviewed for use in the current operating term. The LRA also says that the applicant's 2006 self-assessment of the Reactor Vessel Integrity Program revealed no issues or findings that could impact the effectiveness of this program.
The staff noted that this conclusion is reasonable because to date, the applicant has provided surveillance reports to the staff indicating no difficulty in obtaining fluence and embrittled material information from the surveillance specimens. The staff's acceptance of the applicant's TLAAs on PTS (SER Section 4.2.3) and P-T limits (SER Section 4.2.4) also supports the effectiveness of this AMP. Therefore, the staff determines that the applicant has provided an appropriate description of its plant-specific OE.

Based on the staff's evaluation of the proposed exception and enhancements of the applicant's AMP and consistency of the AMP with the eight criteria of GALL AMP XI.M31, the staff considers the AMP acceptable.

USAR Supplement. The applicant provided its USAR supplement for the Reactor Vessel Surveillance Program in LRA Section A2.1.27. Appendix H of 10 CFR Part 50 requires licensees to submit proposed changes to their Reactor Vessel Surveillance Program withdrawal schedules to the staff for review and approval. To ensure that this reporting requirement will carry forward through the period of extended operation, the staff has imposed a license condition to the applicant's Reactor Vessel Surveillance Program as stated earlier in the staff's evaluation. The staff reviewed the USAR supplement and determines that the information in the supplement, with the license condition, provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Reactor Vessel Surveillance Program and RAI responses, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. The staff reviewed the exception and confirmed that the implementation of it is consistent with the current DCI position and meets the objective of GALL AMP XI.M31. Also, the staff reviewed the enhancements and confirmed that the improvement labeled as "Enhancement 1" will upgrade the existing AMP to meet the GALL AMP XI.M31 requirements, and Enhancement 2 will upgrade the existing AMP to exceed the GALL AMP XI.M31 requirements. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that, with the license condition, it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.17 Steam Generator Tube Integrity Program

Summary of Technical Information in the Application. LRA Section B.2.1.30 describes the existing Steam Generator Tube Integrity Program as being consistent, with an exception, with GALL AMP XI.M19, "Steam Generator Tube Integrity." The applicant stated that the program manages the aging effects of cracking and loss of material for the primary and secondary-side steam generator components made of Ni alloy, stainless steel, and steel. The applicant also stated that the program is based on TS requirements and meets the intent of NEI 97-06, "Steam Generator Program Guidelines." The applicant credited its program for aging management of the tubes, tube plugs, tube sleeves, tube supports, and secondary-side components whose failure could prevent the steam generator from fulfilling its intended safety function. The applicant stated that the program manages aging effects by providing a balance of prevention, inspection, evaluation, repair, and leakage monitoring. The applicant explained that this program: (1) enables it to verify the effectiveness of the Primary Water Chemistry and Secondary Water Chemistry programs; (2) includes foreign material exclusion requirements; and (3) is able to detect flaws in tubes, tube plugs, tube sleeves, tube supports, and secondary-side components needed to maintain tube integrity by using degradation assessments, eddy current testing, and visual inspections. The applicant further stated that it "continually controls the primary-to-secondary leakage during operation."

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

LRA Section B2.1.30 states that the Primary Water Chemistry and Secondary Water Chemistry programs provide preventive measures. During its review, the staff noted that the applicant is following water chemistry guidelines other than those recommended in GALL AMP XI.M19. The applicant stated in LRA Section B2.1.24 that primary water chemistry control is based on the industry guidelines for primary water chemistry, EPRI 1002884 (formerly TR-105714), "Pressurized Water Reactor Primary Water Chemistry Guidelines," Revision 6. The applicant further stated in LRA Section B2.1.28 that secondary water chemistry control is based on the industry guidelines for secondary water chemistry, EPRI 1008224 (formerly TR-102134), "Pressurized Water Reactor Secondary Water Chemistry Guidelines," Revision 6. The staff finds that the use of these more recent guidelines is consistent with GALL AMP XI.M2, which states that the water chemistry program for PWRs relies on monitoring and control of reactor water chemistry based on industry guidelines for primary water and secondary water chemistry, such as EPRI TR-105714, Revision 3 and TR-102134, Revision 3. Since the "preventive actions" program element of GALL AMP XI.M19 refers to GALL AMP XI.M2 for monitoring and maintaining reactor water chemistry, the staff finds this aspect of GALL AMP XI.M19 "preventive actions" program element acceptable.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP XI.M19. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP XI.M19, with the exception of the "scope of the program," "preventive actions," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements. For these program elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs as discussed below.

During its audit, the staff identified one broad issue that affects all program elements and renders them inconsistent with GALL AMP XI.M19. The staff identified numerous inconsistencies between the applicant's program and its implementing documents and industry guidance documents. The staff noted that these inconsistencies can be categorized into three groups: (1) reference and document versions are inconsistent with guidance documents and among applicant procedures, (2) industry guidelines and/or plant TSs have been misinterpreted or misapplied in applicant implementing procedures, and (3) applicant implementing procedures are inconsistent both internally and between documents.

By letter dated July 13, 2009, the staff issued RAIs B2.1.30-1, B2.1.30-2, B2.1.30-4, and B2.1.30-11 to address the first category of inconsistencies (i.e., reference and document versions are inconsistent with guidance documents and among applicant procedures). The staff's evaluation of each RAI is discussed below.

In RAI B2.1.30-1 dated July 13, 2009, the staff requested that the applicant discuss its plans for modifying its program basis document for the Steam Generator Tube Integrity Program, which supports LRA Section B2.1.30, to be consistent with the updated references and provide the list of references.

In its response dated August 17, 2009, the applicant stated that this document has been updated to reflect the revised references and the applicant provided the revised list of references.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-1 acceptable because the staff reviewed the updated references and the references provided are consistent with the applicant's other implementing procedures.

In RAI B2.1.30-4 dated July 13, 2009, the staff requested that the applicant address the inconsistency in the regulatory requirements section of its program document, ER-AP-SGP-101, "Steam Generator Program," which does not appear to list all of the regulatory requirements identified in NEI 97-06.

In its response dated August 17, 2009, the applicant stated that this program section was not intended to include a complete listing of regulatory requirements identified in NEI 97-06, Revision 2, and the applicant took corrective actions to clarify this issue by relocating the documents listed in Section 3.1.9 to the reference section of this procedure.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-4 acceptable because the applicant's actions to relocate the documents listed in Section 3.1.9 to the reference section of this procedure eliminates the prior ambiguity.

In RAI B2.1.30-2 dated July 13, 2009, the staff requested that the applicant confirm whether its program document, SP-36-084, "Steam Generator Tube Inspection," Revision 0, has been updated to reflect the latest version of the EPRI guidelines and to provide its plan to ensure that future updates to the guidelines will be incorporated in a timely manner.

In its response dated August 17, 2009, the applicant confirmed that this procedure needs to be updated. The applicant also explained that the need to update this procedure has been documented in the corrective action program to ensure that it is revised in a timely manner. The applicant stated that, in order to ensure that future updates are incorporated in a timely manner, the procedure SP-36-084 will also be revised to reference fleet program document ER-AP-SGP-101, "Steam Generator Program," which implements the latest version of EPRI PWR Steam Generator Examination Guidelines.

Based on its review, the staff found the applicant's response to RAI B2.1.30-2 unacceptable because the staff could not verify that the modifications to be made to the procedure will be consistent with GALL AMP XI.M19. The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

In RAI B2.1.30-11 dated July 13, 2009, the staff requested that the applicant address whether the secondary-side integrity plan references are current and, if not, to specify its plans for updating this document.

In its response dated August 17, 2009, the applicant stated that the secondary-side integrity plan has been reviewed and it was determined that it references outdated documents as identified during the staff's review. The applicant also stated that this condition has been documented in the corrective action program to ensure that the secondary-side integrity plan references are updated during the next revision of the plan.

Based on its review, the staff found the applicant's response to RAI B2.1.30-11 unacceptable because the staff could not verify that the modifications to be made to the procedure will be consistent with GALL AMP XI.M19. The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

By letter dated July 13, 2009, the staff issued RAIs B2.1.30-3, B2.1.30-5, and B2.1.30-6 through B2.1.30-10 to address the second category of inconsistencies (i.e., industry guidelines and/or applicant TSs that have been misinterpreted or misapplied in applicant implementing procedures). The staff's evaluation of each RAI is discussed below.

In RAI B2.1.30-6 dated July 13, 2009, the staff requested that the applicant discuss whether Section 3.2.5 of ER-AP-SGP-102 is sufficient for verifying tube integrity for loads other than that associated with differential pressure, and if it is not sufficient, to discuss its plans for modifying this section to reflect all the loads that must be considered per NEI 97-06 and the plant's TSs.

In its response dated August 17, 2009, the applicant stated that Section 3.2.5 of ER-AP-SGP-102 has been revised to state that in-situ pressure testing is performed in accordance with the EPRI Steam Generator In-situ Pressure Test guidelines and that Section 3.2.1 of ER-AP-SGP-101 includes the structural integrity performance criterion in NEI 97-06.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-6 acceptable because the applicant will consider all loads to determine the test pressure for verifying tube integrity in accordance with the EPRI Steam Generator In-situ Pressure Test Guidelines called for by NEI 97-06 and, therefore, with GALL AMP XI.M19.

In RAI B2.1.30-8 dated July 13, 2009, the staff requested that the applicant discuss if the procedure ER-AP-SGP-103, "Condition Monitoring and Operational Assessment," is also applicable when steam generator tubes are plugged (without inspection), in accordance with NEI 97-06 and the plant's TSs.

In its response dated August 17, 2009, the applicant stated that ER-AP-SGP-103, "Condition Monitoring and Operational Assessment," has been revised to include the applicability of the procedure when steam generator tubes are plugged.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-8 acceptable because the applicant's procedure is consistent with its TS requirements and NEI 97-06 and, therefore, with GALL AMP XI.M19.

In RAI B2.1.30-9 dated July 13, 2009, the staff requested that the applicant discuss how its program ensures the NEI 97-06 accident-induced leakage criteria will be met, given that there may be accident-induced leakage without observing operational leakage, and that Section 3.2.5 of ER-AP-SGP-103, "Condition Monitoring and Operational Assessment," appears to only require an assessment of accident-induced leakage when operational leakage is observed.

In its response dated August 17, 2009, the applicant stated that ER-AP-SGP-103, "Condition Monitoring and Operational Assessment," has been revised to clarify that accident-induced leakage requires an assessment even if no operational leakage is observed.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-9 acceptable because it is consistent with NEI 97-06 and OE and, therefore, with GALL AMP XI.M19.

In RAI B2.1.30-10 dated July 13, 2009, the staff requested that the applicant discuss why only those conditions identified in the procedure as increasing the differential pressure across the tubes are required to be assessed, since there may be other conditions that result in an increase in the differential pressure across the tubes (e.g., fouling).

In its response dated August 17, 2009, the applicant stated that a revision to ER-AP-SGP-103 relocates this information to ER-AP-SGP-101, "Steam Generator Program," and clarified that there may be other conditions resulting in increased differential pressure across the tubes requiring an operational assessment.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-10 acceptable because it is consistent with NEI 97-06 and OE and, therefore, with GALL AMP XI.M19.

During its audit, the staff reviewed the applicant's surveillance procedure for steam generator tube inspection and identified several discrepancies between the industry guidelines (referenced in NEI 97-06, Revision 2), the plant's TSs, and the plant procedure.

In RAI B2.1.30-3 dated July 13, 2009, the staff requested that the applicant address the discrepancies between the industry guidelines (referenced in NEI 97-06, Revision 2), the plant's TSs, and the plant procedure.

In its response dated August 17, 2009, the applicant stated that the discrepancies identified in RAI B2.1.30-3 have been documented in the corrective action program and the proposed changes for each issue are to be implemented in the next revision of the surveillance procedure for steam generator tube inspection.

Based on its review, the staff found the applicant's response to RAI B2.1.30-3 unacceptable because the staff could not verify that the modifications to be made to the procedure will be consistent with GALL AMP XI.M19. The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

In RAI B2.1.30-5 dated July 13, 2009, the staff requested, in part, that the applicant clarify how it could ensure tube integrity prior to the inspection as discussed in ER-AP-SGP-102, "Steam Generator Degradation Assessment."

In its response dated August 17, 2009, the applicant stated that Section 3.2.1.d of ER-AP-SGP-102 implements the requirement of EPRI Steam Generator Integrity Assessment Guidelines, Revision 2, Section 3.4.

Based on its review, the staff found the applicant's response to RAI B2.1.30-5 unacceptable because the response was incomplete, since the staff noted that, although it is acceptable to determine the repair limit prior to the inspection in order to ensure tube integrity for the operating interval between inspections, the adequacy of this repair limit (determined prior to the inspection) must be confirmed after the inspection once the inspection results are available. The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

In RAI B2.1.30-7 dated July 13, 2009, the staff requested that the applicant address how growth rates are considered in the condition monitoring evaluation and the need to reference the probability and confidence level for assessment of compliance with the accident-induced leakage performance criteria in ER-AP-SGP-103, "Condition Monitoring and Operational Assessment."

In its response dated August 17, 2009, the applicant stated that Section 3.2.2 of ER-AP-SGP 103, "Condition Monitoring and Operational Assessment," reproduces the requirement of EPRI Steam Generator Integrity Assessment Guidelines, Section 7.6.

Based on its review, the staff found the applicant's response to RAI B2.1.30-7 unacceptable because staff did not have the initial text in Section 3.2.2 of ER-AP-SGP-103 or in ER-AP-SGP-101 to verify the adequacy of the applicant's response. The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

By letter dated July 13, 2009, the staff issued RAIs B2.1.30-5, B2.1.30-12, and B2.1.30-13 to address the third category of inconsistencies (i.e., applicant implementing procedures are inconsistent both internally and between documents). The staff's evaluation of each RAI is discussed below.

In RAI B2.1.30-5 dated July 13, 2009, the staff requested, in part, that the applicant clarify when its guidance documents would be updated since ER-AP-SGP-101 and ER-AP-SGP-102 contained conflicting requirements.

In its response dated August 17, 2009, the applicant stated that Section 3.1.3 of ER-AP-SGP-102 was clarified to require compliance with the latest revision of the EPRI guidelines within the timeframe in the transmittal letter for the new guidelines.

Based on its review, the staff finds the applicant's response to this part of RAI B2.1.30-5 acceptable because this is consistent with NEI 97-06 and ER-AP-SGP-101 and, therefore, with GALL AMP XI.M19.

In RAI B2.1.30-13 dated July 13, 2009, the staff requested that the applicant review ER-AP-SGP-10, "Steam Generator Program Description," and ER-AP-SGP-101, "Steam Generator Program," in order to clarify if the responsibilities of each person involved in the Steam Generator Program are identified correctly and consistently.

In its response dated August 17, 2009, the applicant stated that these procedures have been reviewed and revised, where necessary, to clarify the responsibilities of each person involved in the Steam Generator Program. The applicant also stated that all fleet Steam Generator Program procedures have been reviewed and revised, as necessary, to ensure responsibilities are identified consistently.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-13 acceptable because the applicant corrected the inconsistencies identified by the staff during the audit and widened its review and revision to all fleet Steam Generator Program procedures.

In RAI B2.1.30-12 dated July 13, 2009, the staff requested that the applicant address the discrepancy between Section 6.3 of the steam generator secondary-side integrity plan, which makes "recommendations" on sludge lancing, and Section 3.3.6 of ER-AP-SGP-101, "Steam Generator Program," which requires a plan.

In its response dated August 17, 2009, the applicant stated that the steam generator secondary-side integrity plan had been reviewed for consistency with ER-AP-SGP-101, Section 3.6.6. The applicant stated that, as a result of this review, the steam generator secondary-side integrity plan has been determined to be consistent with Section 3.6.6 of ER-AP-SGP-101.

Based on its review, the staff found the applicant's response to RAI B2.1.30-12 unacceptable because staff did not have all the required information to confirm the adequacy of the applicant's response (i.e., that the applicant has plans for performing secondary-side inspections and maintenance). The resolution of this issue is discussed below during discussion of RAI B2.1.30-17.

The staff noted that for RAIs B2.1.30-2, B2.1.30-3, B2.1.30-5, B2.1.30-7, B2.1.30-11, and B2.1.30-12, the staff found the applicant's responses inadequate because the staff was not able to verify that the modifications to be made to the procedure and/or implementing documents will be consistent with GALL AMP XI.M19. By letter dated March 11, 2010, the staff issued the follow-up RAI B2.1.30-17 requesting that the applicant confirm that the modifications it will implement through its corrective action program, in its different documents, will be such that elements one through six of its Steam Generator Tube Integrity Program will be consistent with the corresponding program elements of GALL AMP XI.M19, before entering the period of extended operation for RAIs B2.1.30-2, B2.1.30-3, B2.1.30-5, B2.1.30-7, B2.1.30-11, and B2.1.30-12.

In its response dated March 26, 2010, the applicant stated that the modifications to the Steam Generator Tube Integrity Program and associated implementing documents discussed in the responses to RAIs B2.1.30-2, B2.1.30-3, B2.1.30-5, B2.1.30-7, B2.1.30-11, and B2.1.30-12 have been completed. The applicant further stated that no changes to the Steam Generator Tube Integrity Program are required and the program remains consistent with GALL AMP XI.M19, "Steam Generator Tube Integrity."

Based on its review, the staff finds the applicant's response to RAI B2.1.30-17 acceptable because the applicant has confirmed that it has completed all the modifications discussed in its answers to RAIs B2.1.30-2, B2.1.30-3, B2.1.30-5, B2.1.30-7, B2.1.30-11, and B2.1.30-12 in order to make its implementing documents consistent with its TSs, industry guidelines and, therefore, with all elements of GALL AMP XI.M19. The staff's concerns described in RAIs B2.1.30-2, B2.1.30-3, B2.1.30-5, B2.1.30-7, B2.1.30-11, B2.1.30-12, and B2.1.30-17 are resolved.

Exception. The staff also reviewed the portions of the applicant's program elements associated with the exception to determine whether the program will adequately manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

LRA Section B.2.1.30 states an exception to the program in that the applicant's Steam Generator Tube Integrity Program is implemented using Revision 2 of NEI 97-06, whereas GALL AMP XI.M19 recommends the use of Revision 1 of NEI 97-06, "Steam Generator Program Guidelines." The applicant justified its use of Revision 2 based on the staff-approved KPS Technical Specification Amendment (ADAMS Accession Nos. ML061700091 and ML062430179) that incorporated Technical Specification Task Force Traveler 449, Revision 4, "Steam Generator Tube Integrity."

Since Revision 2 of NEI 97-06 is consistent with the applicant's TSs, the staff finds this exception to GALL AMP XI.M19 acceptable.

Based on its audit and review of the applicant's responses to the RAIs discussed above, the staff finds that elements one through six of the applicant's Steam Generator Tube Integrity Program, with an acceptable exception, are consistent with the corresponding program elements of GALL AMP XI.M19 and, therefore, acceptable.

Operating Experience. LRA Section B2.1.30 summarizes OE related to the Steam Generator Tube Integrity Program. The staff reviewed this information and interviewed the applicant's technical personnel to confirm that the applicable aging effects and industry and plant-specific OE have been reviewed by the applicant. During the audit, the staff independently confirmed that the applicant had adequately incorporated and evaluated OE related to this program.

The staff noted that due to tube degradation, the applicant replaced the original Westinghouse Model 51 steam generators with Westinghouse Model 54Fs in 2001. The applicant stated that, although similar in general design concept and capacity, the replacement steam generators incorporated a number of design improvements in response to OE with recirculating-type steam generators. The staff noted that the major improvements are based on the choice of corrosion resistant materials and on modifications of the upper part of steam generators.

In its LRA, the applicant also provided two examples of plant-specific OE, based on its review of corrective action program items that it considered in evaluating the effectiveness of the program:

> In 2006, during implementation of a work order to visually inspect the annulus, tube lane, and a sample of in-bundle columns of its steam generators, five foreign objects were located in its "A" Steam Generator and nine foreign objects were located in the "B" Steam Generator. The retrieval efforts were 100 percent successful and all objects were removed from the steam generators. Eddy current inspection concluded that there were no indications that require repair.

The applicant stated further that through the 2008 refueling outage, there were zero tubes plugged and zero sleeves installed in either steam generator.

The staff also reviewed the OE documents provided by the applicant for the audit. During its audit, the staff interviewed the applicant's technical personnel to confirm that the plant-specific OE did not reveal any aging effects not bounded by the GALL Report. The staff confirmed that applicable aging effects and industry and plant-specific OE have been evaluated and incorporated into the Steam Generator Tube Integrity Program.

Based on its review, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and implementation of this program has resulted in the applicant taking corrective actions. Therefore, the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.30 provides the USAR supplement for the Steam Generator Tube Integrity Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.1-2. The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Steam Generator Tube Integrity Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.18 Structures Monitoring Program

Summary of Technical Information in the Application. LRA Section B2.1.31 describes the existing Structures Monitoring Program as being consistent, with enhancements, to GALL AMPs 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." In the LRA, the applicant stated that the existing program manages the aging effects of:

- Concrete structural elements for cracking, loss of bond, loss of material, cracks and distortion, increase in porosity and permeability, loss of strength, and reduction in concrete anchor capacity due to local concrete degradation. The program performs opportunistic inspections of inaccessible concrete.
- Masonry walls for cracking.
- Structural steel elements and component supports, including anchoring system, bolts and fasteners, stainless steel, and aluminum for loss of material and loss of mechanical function. This includes structural steel for steel edge supports for masonry walls.

- Non-metallic structural commodities for change in material properties, cracking, increased hardness, shrinkage and loss of strength, loss of sealing, and reduction or loss of isolation function for elastomers.

The applicant also stated in the LRA that the Structures Monitoring Program implements the requirements of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," with the guidance of NUMARC 93-01, Revision 2, and RG 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." In the LRA, the applicant further stated that the program performs periodic visual inspections to monitor the condition of the structures, structural elements, miscellaneous structural commodities, water controlled structures, and masonry walls.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMPs XI.S5, XI.S6, and XI.S7. As discussed in the Audit Report, the staff confirmed that these elements are consistent with the corresponding elements of GALL AMP XI.S6. However, the staff needed further clarification to verify the consistency of program elements "parameters monitored or inspected" and "detection of aging effects" with GALL AMPs XI.S5 and XI.S7. Therefore, by letter dated July 13, 2009, the staff issued RAI B2.1.31-2 asking the applicant to include all the references for implementation in the element by element comparison.

In its response dated August 17, 2009, the applicant stated that it had initiated a change to include the following references during the next update of the Structures Monitoring Program:

- Program Element: 3-Parameters Monitored or Inspected
  [American Concrete Institute] ACI 349.3R-96 and ANSI/ASCE 11-90

- Program Element: 4-Detection of Aging Effects
  ACI 349.3R-96, ANSI/ASCE 11-90, and RG 1.127

During its review of the applicant's response, the staff issued follow-up RAI B2.1.31-2a by letter dated November 20, 2009, requesting that the applicant provide a list of applicable parameters of GALL AMP XI.S7, element 3, and indicate how those parameters will be monitored or inspected. In its response dated December 28, 2009, the applicant provided the list of the parameters that are applicable to its water-control structures within the scope of license renewal. The applicant further stated that it will use the Structures Monitoring Program to monitor those parameters.

Based on its review, the staff finds the applicant's response to RAI B2.1.31-2 and follow-up RAI B2.1.31-2a acceptable because the applicant included the necessary references and provided the list of parameters that will be monitored for KPS water-control structures. The staff also confirmed that those parameters can be adequately monitored by the applicant's Structures Monitoring Program. The staff's concerns described in RAIs B2.1.31-2 and B2.1.31-2a are resolved.

Enhancement 1. In LRA Section B2.1.31, the applicant included an enhancement to "Define In-Scope Structural Elements," to enhance program element 1, "scope of the program." This enhancement clearly defines all the structures, structural elements, and miscellaneous structural commodities that are in scope. LRA Section 2.4 describes in detail the scoping and screening results for structures. Also, the staff reviewed the on-site document that provides information about the in-scope structures, including the components. The staff noted that LRA Section B2.1.31 and the program basis document state that structural elements, including bolting and fasteners, include such items as platforms, gratings, and component supports. Component supports are comprised of supports of the non-ASME Code piping; mechanical and electrical components (including their anchorage); heating, ventilation, and air conditioning (HVAC) ducts; and cable trays and conduits. Specialty items include sliding support surfaces and vibration isolation elements (non-metallic), base plate grout pads, and local concrete at expansion anchors. Miscellaneous structural commodities include such items as HELB barriers, flood barriers, electrical panels and cabinets, bus duct enclosures and gaskets, seals, and sealants. According to the onsite program basis documents, the masonry walls, including steel edged supports, identified in the response to IEB 80-11, are within the scope of the Structures Monitoring Program. The applicant confirmed that if the structure is within the scope of license renewal, then all masonry walls within that structure are in-scope.

On the basis of its review, the staff finds this enhancement acceptable because when it is implemented prior to the period of extended operation, it will be make the program consistent with the recommendations in GALL AMPs XI.S5, XI.S6, and XI.S7.

Enhancement 2. In LRA Section B2.1.31, the applicant stated a further enhancement to program element 1, "scope of the program." This enhancement will periodically monitor groundwater to verify that the groundwater chemistry (e.g., pH, chlorides, and sulfates) remains non-aggressive during the period of extended operation. The staff reviewed the program basis document and found that the frequency of monitoring groundwater chemistry will be at least once every 5 years during the period of extended operation and will take into consideration seasonal variations. The staff also noted evidence of high chlorides and sulfates in LRA Section 3.5.2.2.1.1 and in condition reports, as stated in the audit report.

Therefore, by letter dated July 13, 2009, RAI B2.1.31-3 was issued asking the applicant to:

(a) describe past and present groundwater monitoring activities at KPS, including the results for sulfates, pH, and chlorides

(b) provide the location(s) where test samples were or are taken relative to the safety-related and important-to-safety embedded concrete foundations

(c) indicate seasonal variations

(d) explain the technical basis and acceptance criteria

In its response by letter dated August 17, 2009, the applicant stated that the groundwater samples taken in June 2007; March, July, August, and October 2008; and March and June 2009 indicate a chloride range from 34 ppm to 1,240 ppm. The applicant stated that average chloride readings from the eight wells selected for monitoring for license renewal varied from 120 ppm to 640 ppm. The applicant also stated that use of de-icing salt is the most likely contributor to the elevated chloride concentration found in these wells, and that use of salt, instead of sand as a deicer, for the paved area began sometime between 1992 and 2000. Furthermore, the applicant stated that a 40 mil thick (0.040 inch) PVC waterproofing membrane was installed over the concrete surface which minimizes direct contact between the concrete structures and the groundwater environment.

Based on its review of the applicant's response, the staff issued follow-up RAI B2.1.31-3a, by letter dated November 20, 2009, requesting that the applicant provide the following information:

(a) Show the well locations with reference to the structures on the plant general arrangement plan drawing and indicate the maximum and average chloride content of the groundwater. This should identify the safety-related structures that are located in the areas where the chloride content has been found to be greater than 500 ppm.

(b) Demonstrate that the current level of chloride in the groundwater is not causing any degradation to the structures.

(c) Address the ability of the water proofing membrane to resist ingress of water in the concrete structure based on the plant-specific or/and industrywide experience.

The applicant responded to the follow-up RAI B2.1.31-3a by letter dated December 28 2009. During its review of the response, the staff noted that the maximum chloride content of six out of eight wells exceeded the GALL Report limit for chloride content (less than 500 ppm) and that these wells are located close to the safety-related structures. The staff noted that the groundwater table is 17 feet below grade level, and some parts of the structures are located below the groundwater level. The applicant has credited the water proofing membrane that was provided during initial construction to provide protection for the below-grade concrete structures. The applicant stated that it discontinued the use of sodium chloride-based de-icing products to reduce the possible mechanism, and is currently using pelletized calcium chloride mixed with sand. The applicant expects this new action will reduce the chloride content in the groundwater; however, the applicant provided no evidence that the below-grade concrete has not experienced degradation due to its exposure to groundwater with elevated chloride levels.

The staff held a conference call with the applicant on January 21, 2010, to discuss the aggressive groundwater and its effect on the below-grade structures. During the call, the staff explained that the applicant needed to provide evidence that the concrete has not degraded due to its exposure to an aggressive environment. The staff asked the applicant what actions would be taken if, in the future, the chloride content in the groundwater does not drop below acceptable limits.

By letter dated February 15, 2010, the applicant submitted a supplemental response to address the staff's concerns discussed during the conference call. In its response, the applicant committed to take concrete core samples from the inside surface of a concrete wall, or from the foundation basemat, below the groundwater table elevation in the vicinity of groundwater wells for which the average sampling results have exceeded the chloride limit (Commitment No. 44). The applicant further explained that the cores will be tested to determine if the chloride content within the concrete could cause degradation due to corrosion of reinforcing steel. The applicant also committed to repeat the concrete core sampling prior to the end of the first 10 years of extended operation if the chloride content in the groundwater does not drop below the 500 ppm limit (Commitment No. 45).

The staff reviewed the applicant's response and commitments and found them acceptable because they explain how concrete bore samples will be used to verify that exposure to an aggressive groundwater environment has not degraded the concrete. If the concrete samples reveal any degradation in the concrete or reinforcing steel, the results will be entered into the corrective action program and dealt with appropriately. The response also explains what actions would be taken during the period of extended operation if the groundwater chloride content does not drop below the acceptable 500 ppm limit. Since the applicant has committed to actions which will verify that the aggressive groundwater environment has not degraded the inaccessible concrete, the staff finds the applicant's approach acceptable and the staff's concerns in RAI B2.1.31-3a are resolved.

On the basis of its review, including RAIs B2.1.31-3 and B2.1.31-3a, the staff finds this enhancement acceptable because when it is implemented prior to the period of extended operation, it will make the program consistent with the recommendations in GALL AMPs XI.S5, XI.S6, and XI.S7.

Enhancement 3. In LRA Section B2.1.31, the applicant stated an enhancement to program element 3, "parameters monitored or inspected"; program element 5, "monitoring and trending"; and program element 6, "acceptance criteria," by including provisions for underwater inspection. During the audit, the staff reviewed the onsite document that provides instructions for underwater inspection and repair. The staff also found that the program will be enhanced to require inspection of submerged structures in raw water on a frequency of 5 years. Inspection will be performed by a diver or by using remote video or other special safety equipment. During the audit, the staff reviewed the applicant's Preventive Maintenance Procedure for circulating water inlet and discharge structure inspection. This document provides instructions for diver inspection, cleaning, and repair, if required, of the circulating water inlet and discharge structures, forebay and screenhouse, as well as actions for zebra mussels and other organic macro-fouling as contained in GL 89-13 related to "Service Water System Problem."

On the basis of its review, the staff finds this enhancement acceptable because when it is implemented prior to the period of extended operation, it will make the program consistent with the recommendations in GALL AMPs XI.S5, XI.S6, and XI.S7.

Subsequent to the issuance of the SER on November 4, 2010, the staff identified three areas which required additional clarification from the applicant related to the inspection frequency of the Masonry Wall and Structures Monitoring programs, and to the acceptance criteria of the Structures Monitoring Program.

GALL AMP XI.S6, "Structures Monitoring Program," states that ACI 349.3R is an acceptable basis for selection of parameters monitored for detection of aging effects (i.e., inspection interval) and for acceptance criteria. The applicant had previously stated that it would list ACI 349.3R as a reference for its Structures Monitoring Program; however, it did not clearly state that the AMP's inspection interval and acceptance criteria would align with ACI 349.3R.

The staff discussed this issue with the applicant during a conference call on November 17, 2010. By letter dated November 23, 2010, the applicant responded. In its response, the applicant stated that the inspection frequency for both the Structures Monitoring Program and the Masonry Wall Program was 5 years. The applicant also committed to include the acceptance criteria in ACI 349.3R as the criteria to be used when evaluating concrete structures (Commitment No. 54). The staff reviewed the applicant's response and found it acceptable because the applicant clarified that the inspection interval for both programs was at least as conservative as the recommended interval in ACI 349.3R and committed to implement the quantitative acceptance criteria recommended in ACI 349.3R. The staff's concerns related to the inspection frequency for the Masonry Wall and Structures Monitoring Programs and the acceptance criteria for the Structures Monitoring Program are resolved.

Based on its audit and review of the applicant's responses to RAIs B2.1.31-2, B2.1.31-3, and the corresponding follow-up RAIs, as well as the additional clarifying information in the applicant's letter of November 23, 2010, the staff finds that elements one through six of the applicant's Structures Monitoring Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL AMPs XI.S5, XI.S6, and XI.S7 and are, therefore, acceptable.

Operating Experience. The staff reviewed the OE provided in LRA Section B2.1.31. The staff also searched and reviewed onsite documents, condition reports, and corrective action requests. The LRA states that during the 1997 periodic structure monitoring inspections of the screenhouse and tunnel, the applicant observed cracking with leaching. In March 2003, the applicant observed multiple concrete degradation mechanisms on a wall. The localized deficiencies and aging included cracking, leaching, patterned cracking, and a slight surface offset. Follow-up inspections by the applicant, in December 2004, revealed the condition of the affected area and overall wall to be stable, with no changes observed since the previous inspection. The applicant re-examined the area in April 2008 and included it in the long-range rehabilitation plan. The structure status was evaluated as "acceptable with deficiencies."

The LRA also states that in March 2003, during the periodic structure monitoring inspections of the turbine building, the applicant observed corrosion and chemical residue at the base of building column 1-A. Some localized material loss was observed at the outer flange, anchor bolts, and gussets. The area was re-inspected approximately 2 years later and the degradation had not progressed, so the normal inspection frequency was reinstated.

The LRA further states that in March 2003, during the periodic structure monitoring inspections of the turbine building, the applicant observed deteriorating sealant (i.e., cracking and separation from adjoining concrete surfaces) in three vertical fire protection wall joints. The inspection noted that there was no active leakage observed or detected in the joints and the filler material appeared intact. The applicant stated it repaired the vertical wall joints to restore functionality.

LRA Section B2.1.31 also states that in April 2003, leaching and cracking was observed on the outer concrete surface of the reactor refueling cavity wall (south side). According to the applicant's inspection, the noted indications were localized and the overall structural integrity of the wall appeared sound. The reactor refueling pool was flooded at the time of the observation. The hairline cracking was considered passive and did not affect the structural integrity of the concrete wall. Based on earlier inspection and chemistry sampling, a small amount of borated water found its way down the wall, followed the lip of the narrow crack, and deposited boric acid when it dried. The accessible wall area was cleaned. During a subsequent inspection in October 2004, there was no change in appearance from 2003, nor any indication of an active leak or the presence of moisture.

The staff reviewed OE information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific OE were reviewed by the applicant. As discussed in the Audit Report, the staff conducted an independent search of the plant OE information to determine whether the applicant had adequately incorporated and evaluated OE related to this program.

During its review, the staff identified OE which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAIs as discussed below.

The screenhouse and tunnel degradation discussed in the LRA was observed during the staff's walkdown on the audit. The wall was dry and the cracks were repaired and maintained in good condition. However, several instances of leaching were observed. By letter dated July 13, 2009, the staff issued RAI B2.1.31-6 asking that the applicant provide further explanation of its "Long-range Rehabilitation Plan." The staff also requested that the applicant explain its actions to manage the concrete aging effect and maintain integrity of the structure during the period of extended operation.

The applicant responded to this RAI by letter dated August 17, 2009, stating that LRA Appendix B, Section B2.1.31 incorrectly indicated that the "status of the screenhouse structure following April 2008 inspection was acceptable with deficiencies" and that "the screenhouse structure would be included in the long-range rehabilitation plan." In its response to the RAI, the applicant stated that, as a result of the April 2008 inspection, the status of the screenhouse structure should have been identified as acceptable. In the response, the applicant also stated that the screenhouse wall currently indicates small hairline cracking with some leaching without any indication of spalling of concrete, and that moreover, inspection of screenhouse structures will continue during the period of extended operation to ensure intended functions and structural integrity. Additionally, the applicant stated that the circulating water pump room wall will be inspected during each refueling outage to manage concrete aging. The applicant confirmed that the inspection results will be entered into the corrective action program, evaluated, and, if required, will be repaired or additional corrective actions will be initiated. The staff finds the applicant's response acceptable on the basis that the applicant has identified adequate actions to manage the concrete aging, to maintain integrity of the screenhouse, and to ensure no loss of structure or structural component intended functions during the period of extended operation. The staff's concern described in RAI B2.1.31-6 is resolved.

By letter dated July 13, 2009, the staff also issued RAI B2.1.31-4 requesting more information about the reactor refueling cavity leakage. In the RAI, the staff requested that the applicant:

(a) provide further information on what has been done to monitor the cracking, leaching, and leakage of boric acid after the last inspection in 2004

(b) address what actions will be taken to manage the degradation during the period of extended operation to prevent any loss of intended function

(c) address the adequacy of the current inspection interval considering the specific OE

In its response by letter dated August 17, 2009, the applicant stated that in October 2004, it re-inspected the cracked location with the refueling pool flooded and did not find any active leakage through the crack. Based on the October 2004 inspection, the applicant concluded that no further action was required. The applicant further stated that during the fall 2006 refueling outage, regularly scheduled Boric Acid Corrosion Program inspections did not observe any leakage. The applicant stated that during the spring 2008 refueling outage, regularly scheduled

Structures Monitoring Program inspections did not identify any noticeable boric acid at the crack location. The applicant also stated that it would continue regular Structures Monitoring Program and Boric Acid Corrosion Program inspections. Furthermore, the applicant stated that during the period of extended operation, if the Structures Monitoring Program inspections observe degradation, an increased inspection frequency will be implemented to ensure the intended functions of the affected structures are maintained. However, the applicant also noted that other leak locations were identified during the 2006 and 2008 refueling outages. By letter dated November 20, 2009, the staff issued follow-up RAI B2.1.31-4a requesting the following information:

(a) more details about the leakage volumes and paths observed in 2003, 2004, 2006, and 2008 outages

(b) details of any remedial actions or repairs performed during 2003 and 2004 to stop the leakage

(c) plans to verify the structural integrity of the concrete and rebar at the cracked locations by core drills or other means

(d) plans for permanent remediation of reactor cavity and refueling pool leakage

In its response dated December 28, 2009, the applicant responded to the request (a) by describing three leakage indication sites. Leakage Site No. 1 is the one that is described in the previous RAI response. Leakage Site No. 2 was identified in October 2006. Leakage Site No. 3 was identified by the applicant in March 2008, and is located at the junction between the reinforced concrete biological shield wall and the base of the reactor refueling cavity.

The applicant provided details on Leakage Site No. 2 as follows: This leakage is at the construction joint of the "A" RCS vault. The applicant observed residue streaking and staining and a small amount of moisture on the wall surface below the location of the construction joint. The applicant further noted that there was no measurable leakage or accumulation of boric acid crystals. This leakage site was again inspected during the next refueling outage in April 2008 and the observation indicated wetting or moisture, a small amount of accumulation of residue, and some amount of wall staining and streaking at the "A" RCS vault wall construction joint. This leakage site was re-inspected during the 2009 refueling outage, when multiple inspections were performed at different times during the outage. The initial inspection is noted as an "as-found" inspection. In addition, a follow-up inspection was performed prior to filling the reactor refueling cavity pool, another inspection after filling the pool, and a final inspection at the end of the outage. After the "as-found" inspection, the residue was removed from the leakage area and no further indication was noted until the final inspection, which was performed 17 days after filling the reactor refueling cavity. The applicant described this as small leakage; however, the frequency of inspection using the Structures Monitoring Program has been increased to each refueling in order to document and trend the observed conditions and assess the integrity of the concrete structure.

The applicant provided details on Leakage site No. 3 as follows: This leakage also showed accumulation of residue, streaking, and staining on the wall surface. There was no quantifiable water flow from the junction and the applicant considered this as minor leakage. Similar to Leakage Site No. 2, Leakage Site No. 3 was further inspected multiple times during the refueling outage in 2009. Based on the long delay for leakage indication to reappear on the wall surface, potential reactor refueling cavity pool leakage at this location is also considered minor.

However, the applicant has increased the frequency of inspection using the Structures Monitoring Program to each refueling, in order to document and trend the observed conditions and assess the integrity of the concrete structure.

The applicant further stated that during the refueling outage in 2009, it performed additional inspections to check for the presence of other leakage and to verify that there was no moisture in contact with the RCV. The applicant inspected the containment basement and sump "B," which is located nearest to the containment vessel. From these inspections, the applicant could not find any leakage that would indicate potential for moisture in contact with the RCV. In addition, this inspection did not indicate any additional leakage indication sites that could have resulted from the reactor refueling cavity pool leakage.

In its response to request (b), the applicant determined that the leakage indication at Leakage Site No. 1 in 2003 was due to a small amount of borated water from a source external to the reactor refueling cavity pool. However, the applicant determined the leakage indication at Leakage Sites No. 2 and No. 3 to potentially originate from reactor refueling cavity pool liner leakage. The applicant further stated that the results of the inspections performed during the 2009 refueling outage would be evaluated as an input to the determination of the necessary corrective actions related to the potential reactor refueling cavity pool liner leakage. The applicant also stated that it will add the following commitment to LRA Appendix A, USAR supplement, Table A6.0-1.

Item	Commitment	Source	Schedule
33	Develop a plan for identification and remediation of reactor refueling cavity liner leakage to be implemented during the period of extended operation.	Letter 09-760 Response to RAI B2.1.31-4a	Prior to the period of extended operation

In response to request (c), the applicant determined the leakage at site No. 1 to be a passive condition and acceptable as-is, and that this leakage was from a source external to the reactor refueling cavity pool that flowed along the surface of the wall such that the concrete and reinforcing steel within the wall are not affected. Furthermore, the applicant stated that it performed follow-up inspections during the subsequent four refueling outages which confirmed the structural integrity of the concrete at Leakage Site No. 1.

According to the applicant's inspections and observations, Leakage Sites No. 2 and No. 3 are located at construction joints and originated from the reactor refueling cavity liner. The applicant concluded that the leakage rates at sites No. 2 and No. 3 are very small and the additional inspection within containment could not find any other leakage from the reactor refueling cavity pool. Furthermore, the applicant stated that, based on other nuclear plant evaluations, the effects of borated water on reinforced concrete structural integrity is considered minimal, and that the identified leakages at these locations are very small. Consequently, the applicant concluded that the degradation of the reinforced concrete or the metal RCV is negligible. In order to confirm this conclusion, the applicant stated it will perform a reinforced concrete structural integrity examination for the concrete slab below the spent fuel pool (SFP) in the auxiliary building, as a representative location comparable to Leakage Sites No. 2 and No. 3, since the reinforced concrete material and the environments are the same for both locations.

In response to request (d), the applicant stated that as described in Commitment No. 33 above, it is developing an action plan to pursue additional methods for identification and remediation of reactor refueling cavity pool liner leakage, which will include weld examinations, identification, and re-sealing of potential leakage sites at the liner penetrations.

The staff held a conference call with the applicant on January 21, 2010, to discuss Commitment No. 33, as well as the applicant's plans related to the refueling cavity leakage. During the call, the staff expressed its need to review the refueling cavity liner leakage action plan during the LRA review process. The staff also explained that wording needed to be added to the commitment which says a concrete sample will be taken from the refueling cavity concrete if the SFP core indicates degradation.

By letter dated February 15, 2010, the applicant submitted a supplemental response to address the staff's concerns discussed during the conference call. In the response, the applicant outlined a remediation plan for the refueling cavity liner leakage as summarized here. The outline explained that the current leakage sites will continue to be inspected during each refueling outage. Inspections will also be conducted during each refueling outage of containment internal structures with the objective of identifying any additional leakage indication sites. New leakage indications, or changes in existing leakage rates, will be documented in the corrective action program and evaluated. The outline also explained that a multi-discipline team will be formed to develop recommendations for inspection, testing, and repairs to remediate the liner leakage. The supplemental response also included a new commitment to take at least one core bore sample near at least one of the refueling cavity leakage indication sites, if the core sample below the SFP indicates degradation (Commitment No. 46). The core sample will be tested for compressive strength and will undergo a petrographic examination.

The staff reviewed the applicant's response and finds it acceptable because it outlines a remediation plan which includes continued inspections of the existing leakage sites, inspections to identify possible additional leakage sites, as well as plans to ultimately repair the leakage. In addition, the concrete core bore discussed in Commitment No. 46 ensures that any degradation that may have been caused by the leakage will be captured and addressed prior to the period of extended operation. Since the applicant now has plans in place to stop the leakage and to address any concrete degradation that may have occurred as a result of the leakage, the staff's concerns in RAI B.2.3.31-4a are resolved.

During the audit, while reviewing condition reports, the staff found that a white substance was observed on the wall and ceiling of the waste drumming room, below the SFP. The issue was discovered in December 2007. According to the condition report, it is boric acid-related. The staff conducted a walkdown during the audit and saw the white material; however, due to limited visibility, the staff was unable to arrive at any conclusion. The white substance indicates leakage of borated water through the concrete, which may be degrading the concrete and rebar. Therefore, by letter dated July 13, 2009, the staff issued RAI B2.1.31-5 asking the applicant to:

(a) provide information regarding the source of the leakage and any plan to fix the leakage prior to entering the period of extended operation

(b) if no plan exists to fix the leakage, provide the monitoring plan, inspection methods, and inspection schedule to ensure that degradation will be detected and quantified before there is a loss of intended functions

In its response dated August 17, 2009, the applicant stated that after the identification of white deposits on the wall and ceiling of the waste drumming room in December 2007, it held several meetings to discuss fuel pool makeup, housekeeping and contamination, groundwater concerns, and the possibility of structural degradation. The applicant also stated that it cleaned the area, continued to observe, tried to find the cause of the condition, and established a corrective action plan. While monitoring, the applicant observed residue again in the cleaned area a little more than a month after the area was cleaned, but there was no active dripping. In June 2008, the applicant decided to: (1) monitor and troubleshoot as follow-up action; (2) add a monthly visual inspection to monitor the change in size, shape, and color of the deposit; and (3) photograph the leak location for comparative analysis. After 1 year of monitoring the wall and ceiling of the waste drumming room, the applicant observed that the residue formation remained constant. The applicant stated that the residue formation rate was slow and, therefore, there was no near-term concern for the integrity of the structure or potential loss of intended function. The applicant decided to take action if it observed any change in leakage trend or other signs of concrete distress.

Based on its review, by letter dated November 20, 2009, the staff issued follow-up RAI B2.1.31-5a to the applicant requesting the following information:

(a) verification of the condition of the concrete and rebar at the crack locations by appropriate NDE

(b) clarification of the applicant's basis for assuming the reinforcing bars will remain protected by concrete, even when they come in contact with boric acid water for a sustained period, since leakage of boric acid water could change the pH and could be a potential cause for corrosion of the rebar

(c) a description of the applicant's plan for permanent remediation

(d) a description of the functioning of leakchase channels and monitoring of water level in the SFP

In its response dated December 28, 2009, the applicant stated that it monitors groundwater and, to date, the result did not indicate any detectable level of tritium outside the auxiliary building or in the groundwater. The applicant confirmed that all the minor leakage from the SFP is contained within the auxiliary building or the radioactive waste disposal system because at KPS, the SFP is actually at an intermediate elevation in the auxiliary building. The SFP base is 7 feet thick concrete and it is 15 feet above the auxiliary building basement floor.

In response to items (a) and (b), the applicant referred to investigations, studies, and tests regarding the Salem SFP leakage in 2002, the liner leakage of the reactor cavity and SFP at Indian Point Units 2 and 3 (NUREG-1930), and the water seepage from the refueling cavity at Prairie Island Units 1 and 2 ("Safety Evaluation Report Related to the License Renewal of Prairie Island Nuclear Generating Plants"). The applicant stated that industry data indicate that even in the presence of borated water, the conditions at the rebar remain sufficiently alkaline, resulting in negligible corrosion. In order to confirm that potential SFP liner leakage is not causing significant degradation of SFP reinforced concrete, the applicant will obtain a concrete core sample at the greatest leak location and perform a strength test and petrographic examination. After the test, the applicant will enter the results in the corrective action program, evaluate the impact on SFP structural integrity, and identify additional actions.

The applicant will add the following commitment to LRA Appendix A, USAR supplement, Table A6.0-1:

Item	Commitment	Source	Schedule
34	At least one core bore sample will be taken from the waste drumming room reinforced concrete ceiling below the spent fuel pool. The core sample location and depth will be sufficient to validate the strength of the concrete and the extent of any degradation. The core sample will be tested for compressive strength and will be subjected to petrographic examination. Reinforcing steel in the core sample area will be exposed and inspected for material condition.	Letter 09-760 Response to RAI B2.1.31-5a	Prior to the period of extended operation

In response to item (c), the applicant stated that it will develop an action plan based on the observed leakage and in consideration of the available techniques to inspect for leaks, including leak testing of the accessible SFP liner pressure boundary weld seams. The applicant further noted that the presence of spent fuel in the storage pools makes inspection of a large part of the storage pool liners impractical due to access restrictions. The applicant will add the following commitment to LRA Appendix A, USAR supplement, Table A6.0-1:

Item	Commitment	Source	Schedule
35	Develop a plan for identification and remediation of spent fuel pool liner leakage to be implemented during the period of extended operation.	Letter 09-760 Response to RAI B2.1.31-5a	Prior to the period of extended operation

The applicant further added that if repair efforts to eliminate the SFP leakage in the waste drumming room are not successful, an additional core sample will be subjected to the same tests prior to the end of the first 10 years of extended operation, and this commitment will be added to the following commitment to LRA Appendix A, USAR supplement, Table A6.0-1. After the test, the applicant will enter the results in the corrective action program, evaluate the impact on SFP structural integrity, and identify additional actions.

Item	Commitment	Source	Schedule
36	If SFP liner leakage persists during the period of extended operation, an additional concrete core sample will be taken from the waste drumming room reinforced concrete ceiling below the spent fuel pool. The core sample location and depth will be sufficient to validate the strength of the concrete and the extent of any degradation. The core sample will be tested for compressive strength and will be subjected to petrographic examination. Reinforcing steel in the core sample area will be exposed and inspected for material condition.	Letter 09-760 Response to RAI B2.1.31-5a	Prior to the end of the first ten years of extended operation

In response to item (d), the applicant described that the SFP and the fuel transfer canal are divided into 10 leak detection zones, five for the pools and five for the canal. The applicant also stated that, at present, three zones, zone nos. 1, 4, and 5, are indicating leakage of approximately 6, 3, and 9 ounces per day, respectively, which totals to one gallon per week. Furthermore, the applicant stated that plant auxiliary operator records the SFP water level each shift and the operating crews review all logs for trends or abnormal readings. In the control room, there is an SFP high/low alarm and the SFP level is maintained in accordance with the normal operating procedure.

The staff held a conference call with the applicant on January 21, 2010, to discuss Commitment Nos. 34 and 35, as well as the applicant's plans related to the SFP leakage. During the call, the staff explained that it needs to review the SFP leakage action plan (Commitment No. 35) during the LRA review process. The staff also explained that the applicant needs to explain why scheduling the concrete core bore "prior to the period of extended operation" is acceptable.

By letter dated February 15, 2010, the applicant submitted a supplemental response to address the staff's concerns discussed during the conference call. In the response, the applicant outlined a plan to identify and remediate the SFP liner leakage. The outline explained that the leakage indication sites would continue to be inspected monthly. Portions of the auxiliary building adjacent to the SFP will be inspected annually during the period of extended operation to identify any additional leakage indications. Any additional indications will be documented and entered into the corrective action program. The outline also explained that a multi-discipline team will be formed to develop recommendations for inspection, testing, and repairs to remediate the SFP liner leakage. In addition, the SFP liner seam weld leakage detection and collection system drain lines will be inspected and repaired, if required, to ensure a clear drain path. The applicant explained that this will minimize the potential for re-direction of liner leakage through the concrete structure due to clogged drain lines. The applicant further explained that a routine maintenance activity will be created to continue inspection of the drain lines through the period of extended operation.

The applicant's supplemental response also revised the timing of a previous commitment to take a concrete core sample from below the SFP. The schedule was changed from "prior to the period of extended operation" to "prior to the end of 2011" (Commitment No. 34). Due to the low safety significance of the leakage, as well as the necessary preparation, the applicant feels this timing is reasonable and adequately supports the objective of the commitment.

The staff reviewed the applicant's response and finds it acceptable because it outlines a remediation plan which includes continued inspections of the existing leakage sites, inspections to identify possible additional leakage sites, as well as plans to ultimately identify and repair the leakage source. The plan also includes inspections, and any necessary repairs, of the drain line system. These inspections should reduce the likelihood of future leakage through the concrete by ensuring the drain lines are clear. In addition, the concrete core bore discussed in Commitment No. 34 ensures that any degradation that may have been caused by the leakage will be captured and addressed prior to the period of extended operation. Due to the minor amount of leakage, along with the relatively recent identification of the issue (2007), the staff finds that the schedule for the commitment is appropriate. Since the applicant has plans in place to stop the SFP leakage through the concrete and to address any concrete degradation that may have occurred as a result of the leakage, the staff's concern described in RAI B.2.3.31-5a is resolved.

Based on its audit and review of the application, and review of the applicant's response to RAIs B2.1.31-4, 4a, 5, and 5a, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A2.1.31 provides the USAR supplement for the Structures Monitoring Program. The staff reviewed this USAR supplement description of the program against the recommended description for this type of program as described in SRP-LR Table 3.5-2.

The staff noted that LRA Section A2.1.31 does not clearly describe the program summary with all necessary references for implementation as defined in SRP-LR, Revision 1. By letter dated July 13, 2009, the staff issued RAI B2.1.31-1 requesting that the applicant revise Appendix A, "Program Description," to summarize the Structures Monitoring Program consistent with the level of detail provided in SRP-LR, Revision 1. By letter dated August 17, 2009, the applicant responded to this RAI stating that the LRA Appendix A, USAR supplement, Section A2.1.31, "Structures Monitoring Program," will be revised to add:

> The program implements the requirements of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of NUMARC 93-01, Revision 2, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and Regulatory Guide 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants."

The staff noted that the response covers GALL AMP XI.S6 only. By letter dated November 20, 2009, the staff issued follow-up RAI B2.31-a asking the applicant to incorporate the summary description of the "Masonry Wall" and "Inspection of Water-Control Structure" program because the applicant has combined those programs in its Structures Monitoring Program. In its response dated December 28, 2009, the applicant stated that it will add the following description to LRA Section A2.1.31:

> For masonry walls within the scope of license renewal, the Structures Monitoring Program manages aging effects based on guidance provided in IE Bulletin 80-11, "Masonry Wall Design," and plant-specific monitoring proposed by NRC Information Notice 87-67, "Lessons Learned from Regional Inspections of License Actions in response to NRC IE Bulletin 80-11." For water-control structures within the scope of license renewal, the Structures Monitoring Program manages aging effects consistent with the guidelines of RG 1.127, "Inspection of Water Control Structures associated with Nuclear Power plants."

The staff also noted that the applicant committed (LRA Table A6.0-1; Commitment Nos. 22, 23, and 24) to enhance the Structures Monitoring Program prior to entering the period of extended operation. Specifically, the applicant committed to: (1) Commitment No. 22, "Define In-Scope Structural Elements: the Structures Monitoring Program will be enhanced to clearly define structures, structural elements, and miscellaneous structural commodities that are in scope"; (2) Commitment No. 23, "Groundwater Monitoring: the Structures Monitoring Program will be enhanced to monitor groundwater quality and verify that it remains non-aggressive to below-grade concrete"; and (3) Commitment No. 24, "Underwater Inspections: the Structures Monitoring Program will be enhanced to improve criteria for detection of aging effects for the underwater visual inspections of the in-scope structures."

Additionally, the applicant added Commitment Nos. 44 and 45 related to aggressive groundwater, Commitment Nos. 33 and 46 for reactor refueling cavity leakage, and Commitment Nos. 34, 35, and 36 for SFP leakage.

The applicant also added Commitment No. 54 to include the evaluation criteria of ACI 349.3R as the criteria to be used when evaluating conditions or findings identified during concrete structure inspections.

The staff determines that the modified information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Structures Monitoring Program and RAI responses, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancements and confirmed that their implementation through Commitment Nos. 22, 23, 24, 33, 34, 35, 44, and 46, prior to the period of extended operation, and Commitment Nos. 36 and 45, prior to the end of the first 10 years of extended operation, would make the existing AMP consistent with the GALL Report AMPs to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.19 Work Control Process Program

Summary of Technical Information in the Application. In the applicant's letter dated September 25, 2009, the applicant amended LRA Section B2.1.32, "Work Control Process (WCP) Program," from a plant-specific AMP to a new AMP that will be consistent with the program elements in GALL AMP XI.M32, "One-Time Inspection," with an enhancement, and with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," with noted exceptions and an enhancement. The applicant's exceptions to GALL AMP XI.M38 include exceptions on the "scope of the program," "parameters monitored," "detection of aging effects," and "acceptance criteria" program elements in GALL AMP XI.M38. Specifically, the applicant identified that these exceptions pertain to the applicant's use of this AMP to manage new component materials, environments, and aging effects beyond those cited in GALL AMP XI.M38 and on the acceptance criteria that will be used to assess those aging effects that are applicable to these component material-environment-aging effect combinations. The applicant provided the specific details for these exceptions in its letter dated September 25, 2009.

The applicant clarified that the WCP Program, with a noted enhancement, will be consistent with the program elements in GALL AMP XI.M32, "One-Time Inspection," for those GALL Report-based AMR items in the LRA in which the WCP Program will be used to verify the effectiveness of five AMPs: (1) the Primary Water Chemistry Program, (2) the Secondary Water Chemistry Program, (3) the Closed-Cycle Cooling Water Program, (4) the Fuel Oil Program, and (5) the Lubricating Oil Analysis Program.

The applicant also clarified that the WCP Program, with noted exceptions and an enhancement, will be consistent with the program elements in GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," when applied to those GALL Report-based and plant-specific AMR items in the LRA in which the WCP Program is credited as a periodic, condition monitoring program. The applicant further stated that the methodology in EPRI TR-107514 will be considered in the determination of the overall sample size, and that a technical review of plant-specific inspection results and a plant-specific OE evaluation will be performed.

Staff Evaluation. During its audit and review, the staff confirmed the applicant's claim of consistency with GALL AMP XI.M32, "One-Time Inspection." The staff reviewed the enhancement to determine whether the AMP, with the enhancement, is adequate to manage the aging effects for which the LRA credits it. The staff confirmed that all of the program elements claimed by the applicant to be consistent with program elements in GALL AMP XI.M32 were consistent with those described in the GALL AMP, except for those program element aspects in which the staff felt that additional clarification was necessary, or for which the staff felt additional information was necessary and for which an RAI was issued. The staff's evaluation of these program element aspects is presented in the paragraphs that follow.

The staff noted that, for those components or commodity groups associated with AMR items crediting the Primary Water Chemistry Program, the Secondary Water Chemistry Program, the Closed-Cycle Cooling Water Program, the Fuel Oil Program, or the Lubricating Oil Analysis Program to manage loss of material, cracking, or loss of heat transfer function in the components, the applicant will apply the WCP Program to verify that these preventive or mitigative monitoring AMPs are achieving their aging management functions and that the aging effects of concern either do not occur, are progressing at an extremely slow growth rate, or that the time for initiation of the applicable aging effects involves an extremely long incubation time. The staff confirmed that, for these AMR items, the applicant's intent to use the WCP Program conforms to the staff's guidance in GALL AMP XI.M32 on when a one-time examination can be applied as a condition-monitoring aging management basis.

The staff also noted that, in the "detection of aging effects" program element for the AMP, the applicant's one-time inspection methods for managing loss of material, cracking, and loss of heat transfer function inducing mechanisms were consistent with those listed in the inspection method table in GALL AMP XI.M32. As a result, the staff found the applicant's inspection techniques for the one-time examinations to be acceptable because they were in conformance with those recommended in GALL AMP XI.M32 to manage loss of material, cracking, and reduction of heat transfer capability.

The applicant indicated that the sample of components inspected for the one-time examinations would be done on a representative sampling basis, and that the applicant's sampling basis was consistent with the sampling basis statement for one-time inspections, as given in the "detection of aging effects" program element in GALL AMP XI.M32. However, the staff also noted that the applicant's representative sampling basis did not clearly establish how the sampling would be accomplished because the WCP Program is credited with aging management of a varied set of environments, materials, and aging effects. As a result, the staff identified that the applicant's sampling basis did not clearly establish whether one sample population would be selected to represent the entire set of material-environment-aging effect combinations the program manages, or whether a representative sample of components would be selected for each of the material-environment-aging effect combinations that the program manages. In addition, the staff identified that additional explanations were needed regarding the type of conditions that would be used to factor in which component locations would be inspected under the program's one-time, representative sampling basis (e.g., loss of material due to corrosion could be expected to occur more readily in stagnant areas or creviced regions, etc.).

In a letter dated December 3, 2009, the staff issued RAI B2.1.32-1 requesting that the applicant clarify whether the WCP Program would inspect a representative sample of the component or structure populations for each of the material-environment-aging effect combinations that is managed, in accordance with one of the referenced preventative or mitigative monitoring programs, or whether some other type of sampling basis would be used. The staff also asked the applicant to clarify which type of engineering, design, operational, or OE considerations would be used to select the sample of components for the one-time examinations, and to explain why the considerations used for the selection process are considered to be adequate, particularly if a given sample of structures or components is used to represent more than one material-environment-aging effect combination.

In its response dated January 21, 2010, the applicant clarified that, for those inspections performed under the WCP Program for verification of the effectiveness of the implementation of the Primary Water Chemistry Program, Secondary Water Chemistry Program, Closed-Cycle Cooling Water Program, Fuel Oil Program, or Lubricating Oil Analysis Program, the WCP Program will establish a population set for each material for which the WCP Program is credited, and that this AMP will inspect a number (sample) of components for each environment to which the materials are exposed.

The applicant stated that the total sample size and selection of locations for inspection will be based on an assessment of the materials of fabrication, operating environments, plausible aging effects, and OE relative to the components in the populations for the material sets, consistent with the methodology in EPRI TR-107514, "Age-Related Degradation Inspection Method and Demonstration on Behalf of Calvert Cliffs Nuclear Plant," for performing this type of assessment. More specifically, the applicant clarified that the locations selected for inspection will be based on identifying those locations that are most susceptible to aging, in light of the time in service, component design aspects (such as geometry), environmental factors, severity of operating conditions, and remaining component safety margins for the populations of components in the material sets.

The staff finds the applicant's basis for selecting component locations for inspection to be acceptable because it is in conformance with the "monitoring and trending" program element in GALL AMP XI.M32, which identifies that the sample size and sample locations for inspection should be based on an assessment of the materials of fabrication, environment, plausible aging effects, and OE for the components that are within the component population sets.

However, the staff also noted that the applicant is crediting methodology in EPRI TR-107514 as the basis for selecting the sample sizes for the material-environment-aging effect combinations that will be managed using this one-time inspection basis, and that this report states that the sample sizes should achieve a desired confidence level. Thus, the staff also noted that the applicant's sampling basis left some uncertainty with respect to establishing the sample size for one-time inspections: the applicant did not exactly specify or provide a justification for the minimum sample sizes that would be used for these one-time inspections, or establish a limit, with justification, on when these one-time examinations would need to be completed to ensure appropriate and timely verification of preventive or mitigative program effectiveness. By letter dated April 14, 2010, the staff issued follow-up RAI B2.1.32-5, Parts 1 through 4. In Part 1 of the RAI, the staff asked the applicant to specify and justify the minimum percentage of components that would be used to establish the sample sizes for the one-time examinations of the stated component populations. The staff also asked the applicant to identify and justify when the one-time inspections for the WCP Program would be completed. The staff identified this as **Open Item B2.1.32-1, Part 1.**

The applicant responded to RAI B2.1.32-5, Part 1, by letter dated May 13, 2010. In its response to Part 1 of the RAI, the applicant stated it is using the engineering sample size criteria in EPRI Report TR-107514 to establish the sample size for one-time inspections that would be applied to those steel, stainless steel, and copper alloy components for which the WCP is being used to verify the effectiveness of either the Primary Water Chemistry Program, Secondary Water Chemistry Program, Closed-Cycle Cooling Water Program, Fuel Oil Program, or Lubricating Oil Analysis Program in managing aging. The applicant stated that the sample sizes are as follows:

Table 3.0.3.2.19-1: Component Populations and Sample Sizes for WCP One-Time Inspections

Material Group	Component Population	Sample Size
Steel Components	200	25
Stainless Steel Components	200	25
Copper Alloy Components	~ 200	25
Aluminum Alloy Components	1	1

The applicant stated that the EPRI Report establishes a minimum sample size of 25 for component population sets containing 200 or more components.

The staff noted that the applicant's program will perform a one-time inspection of the one aluminum component that is within the scope of the WCP's one-time examinations, and a one-time inspection of 25 components for each of steel, stainless steel, and copper alloy commodity groups that are within the scope of the programs' one-time examinations. The staff noted that it has previously approved the EPRI sampling methodology as an acceptable sampling basis methodology for past applications. As a result, the staff finds that the applicant's use of the EPRI sampling basis is acceptable because the applicant is applying a sampling methodology that has been approved by the staff for past applications, and because the applicant will inspect at least 25 components for the steel, stainless steel, and copper alloy component populations in the program, as well as the sole aluminum component that is within the scope of the program's one-time inspections. Staff's concerns in RAI B2.1.32-5, Part 1 and RAI B2.1.32-1, relative to establishing and justifying the component populations and samples sizes for the components that will be subject to the one-time inspections of the WCP, are resolved, and Open Item B2.1.32-1, Part 1 is closed.

Based on this assessment, the staff finds that the applicant has provided an acceptable one-time sampling basis for the WCP Program for each of the populations that will be managed in accordance with either the Primary Water Chemistry Program, Secondary Water Chemistry Program, Closed-Cycle Cooling Water Program, Fuel Oil Program, or Lubricating Oil Analysis Program, and that this aspect of the WCP Program is consistent with the recommendations in GALL AMP XI.M32, "One-Time Inspection."

Consistency with GALL AMP XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components. During its audit and review, the staff confirmed the applicant's claim of consistency with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The staff reviewed the enhancement to determine whether the AMP, with the noted exceptions and the enhancement to the program, is adequate to manage the aging effects for which the LRA credits the WCP Program as a periodic, condition monitoring program. The staff confirmed that all of the program elements, claimed by the applicant to be consistent with program elements in GALL AMP XI.M38, were consistent with those described in the GALL AMP, except for those program element aspects in which the staff identified that additional clarification or additional information was necessary and for which an RAI was issued. The staff also issued RAIs on the exceptions taken to GALL AMP XI.M38.

"Detection of Aging Effects" Program Element. The staff noted that the applicant provided its bases for applying the WCP Program as a periodic, condition monitoring (inspection-based) program in the applicant's letter of September 25, 2009. The staff noted that the "detection of aging effects" program element in GALL AMP XI.M38 recommends that locations for inspection should be chosen to include conditions likely to exhibit the aging effects and that the inspection intervals should be established such that they provide for timely detection of degradation. The staff also noted that the applicant's "detection of aging effects" program element basis did not specifically establish or justify what sample populations, sample sizes, and inspection frequencies would be used for the periodic examinations that are performed in accordance with the WCP Program when the program is credited as a periodic, condition monitoring program basis. In a letter dated December 3, 2009, the staff issued RAI B2.1.32-2 requesting that the applicant clarify which type of environmental, design, operational, or engineering factors will be used to select the specific sample populations, sample sizes, and inspection frequencies for those aging effects and mechanisms that the WCP Program will be used to manage on a periodic, condition monitoring program basis.

In its response dated January 21, 2010, the applicant clarified that, for each material-environment combination managed by the WCP Program on a periodic basis, the WCP Program will perform a review of the scheduled periodic surveillance and preventative maintenance activities to enable selection of specific activities to ensure that the sampled locations in the WCP Program will be representative of the components in the program. The applicant clarified that the review will consider material, environmental, and OE factors in selecting the locations for inspections, and will take other operational and design-based factors into account, such as time at service, remaining design margins, and severity of operating conditions. The applicant also clarified that selected scheduled, surveillance, and maintenance activities will be performed on a repetitive basis and that any evidence of aging detected during the activities will be documented and evaluated for applicability to other components with the same material-environment combination as the component for which the degradation was detected. The applicant clarified that an engineering review will be performed to evaluate the condition, extent of condition, and need for corrective actions.

The applicant also clarified that the implementation of the internal surfaces monitoring portion of the WCP Program will require engineering personnel at the site to perform the following activities: (1) review the program inspection results to identify any new degradation mechanisms not previously considered, (2) monitor and/or perform walkdown activities to verify adequate identification and documentation of aging effects and initiation of corrective actions, (3) perform trending of inspection results, and (4) review site OE through the plant's corrective action program to ensure that aging effects are addressed.

The staff noted that the "detection of aging effects" program element in GALL AMP XI.M38 recommends that, for AMPs conforming to GALL AMP XI.M38, the applicant "should identify and justify the inspection technique used for detecting the aging effects of concern," and that the locations chosen for inspection should include those with conditions likely to exhibit these aging effects. The staff also noted that the "monitoring and trending" program element in GALL AMP XI.M38 recommends that the visual examination activities of the program be qualified in accordance with site procedures and processes, that intervals for the examinations be based on the materials and environments for the components in the program, and that consideration be given to both generic and plant-specific OE. Based on these program elements, the staff finds the applicant's inspection and monitoring and trending bases (as supplemented in the letters of September 25, 2009, and January 21, 2010) to be acceptable because: (1) they are in conformance with the GALL AMP XI.M38 recommendations for using material, environmental, operational, and OE considerations in the selection of the program's inspection intervals, sample size, and component locations for inspection, and (2) the applicant's bases are consistent with GALL AMP XI.M38 recommendations that the program be directed at inspecting and detecting degradation in those components that have the highest probability of exhibiting the conditions and aging effects that are managed by the program. Therefore, the staff's concern described in RAI B2.1.32-2 is resolved.

Exceptions to GALL AMP XI.M38. The applicant took four exceptions to GALL AMP XI.M38.

Exception 1. In its letter dated September 25, 2009, the applicant took an exception to the "scope of the program" program element in GALL AMP XI.M38, which identifies that the scope of the program is applicable to management of loss of material in the internal surfaces of steel piping, piping elements, ducting, and components in internal environments (such as internal indoor uncontrolled air, condensation, or steam environments). The applicant identified that the scope of the WCP Program, as applied as a periodic, condition monitoring program, is being credited for additional materials, environments, and aging effect combinations that are not included in GALL AMP XI.M38.

The staff noted that the exception applies the scope of the WCP Program to the following additional material-environment-aging effect combinations:

- aluminum components – loss of material and reduction of heat transfer capability under exposure to moist air environments and loss of material in outdoor air environments

- copper alloy components – loss of material and reduction of heat transfer capability under exposure to uncontrolled indoor air environments, moist air environments, or raw water environments; loss of material under exposure to moist air environments and loss of material in outdoor air environments or closed-cycle cooling water environments

- stainless steel components – loss of material in uncontrolled indoor air environments, moist air environments, outdoor air environments, raw water environments, and closed-cycle cooling water environments; loss of material and cracking in diesel exhaust environments

- steel components – loss of material in uncontrolled indoor air environments, moist air environments, raw water environments, closed-cycle cooling water environments, and diesel exhaust environments

- elastomeric components – changes in material properties (hardening and loss of strength) in indoor uncontrolled air, indoor controlled air, moist air, and raw water environments; loss of material in indoor uncontrolled air and raw water environments; loss of sealing in indoor uncontrolled air and outdoor air environments; cracking in indoor uncontrolled air environments

- non-metallic paper filters – loss of strength in dried air environments

The staff finds the applicant's exception to use the WCP Program for the management of loss of material in steel, stainless steel, and copper alloy components under exposure to various air, treated water, or raw water environments acceptable because: (1) the applicant's basis is consistent with the criteria in GALL Table IX.C, which identifies that stainless steel, steel, and copper alloy (greater than 15 percent zinc (Zn) alloying content) materials may be susceptible to loss of material by pitting and crevice corrosion (and for steel by general corrosion); and (2) consistent with the AMR items of the GALL Report, the applicant's basis accounts for the fact that loss of material may occur in these materials as a result of MIC when the materials are exposed to a raw water source. The staff evaluated the periodic inspection methods used to detect loss of material in these steel, stainless steel, and copper components in the staff's evaluation of the applicant's exception on the "detection of aging effects" program element for this AMP.

The staff finds the applicant's exception to apply the WCP Program to the management of loss of material in aluminum alloy components conservative because aluminum alloy components are normally resistant to significant corrosion due to the development of a protective surface (thin aluminum oxide layer) that protects the underlying aluminum material from further corrosion by an oxidizing environment (such as sources of oxygenated water or uncontrolled air environments).

The staff finds the applicant's basis to use visual methods to monitor for aging (loss of strength) in the non-metallic filter papers conservative because, although the applicant is applying the WCP Program to monitor for and manage loss of strength in the filter paper components, the components are replaced when the differential pressure across the filter reaches a pre-described limit and thus, the filter papers represent consumable components for the application.

The staff finds the applicant's exception to apply the WCP Program to the management of changes in material properties (including drops in the strength modulus or elastomeric hardening) in elastomeric components acceptable because the applicant's basis is consistent with GALL Table IX.C, which identifies that loss of strength and hardening are applicable aging effect mechanisms for elastomeric components. The staff finds the applicant's exception to apply the WCP Program to the management of loss of sealing in elastomeric components acceptable because the applicant's basis is consistent with the GALL Report Table IX.E, which identifies that loss of sealing may be applicable in elastomeric components. The staff finds the applicant's exception to apply the WCP Program to the management of cracking in elastomeric components to be acceptable because the applicant's basis is consistent with the basis in the GALL Report Table IX.F, which identifies that degradation of elastomeric materials may include cracking (including crazing, which is a form of cracking).

The staff noted that the applicant was crediting the WCP Program to manage loss of material due to pitting and crevice corrosion and cracking due to SCC in the stainless steel piping, piping components, and piping elements of the diesel generator exhaust lines under internal exposure in a diesel exhaust environment. The staff noted that this specific environment is limited to only a small number of component locations, and that the staff's recommendations for managing loss of material and cracking in these lines is addressed in SRP-LR Sections 3.3.2.2.2.3 and 3.3.2.2.7.3, respectively. In a letter dated December 3, 2009, the staff issued RAI 3.3.2.2.3.3-1, requesting that the applicant discuss whether the WCP Program would actually inspect the diesel generator exhaust lines to monitor loss of material and cracking.

In its response to RAI 3.2.2.3.3-1, dated January 21, 2010, the applicant stated that the stainless steel diesel generator exhaust flexible connections would be components that are explicitly selected for periodic enhanced VT-1 inspections under the periodic, condition monitoring bases of the WCP Program to monitor for evidence of loss of material and cracking in the interior surfaces of the components. The staff finds this condition monitoring basis to be acceptable because: (1) it is in conformance with recommendations in SRP-LR Sections 3.3.2.2.3.3 and 3.3.2.2.7.3, which state that a plant-specific AMP (using either GALL Report-based elements or plant-specific program elements) be credited to manage cracking and loss of material due to pitting and crevice corrosion in stainless steel diesel engine exhaust piping components; (2) the applicant will be using enhanced VT-1 examinations to inspect the internal surfaces of the stainless steel diesel exhaust flexible connections; and (3) the ASME Code Section XI lists VT-1 visual methods (including enhanced VT-1) as being capable of detecting these types of aging effects. The staff's concern described in RAI 3.3.2.2.3.3-1 is resolved with respect to its relationship to the WCP Program.

The staff also noted that, with respect to the comparison that was made to the "scope of the program" program element in GALL AMP XI.M38, the applicant identified that the program scope includes periodic examinations of the external surfaces of the electrical box gaskets, the spent fuel gate seals and hoses, and reactor cavity seal ring, which are made from elastomeric materials. The staff observed that these components are not piping or ducting components that would meet the scope of components in GALL AMP XI.M38. The staff also observed that the scope of GALL AMP XI.M38 does not apply to inspection of external surface locations. As a result, the staff noted that the applicant's letter, dated September 25, 2009, did not identify the inclusion of the electrical box gaskets, the spent fuel gate seals and hoses, and reactor cavity seal ring, or the proposal to inspect the external surfaces of these components, as exceptions that are applicable to the "scope of the program" program element criteria in GALL AMP XI.M38. In addition, the staff noted the "scope of the program" and "parameters monitored or inspected" program element discussions in the applicant's license renewal basis document indicated that the WCP Program inspections would be performed only during periodic surveillance or preventative maintenance activities when the components are opened up and the internal surfaces of the components are made accessible for examination.

The staff also noted that Commitment No. 25 in the applicant's letter, dated September 25, 2009, clarifies that the visual examinations for monitoring for aging in the elastomeric electrical box gaskets, spent fuel gate seals and hoses, and reactor cavity seal ring will be performed when the external surfaces of the components are made available for examination during preventative maintenance activities or periodic surveillance activities performed on the components. Based on its review, the staff finds that the applicant has provided an acceptable basis for adding the elastomeric electrical box gaskets, spent fuel gate seals and hoses, and reactor cavity seal ring to the scope of the WCP Program inspections because they are within the scope of Commitment No. 25, and because it is clear from the commitment that the visual examinations of these components will be performed when the external surfaces of these elastomeric components are made accessible for examination during periodic surveillance or preventative maintenance activities.

Based on the considerations discussed in the previous paragraphs and the staff's bases for concluding that the stated additional materials and environments are acceptable materials and environments to add to the scope of the WCP Program, the staff finds that the applicant has provided an acceptable basis for adding stainless steel, aluminum, copper, and selected elastomeric and paper filter components to the scope of the program, and finds this exception to be acceptable.

Exceptions 2 and 3. In its letter dated September 25, 2009, the applicant took an exception to the "parameters monitored or inspected" element in GALL AMP XI.M38, which identifies that visual inspections of internal surfaces of plant components are performed during maintenance or surveillance activities, and that the parameters monitored or inspected include visible evidence of corrosion to indicate possible loss of material. The applicant also took an exception to the "detection of aging effects" element in GALL AMP XI.M38, which states, in part, that applicants for renewal should identify and justify the inspection technique used for detecting the aging effects of concern, that the locations should be chosen to include conditions likely to exhibit these aging effects, and that the inspection intervals selected should be established such that they provide timely detection of degradation. In these exceptions, the applicant identified that the WCP Program will monitor the following conditions or parameters:

- loss of material in aluminum, copper alloy, steel and stainless steel components – monitor for evidence of localized discoloration or surface irregularities that are caused by either rust, scale, deposits, surface pitting, discontinuities, and coating degradation using visual examination methods on the internal surfaces of the components
- cracking in stainless steel diesel exhaust components – monitor for localized corrosion, discoloration, linear discontinuities, or surface irregularities that may be indicative of cracking using enhanced VT-1 or equivalent examinations
- reduction of heat transfer capability – monitor for evidence of fouling, deposits, or scale on heat exchanger tubes using visual examinations of the internal surfaces of the components
- elastomeric component degradation – monitor for evidence of cracking and crazing, discoloration, distortion, swelling, tears, usual wear, or leaks using the visual examination methods of the program, and monitoring for signs of tackiness, resiliency, or abnormal indentation recovery using the supplement physical manipulation methods of the program
- loss of strength in non-metallic filter papers – monitor for evidence of tears, material degradation, discoloration, unusual wear, or loss of form using visual examination methods

The staff noted that the applicant was appropriately looking for evidence of linear surface discontinuities as its basis for monitoring for cracking in stainless steel components and that the applicant was crediting either VT-1 or enhanced VT-1 methods as visual inspection methods for the detection of cracking. The staff found these bases to be acceptable because they are consistent with bases in the ASME Code Section XI that indicate VT-1 methods are acceptable visual examination methods for the detection of linear surface discontinuities or cracks. Based on these findings, the staff concluded that the "parameters monitored" and "detection of aging effects" program elements exception bases for detection of cracking to be acceptable.

The staff noted that, for the management of loss of material in aluminum, copper alloy, steel or stainless steel components, the applicant will use the visual examinations of the WCP Program to monitor for both localized discoloration in the components and for evidence of surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, or (for coated metallic components) coating degradation. The staff noted that, for the management of loss of heat transfer capability in aluminum and copper alloy heat exchanger components, the applicant will use the visual examinations of the WCP Program to monitor for evidence of fouling, deposits, or scale on the heat exchanger/cooler tubes. The staff found the applicant's parameters for detecting loss of material in the aluminum, copper alloy, steel or stainless steel components and for reduction of heat transfer capability in aluminum or copper alloy heat exchanger tubes to be acceptable because they are consistent with the type of parameters mentioned in Article IWA-2000 of the ASME Code Section XI for providing evidence of abnormal surface conditions. Based on these findings, the staff concluded that the "parameters monitored" program element exception basis on the parameters that will be monitored for indication of loss of material or reduction of heat transfer capability to be acceptable.

However, the staff also noted that the exception to use visual examination methods for the detection of aging effect conditions or parameters that would be indicative of loss of material in a metallic component or that could reduce a heat exchanger component's heat transfer capability did not define which type of visual examination methods would be used for the component inspections. In contrast, the staff noted that the applicant did identify which visual examinations or non-visual inspection techniques would be used to monitor for loss of material or fouling for the aspects of the program that would be implemented in accordance with the one-time inspection criteria of GALL AMP XI.M32.

In a letter dated December 3, 2009, the staff issued RAI B2.1.32-3 requesting that the applicant clarify whether the visual inspection techniques that have been specified for detecting loss of material (induced by corrosion, wear, erosion, etc.) or reduction of heat transfer capability (fouling), when the program is implemented in conformance with the criteria in GALL AMP XI.M32, are also applicable to the monitoring of these aging effects/mechanisms when the WCP Program is credited on a periodic, aging management basis (i.e., the inspections that will be performed in accordance with recommendations in GALL AMP XI.M38).

In its response to RAI B2.1.32-3, dated January 21, 2010, the applicant clarified that the visual examinations for detecting loss of material due to wear, corrosion, or erosion or reduction of heat transfer, when the program is implemented on a periodic basis in conformance with GALL AMP XI.M38, will not be VT-1 or VT-3 visual inspection techniques. The applicant clarified that, instead, the visual examinations will be performed by KPS maintenance personnel who receive specific training and qualifications on detecting the parameters that are associated with these aging effects. The applicant clarified that, specifically, the maintenance workers will be trained and qualified to look for and detect localized surface discolorations and/or surface irregularities (such as rust, scale, corrosion deposits or products, or surfaces pits) that may be indicative of these aging effects.

The staff noted that the scope of the "detection of aging effects" program element in GALL AMP XI.M38 only covers the general visual inspection techniques that may be used to detect evidence of abnormal surface conditions that may be associated with loss of material or reduction of heat transfer capability aging effects. As a result of this determination, the staff observed that the applicant's visual "detection of aging effects" program element basis for managing loss of material in metallic components and reduction of heat transfer capability in the copper and aluminum heat exchanger tubes was in conformance with the "detection of aging effects" program element criterion in GALL AMP XI.M38, which states that personnel performing the visual examination activities of the program should be qualified for the examinations in accordance with site controlled procedures and processes.

However, the staff also observed that under the applicant's amended WCP Program basis, as given in the applicant's letter of September 25, 2009, and supplemented with information in the letter of January 21, 2010, the WCP Program lends itself to being a program that monitors for abnormal surface conditions, such as rust, discoloration, deposits, scale, or abnormal surface conditions, or for evidence of cracking or changes in the material properties for elastomeric components (except for the visual techniques that the applicant credited for detection of cracking in metallic components: the applicant's letter dated September 25, 2009, states that these will be enhanced VT-1 techniques or their equivalent). As a result, the staff noted that the applicant's amended "detection of aging effects" and "monitoring and trending" program elements bases still did not establish its criterion for establishing and justifying the sample size that would be applied to the material-environment-aging effect populations being managed by the AMP on a periodic basis, or for establishing and justifying a minimum inspection frequency for the components being managed by the WCP Program on a periodic basis (i.e., specifying the maximum time that could elapse before an inspection of the components in the sample would actually have to be scheduled and performed). As a result, the staff concluded that the applicant's "detection of aging effects" program element exception basis would need to be supplemented to provide additional details on: (1) clarifying and justifying the minimum percentage of components in the component samples that would be inspected to be representative of the component populations that the samples are representative of, and (2) defining and justifying a maximum limit on the time that could elapse before components in samples being examined would, with certainty, need to be scheduled for inspection.

By letter dated April 14, 2010, the staff issued RAI B2.1.32-5, Part 2, to resolve this issue. In RAI B2.1.32-5, Part 2, the staff asked the applicant to provide additional details on how the WCP Program would be applied as a period inspection program as made relative to the management of loss of material and reduction of heat transfer capability in metallic components, and implemented in a manner consistent with the "parameters monitored or inspected" and "detection of aging effects" program elements of GALL AMP XI.M38 (with noted exceptions). Specifically, the staff asked the applicant to: (1) specify and justify the minimum percentage of components that will be used to establish the sample sizes for the component populations that are associated with these material-aging effect combinations and will be managed on a periodic WCP-inspection basis, and (2) specify and justify the maximum frequency for the periodic examinations of the components in these samples. Resolution of RAI B2.1.32-3 is pending acceptable resolution of RAI B2.1.32-5, Part 2. The staff identified this as **Open Item B2.1.32-1, Part 2**.

The staff also noted that the applicant did not specify the minimum percentage of components that would be used to establish the sample size of elastomeric components that will be inspected on a periodic inspection basis or the maximum time limit that could elapse before inspections of the elastomer components in the sample would have to be, with certainty, scheduled for examination. As a result, the staff noted that the same issues raised in RAI B2.1.32-5, Part 2 and Open Item B2.1.32-1, Part 2, for managing loss of material and loss of heat transfer capability in metallic components, are also applicable to the applicant's "detection of aging effects" program element basis for elastomeric components. Thus, the issue raised in RAI B2.1.32-5, Part 2 and Open Item B2.1.32-1, Part 2 are also applicable to the "detection of aging effects" program element basis for managing cracking and changes in material properties in elastomeric components.

The applicant responded to RAI B2.1.32-5, Part 2 by letter dated May 13, 2010. In its response, the applicant restated its initial basis for the sample sizes and inspections that would be used to manage loss of material and reduction of heat transfer capability in the metallic components that would be managed under the WCP Program's periodic visual examinations and to manage cracking and changes in the material properties for the elastomeric components that are within the scope of these periodic examinations. Specifically, the applicant clarified that the WCP Program historically performs enough periodic surveillance or preventive maintenance activities such that a sample of the population of components in each material/environment population set would be made available and accessible for inspection under the program elements of the WCP Program.

However, the staff also noted that, in the applicant's response to RAI B2.1.32-2 (contained in applicant's letter dated January 21, 2010), the applicant had indicated that:

> For each material-environment combination, sufficient internal surfaces inspections will be performed during scheduled surveillance and maintenance activities to provide an overall assessment of any aging degradation that may be occurring. A review of the scheduled surveillance and maintenance activities will be performed to select activities that will provide a set of inspections that will be representative of the components in the program. The review will consider component materials; operating environments; industry and plant-specific operating experience; engineering evaluations of equipment performance; and susceptibility to aging due to time in service, severity of operating conditions, and lowest design margins.

Based on the response to RAI B2.1.32-2, the staff noted that the applicant had previously identified that it would define a sample set of component inspections that would be representative of the components in the material/environment populations of the program that would be inspected on a periodic basis. Thus, the staff noted that the applicant's response to RAI B2.1.32-5, Part 2 did not resolve the staff's issue on having assurance that the components selected for these material/environment sets would actually be scheduled for inspection on a periodic basis during the period of extended operation. Specifically, the staff noted that the applicant would need to provide further assurance that each of the lead-indicator components' material/environment sample sets would be inspected at least once prior to the period of extended operation to set a baseline set of results for these lead indicator components, and at least twice during the period of extended operation to conform to the definition of a periodic condition monitoring program. By letter dated September 10, 2010, the staff issued RAI B2.1.32-5a, requesting that the applicant provide a description on how the WCP Program would be modified to ensure that a limit is placed on the maximum amount of time that could elapse before the lead indicator components in the sample sets would need to inspected.

The applicant responded to RAI B2.1.32-5a by letter dated September 23, 2010. In its response, the applicant stated the program will be supplemented to include the following amended "detection of aging effects" and "monitoring and trending" program element bases to ensure that the components selected for the sample sets would be inspected:

> Prior to the period of extended operation, the inspections performed in accordance with the Internal Surfaces Monitoring portion of the Work Control Process program will be audited. The audit will confirm that inspections have been performed for each material/environment combination credited in the Work Control Process program for the inspection of internal surfaces. If a material/environment combination has not been inspected prior to the period of extended operation, supplemental inspections will be planned. Any identified supplemental inspections will be performed within 5 years from completion of the audit.

> Additionally, to confirm that the Internal Surfaces Monitoring portion of the Work Control Process program continues to adequately manage aging of the components for which it is credited; this audit will be repeated during each 10 years of the period of extended operation. As with the initial audit, additional supplemental inspections will be performed if any material/environment combinations have not been inspected at least once during the 10-year period.

The staff noted that the applicant included these amended periodic "detection of aging effects" and "monitoring and trending" program element bases as license renewal Commitment No. 50 in LRA Appendix A (USAR supplement) Table A6.0-1. In this commitment, the applicant committed to performing the stated audit of inspected components and material/environment combinations for these components a first time as a baseline inspection audit at least once within 5 years prior to entering the period of extended operation, and subsequently at least once within each 10-year interval scheduled for the 20-year period of extended operation. By letter dated October 20, 2010, the applicant amended Commitment No. 50 to clarify that the stated audits would be to confirm that the components in the lead material/environment sample sets had been inspected, or else to schedule them for inspection.

The staff noted that the applicant's amended bases, as committed to in the letter of September 23, 2010, resolve the staff's concern regarding frequency and number of periodic inspections performed on each of the components that will be selected for material/environment sample sets because it will ensure that the components will be inspected at least once prior to the period of extended operation and at least twice during the period of extended operation. Staff concerns in RAIs B2.1.32-2, B2.1.32-3, and B2.1.32-5a are resolved, and Open Item B2.1.32-1, Part 2 is closed.

The staff finds the applicant's exception, to apply the WCP Program and use visual examination methods to monitor for and manage loss of strength in the non-metallic filter papers, to be an acceptable and conservative aging management basis because: (1) the applicant will replace these filters when the differential pressure across the filter exceeds a pre-defined threshold; (2) under the provisions of 10 CFR 54.21(a)(1), these components do not need to be within the scope of an AMR because they are consumable components (i.e., the filters will be replaced on a specified frequency when the differential pressure threshold is achieved); (3) under this AMP, the applicant will conservatively monitor for loss of strength-related degradation in the filters, even though the requirements in 10 CFR 54.21(a)(1) do not require these consumable components be within the scope of an AMR; and (4) the parameters that the applicant will monitor for as providing for indications of loss of strength (i.e., monitor for evidence of tears, material degradation, discoloration, unusual wear, or loss of form in the filter papers) are easily detected in the papers using general visual examination methods.

Based on its review, the staff finds the exceptions on the "parameters monitored or inspected" and "detection of aging effects" program elements on GALL AMP XI.M38, as made relative to the various materials and aging effects that the program manages, to be acceptable.

Exception 4. In its letter dated September 25, 2009, the applicant took an exception to the "acceptance criteria" program element in GALL AMP XI.M38, which identifies that indications of various corrosion mechanisms or fouling will be reported and evaluated, and that the acceptance criteria are established in the maintenance and surveillance procedures or other established plant procedures.

In this exception, the applicant clarified that the scope of the WCP Program, as applied as a periodic, condition monitoring program, is being credited for additional materials, environments, and aging effect combinations that are not included in GALL AMP XI.M38. Therefore, the acceptance criteria for the program includes additional acceptance criteria for the additional aging effects that the program manages (i.e., the program includes additional acceptance criteria for cracking in stainless steel components; for loss of material, cracking, loss of sealing, changes in material properties, including hardening and loss of strength, in elastomeric components; and for loss of strength in the non-metallic filter papers). The applicant also clarified that the appropriate acceptance criteria are contained in applicable design standards, design codes, and manufacturer information, or vendor manuals, and that in the event that the acceptance criteria are not available in applicable source documents, an engineering evaluation would be performed to establish the specific acceptance criteria. The staff found this basis to be acceptable because it meets the staff acceptance criteria position in SRP-LR Section A.1.2.3.6, which states, in part, that acceptance criteria could be specific numerical values, or that acceptance criteria from available references may be cited.

The staff noted, however, that in this exception, the applicant indicated that the acceptance criteria will be established in the license renewal trailer when the program is implemented and that the acceptance criteria are no unacceptable wear, corrosion, cracking, change in material properties (for materials and non-metallics) or significant fouling. The staff noted that the statement, "no unacceptable wear, corrosion, cracking, change in material properties (for materials and non-metallics) or significant fouling," is vague and ambiguous.

In a letter dated December 3, 2009, the staff issued RAI B2.1.32-4 requesting that the applicant clarify the intent of the phrase, "no unacceptable wear, corrosion, cracking, change in material properties (for materials and non-metallics) or significant fouling." Specifically, the staff asked the applicant to clarify whether the intent was to establish a go/no-go acceptance criterion for the GALL AMP XI.M38 aspects of the program (meaning that no evidence of aging would be acceptable and any evidence was unacceptable), or whether a certain amount of wear, corrosion, cracking, change in material properties, or significant fouling could be permitted in the components as long as it is within the bounds of the acceptance criteria for the detected aging effect mechanism (as established in implementing procedures).

In its response to RAI B2.1.32-4, dated January 21, 2010, the applicant clarified that the intent of the phrase, "no unacceptable wear, corrosion, cracking, change in material properties (for materials and non-metallics) or significant fouling," was to indicate that a certain amount of degradation could be permitted as long as it was within the acceptance criteria bounds established in the plant implementing procedures. The staff found that the applicant's exception basis taken on the "acceptance criteria" program element of GALL AMP XI.M38, as supplemented by this clarification, to be acceptable because it is in conformance with the "acceptance criteria" program element recommendation in GALL AMP XI.M38, which states that:

> Indications of various corrosion mechanisms or fouling that would impact component intended function are reported and will require further evaluation. The acceptance criteria are established in the maintenance and surveillance procedures or other established plant procedures. If the results are not acceptable, the corrective action program is implemented to assess the material condition and determine whether the component intended function is affected.

Based on its review, the staff finds the exception taken on the "acceptance criteria" program element in GALL AMP XI.M38 to be acceptable. Therefore, the staff's concern described in RAI B2.1.32-4 is resolved.

Enhancement. In the applicant's letter of September 25, 2009, the applicant stated that the WCP Program is a new AMP and that the program will be enhanced to make it consistent with the program elements in GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components."

The staff confirmed that the applicant included this enhancement of the program in LRA Commitment No. 25, which was amended in the letter of September 25, 2009, and placed in LRA Appendix A, USAR Supplement, Table A6.0-1 as follows:

> The work control process will be established. The program will perform one-time inspections as a verification of the effectiveness of chemistry control programs. The program will also perform visual inspections of component internal surfaces, and external surfaces of selected components, to manage the effects of aging when the surfaces are made available for examination through surveillance and maintenance activities.

The staff's evaluation of this enhancement is given in the staff's evaluation of the USAR supplement for the WCP Program, which follows later on in this evaluation.

Operating Experience. The staff also reviewed the OE described in LRA Section B2.1.32. The applicant stated that the WCP Program is a new program and that, therefore, there is currently no documentation of programmatic OE that had been obtained and is available through implementation as an AMP. The applicant clarified that, as OE is obtained, lessons learned will be used to adjust this program as needed.

However, the applicant stated that inspections have been performed and documented during the performance of applicable surveillance and preventive maintenance procedures, and as a result of this, the following OE discussions represent examples of the type of OE that will be obtained when the WCP Program is implemented as an AMP during the period of extended operation:

> In April 2002, Maintenance personnel were replacing the fire protection jockey pump discharge relief valve and identified the adjacent piping was approximately 90% blocked with rust-like debris. Additionally, it was identified that a nearby pipe nipple was corroded and required replacement. The work order instructions were revised, the piping was cleaned, and the welded nipple was replaced.
>
> In April 2008, a detailed inspection of a service water valve revealed that the disc guides in the valve body were eroded. The inspection was performed in response to a work order written in 2006 when poor valve seat contact was visually noted during service water pipe replacement. It was noted in 2006 that the seat conditions would probably cause the valve to weep. Visual inspection of the valve at that time indicated the valve would continue to perform its isolation function. As a result of the 2008 inspection, it was determined that the guides could not be repaired and the valve was replaced.

> In April 2008, during an overhaul of the "B" Component Cooling Water pump, the lower pump casing was found to have an area of material loss on the outboard wear ring casing groove land. It was determined that the condition appeared to have developed over a long period of time, most likely since the pump was installed in October 2001. A review of operating experience did not identify any horizontal pumps with similar conditions. As part of the extent of condition review, the historical operating performance of the "A" and "B" Component Cooling Water pumps was reviewed. The results indicated that these pumps were operating at or near the reference vibration levels and hydraulic performance values that were established when the pumps were initially installed. Periodic performance testing (vibrations and hydraulic performance) of the "B" Component Cooling Water pump is being performed to validate the continued operability of the pump.

The applicant's letter, dated September 25, 2009, amended the status of the WCP to define the program as a new AMP that will be consistent with the guidelines in GALL AMP XI.M32, "One-Time Inspection," when subjected to an enhancement and applied as a one-time condition verification program for water chemistry and oil analysis preventive monitoring programs, and with the guidance in GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," with noted exceptions and when subject to an enhancement and applied as a periodic, condition monitoring program. Thus, the WCP Program is a new condition monitoring program for the LRA that will be implemented (Commitment No. 25) prior to the period of extended operation. The staff noted, however, that for all three examples given, the applicant summarized: (1) when the periodic surveillances or preventive maintenance activities were performed, (2) the type of conditions that were detected during the implementation of the stated periodic surveillance or preventative maintenance activities, (3) the relevant results of the relevant monitoring and trending activities that were implemented following detection of the stated conditions, and (4) which corrective actions or activities were implemented to justify continued operation of the plant.

In addition, during the audit of October 2009, the staff confirmed that the applicant has either updated its relevant WCP Program implementation procedures to add specific instructions for implementing aging management inspections when the in-scope components are opened up and made accessible for examination during preventative maintenance or periodic surveillance activities, or identified which WCP Program implementation procedures would need to be revised in the near future to incorporate these type of inspection guidelines. The staff also confirmed that the WCP Program implementing procedures were revised to incorporate appropriate monitoring and trending activities, acceptance criteria, and corrective actions when implemented as an AMP for the applicant's facility. When this is taken into account with the OE examples provided for the applicant, the staff noted that the applicant provided some evidence that the applicant's WCP Program will be capable of detecting and managing those aging effects the AMP is credited for, and if necessary, of taking corrective actions and adjusting the program based on the steps that will be taken to disposition the aging effects associated with the relevant OE.

However, the staff noted that the three examples of OE provided by the applicant for the WCP Program create some doubt on whether the program element criteria for the AMP (and the future implementation of the program in accordance with these program elements) would be capable of managing the aging effects that are within the scope of the program.

In a conference call with the staff dated March 18, 2010, the applicant informed the staff that the WCP Program is a new program that, when implemented, will be consistent with the criteria of

GALL AMP XI.M32, "One-Time Inspection," when performed on a one-time condition monitoring basis, and with the criteria in GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," with exceptions, when performed on a periodic, condition monitoring basis. During this conference call, the applicant stated that, since the AMP is a new program, the OE discussions provided in the letter of September 25, 2009, were only provided as examples to indicate that the program had, in the past, detected relevant aging effects and that the examples were not used for the purpose of demonstrating the capability of the AMP to detect and manage aging.

The staff noted that, in the general license renewal guidance of SRP-LR Section A.1.2.3.4, "Detection of Aging Effects," the staff established its recommended position that AMPs "based solely on detecting structure and component failure should not be considered as an effective aging management program for license renewal." As a result, the staff issued RAI B2.1.32-5, Part 3 to address the issue on the acceptability of OE examples that were listed for the WCP Program in the applicant's letter of September 25, 2009. In this RAI, the staff asked the applicant to provide its basis on why the staff should not use the OE examples provided in the September 25, 2009, letter to assess whether the WCP Program will be capable of managing the aging effects for which the AMP is credited to manage. In addition, the staff asked the applicant to clarify whether it would be willing to amend the LRA to include the type of commitment that is recommended for new AMPs in SRP-LR Section A.1.2.3.10 and to apply this commitment to the future implementation of the WCP Program during the period of extended operation. The staff identified this as **Open Item B2.1.32-1, Part 3.**

By letter dated May 13, 2010, the applicant responded to RAI B2.1.32-5, Part 3. In its response to Part 3 of the RAI, the applicant stated that it agreed the three examples of WCP-related OE do not directly substantiate the future effectiveness of the WCP Program in managing the aging effects for which the AMP is credited. Instead, the applicant amended the AMP to remove the OE mentioned in its response dated September 25, 2009, from the program and amended the OE discussion to state that the WCP Program is a new program, in part, that will be implemented during the period of extended operation, and that consistent with the criteria in SRP-LR Branch Position RLSB-1, the LRA is amended to include Commitment No. 47, which will be added to LRA Appendix A, USAR Supplement, Table A6.0-1, and states as follows:

> Submit three examples of operating experience associated with the *Work Control Process – Internal Surfaces Monitoring* program for NRC staff review in determining the effectiveness of the program to detect and correct the effects of aging prior to the loss of intended function.

In SRP-LR Appendix A.1, Section A.1.2.3.10, "Aging Management Review – Generic (Branch Position RLSB-1)," the staff makes the following recommendation relative to providing OE for new programs that have yet to be implemented at an applicant's facility: "An applicant may have to commit to providing operating experience for new programs to confirm their effectiveness."

The staff noted that the applicant's amendment of the OE basis for the WCP Program in the applicant's letter dated May 13, 2010, and amendment of the LRA to include Commitment No. 47 is consistent with the recommended guidance for new programs in SRP-LR Appendix A.1, Section A.1.2.3.10. Based on this review, the staff finds that the applicant's amended "operating experience" program element basis for the WCP Program in its letter of May 13, 2010, and commitment to submit three examples of OE for the WCP Program for staff review is acceptable because it is in conformance with the commitment-based recommendation for new programs in SRP-LR, Appendix A.1, Section A.1.2.3.10. Staff concerns in RAI B2.1.32-5, Part 3 are resolved, and Open Item B2.1.32-1, Part 3 is closed.

Based on its review, the staff finds the applicant's "operating experience" program element acceptable.

USAR Supplement. In its letter dated September 25, 2009, the applicant amended LRA Section A2.1.32 and the USAR supplement for the WCP Program as follows:

> Program Description
>
> The *Work Control Process* program is a new program that will correspond to NUREG-1801, Section XI.M32, "One-Time Inspection," and Section XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." One-time inspections will manage the aging effects of cracking, loss of material, and reduction of heat transfer to verify the effectiveness of the *Primary Water Chemistry, Secondary Water Chemistry, Closed-Cycle Cooling Water System, Fuel Oil Chemistry,* and *Lubricating Oil Analysis* programs through inspections implemented in accordance with the work management process. The one-time inspections will be performed using NDE techniques that have been determined to be effective for the identification of potential aging effects. The program will use a representative sampling approach to verify degradation is not occurring. The sample size and location for the one-time inspections will be established to ensure that the number and scope of the inspections are sufficient to provide reasonable assurance that the aging effects will not compromise the intended functions during the period of extended operation.
>
> The inspections of internal surfaces in miscellaneous piping and ducting components will manage the aging effects of change in material properties, cracking, hardening and loss of strength, loss of material, loss of sealing, loss of strength, and reduction of heat transfer for the in-scope structures and components through inspections implemented in accordance with the work management process. The program will perform visual inspections of piping, piping components, ducting and other components fabricated of aluminum, copper alloys, stainless steel, and steel to detect loss of material, reduction of heat transfer, and cracking. Visual inspections will also manage the degradation of the paper filter elements in the Compressed Air System. The program will include physical manipulation of elastomeric components as a supplement to the visual inspections. An enhanced VT-1 NDE examination will be performed to detect cracking of stainless steel diesel exhaust flexible connections.
>
> Commitments
>
> - Program Implementation:
>   The *Work Control Process* program will be established.
>   The commitment is identified in Appendix A, Table A6.0-1 License Renewal Commitments, Item 25.

The staff also noted that in the letter of September 25, 2009, the applicant also stated that the program would be enhanced to be "consistent with the recommendations in NUREG-1801, Section XI.M32 'One-Time Inspection,' and NUREG-1801, Section AMP XI.M38, 'Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,'" and that this enhancement is reflected in Commitment No. 25 of the LRA which was placed in USAR Summary Table A6.0-1 and revised in the letter of September 25, 2009, to state:

> The Work Control Process program will be established. The program will perform one-time inspections as a verification of the effectiveness of chemistry control programs. The program will also perform visual inspections of component internal surfaces and external surfaces of selected components to manage the effects of aging when the surfaces are made available for examination through surveillance and maintenance activities.

The staff noted that SRP-LR Section 3.0 defines AMP enhancements as follows:

> In some cases, an applicant may choose an existing plant program that does not currently meet all the program elements defined in the GALL Report AMP. If this is the situation, the applicant may make a commitment to augment the existing program to satisfy the GALL Report AMP element prior to the period of extended operation. This commitment is an AMP enhancement.
>
> Enhancements are revisions or additions to existing aging management programs that the applicant commits to implement prior to the period of extended operation. Enhancements include, but are not limited to, those activities needed to ensure consistency with the GALL Report recommendations. Enhancements may expand, but not reduce, the scope of an AMP.

The staff noted that the SRP-LR Section 3.0 guidance does not indicate that enhancements can be applied to new AMPs. As a result, the staff noted that in the enhancement of the WCP Program (as given in the applicant's letter of September 25, 2009), the applicant only indicated that the program is a new program that "will be consistent with the recommendations in NUREG-1801, Section XI.M32, 'One Time Inspection,' and NUREG-1801, Section XI.M38, 'Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,'" and that this enhancement is being reflected in Commitment No. 25, which was placed in USAR Table A6.0-1. In contrast, the staff noted that Commitment No. 25 only indicated that the WCP Program will be implemented as a new AMP during the period of extended operation, as implemented on a one-time basis for verification of the effectiveness of chemistry programs or on a periodic basis when applied as a periodic, condition monitoring program. Thus, it was not evident to the staff whether Commitment No. 25 was being placed on the USAR Table A6.0-1: (1) solely for the purpose of reflecting the need to implement the program during the period of extended operation (without any real need for enhancement of the program) or (2) to reflect that the particular program element criteria for the WCP Program would need to be enhanced to make them consistent with the stated definition for AMP enhancements given in SRP-LR Section 3.0 and with the program elements in either GALL AMP XI.M32 (when applied on a one-time condition monitoring basis) or in GALL AMP XI.M38 (when applied on a periodic, condition monitoring basis).

In addition, the staff also observed that there were some apparent inconsistencies among the information provided in the letter of September 25, 2009, on the WCP Program, the enhancement of the WCP Program, USAR supplement Section A2.1.32, and Commitment No. 25. In particular, the updated enhancement and USAR supplement summary description for the WCP Program reflect that the AMP would be implemented consistent with the recommended program element criteria in GALL AMP XI.M32, when applied on a one-time inspection basis, and with those in GALL AMP XI.M38, when applied as a periodic, condition monitoring program. However, the revised WCP Program basis for the AMP, as proposed in the letter of September 25, 2009, indicated that the AMP would be implemented consistent with the guidance in GALL AMP XI.M38 when applied as a periodic, condition monitoring program, but also when subjected to four specifically defined exceptions that the applicant was making to the program elements in GALL AMP XI.M38.

The staff issued RAI B2.1.32-5, Part 4 to resolve the issues with the applicant's enhancement of the WCP Program and with Commitment No. 25, as placed in USAR Table 6.0-1 and placed relative to the summary description for the WCP Program in USAR supplement Section A2.1.32. In this RAI, the staff asked the applicant to review the information that has been supplied for the WCP Program, the enhancement for the WCP Program, USAR Section A.2.1.32, and Commitment No. 25 in the September 25, 2009, letter (as supplemented by the letter of January 21, 2010), for consistency against each other. In this RAI, the staff also asked the applicant to clarify whether Commitment No. 25 was being placed on the LRA: (1) solely for the purpose of indicating that the WCP Program, as a new AMP, would be implemented during the period of extended operation, without any need to enhance the program elements of the AMP prior to implementation of the program; or (2) whether the commitment was being placed on the LRA to reflect that particular program elements for the WCP Program would need to be enhanced to make them consistent with the GALL Report, or with the GALL Report as subjected to particular exceptions, prior to implementation of the program. The staff identified this as **Open Item B2.1.32-1, Part 4**.

By letter dated May 13, 2010, the applicant responded to RAI B2.1.32-5, Part 4. In its response, the applicant stated that the WCP Program, as specified in LRA Section B.2.1.32 and supplemented in the applicant's letter dated September 25, 2009, is defined as a new AMP that will be implemented during the period of extended operation, and includes Commitment No. 25 to implement the program during the period of extended operation consistent with the program element recommendations in GALL AMP XI.M32 for the components in the program that would be inspected on a one-time basis for confirmation of preventive program effectiveness, and with the program element recommendations in GALL AMP XI.M38 for managing age-related degradation in components that will be inspected on a periodic basis. The staff noted that this provides an adequate description of the program, considering also that the program includes four exceptions that were taken to GALL AMP XI.M38 as defined by the applicant and accepted by the staff in this SER section.

The staff also noted that, in the applicant's letter of May 13, 2010, the applicant amended its "operating experience" program element for the WCP Program to include Commitment No. 47 in LRA USAR Supplement Table A6.0-1, and that in this commitment the applicant committed to submitting three examples of OE for the new WCP Program for staff review. The staff found this commitment to be acceptable because it is in conformance with the commitment based recommendation for new AMPs in SRP-LR, Appendix A.1, Section A.1.2.3.10.

The staff also noted that, in its letter of September 23, 2010, the applicant amended the program to include Commitment No. 50 in LRA USAR Supplement Table A6.0-1 in order to provide additional assurance that each of the components in the material/environment sample sets for the periodic condition monitoring portion of the program would be inspected on a periodic basis during the period of extended operation. Thus, based on this review, the staff finds that the information in the USAR supplement is an adequate summary description of the program as required by 10 CFR 54.21(d), because the summary description provides an adequate summary of the program and because the USAR supplement for this program includes Commitment Nos. 25, 47, and 50 as found acceptable for implementation by the staff. RAI B2.1.32-4 is resolved, and Open Item B2.1.32-1, Part 4 is closed.

Conclusion. On the basis of its audit and review of the applicant's WCP Program, the staff determined that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the four exceptions taken to GALL AMP XI.M38 and their justifications, and determined that the AMP, with the exceptions taken, is adequate to manage the aging effects for which the LRA credits it. The staff also reviewed the applicant's enhancements to implement the program during period of extended operation, to submit three examples of OE results for staff review, and to perform audits of the program to ensure that the components in the program's material/environment sample sets will be inspected during the period of extended operation, and confirmed that their implementation through Commitment Nos. 25, 47, and 50 in accordance with their schedules will make the new AMP consistent with the program elements in GALL Report AMPs XI.M32 and XI.M38 (as subject to the four exceptions), and with SRP-LR Section A1.2.3 to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.20 Metal Fatigue of Reactor Coolant Pressure Boundary Program

Summary of Technical Information in the Application. LRA Section B3.2 describes the existing Metal Fatigue of Reactor Coolant Pressure Boundary Program as consistent, with an enhancement, with GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." The applicant stated that its program will monitor and track the critical thermal and pressure transients listed in USAR Table 4.1-8 to ensure that the design cycle limits are not exceeded so that the assumptions used in the fatigue analyses for the ASME Code Class 1 vessels and pressurizer surge line are maintained. The applicant also stated that it has evaluated the effects of the reactor coolant environment on component fatigue life for a sample of critical components identified in NUREG/CR-6260 that are applicable to an older vintage Westinghouse plant. The applicant further stated that the hot leg surge line nozzle and the charging nozzle locations will be managed by its program to ensure adequate margin against fatigue cracking due to anticipated cyclic strains and the effects of the reactor coolant environment. The applicant also stated that its program will monitor thermal cycles associated with selected auxiliary heat exchangers.

The applicant stated that its program uses EPRI software, FatiguePro™, to monitor transient cycles and fatigue usage for selected ASME Code Class 1 components. In addition, the applicant stated that its program provides for corrective actions in response to approaching an "Action Limit" on cycle counts or fatigue usage. The applicant also stated that when the monitored transient cycles or fatigue usage exceeds 80 percent of the design limit, the condition is evaluated and appropriate corrective action is initiated to ensure the design limit is not exceeded.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether they are bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL AMP X.M1. As discussed in the Audit Report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL AMP X.M1, with the exception of the areas identified below. For these areas, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

During its audit, the staff determined the need for additional clarification in areas regarding procedures for transient tracking, use of nonconforming analysis methodology, and issues related to OE, which resulted in RAIs B3.2-1 through RAI B3.2-4 issued by letter dated July 13, 2009.

The staff noted the applicant's program relies on transient cycle monitoring to evaluate the fatigue usage described in the LRA. However, the staff also noted there was no description or discussion regarding how the applicant has been and will be monitoring the severity of pressure and thermal (P-T) activities during plant operations. The staff noted that it is essential that all thermal and pressure activities (transients) are bounded by the design specifications, including P-T excursion ranges and temperature rates, for an effective and valid AMP.

By letter dated July 13, 2009, the staff issued RAI B3.2-1 requesting that the applicant: (a) describe the procedures that it uses for tracking thermal transients, (b) confirm that all monitored transient events were bounded by the design specifications, (c) confirm that transient events were continuously monitored since the plant startup, and (d) provide a histogram of cycles accrued for plant heatup and cooldown transients.

In its response dated August 17, 2009, the applicant responded to parts (a) and (b) stating that the thermal and pressure transients listed in LRA Table 4.3-1 and USAR Table 4.1-8 are tracked by its program and that the requirements of the program are implemented by a plant surveillance procedure, which includes a summary description of critical parameters associated with the transient definition and requires tracking the occurrence of transients listed in LRA Table 4.3-1. The applicant also stated that transient conditions were defined for fatigue evaluation based on a conservative estimate of the magnitude and frequency of the temperature and pressure cycles resulting from normal operation, normal and abnormal load transients, and accident conditions. The applicant further stated that if a thermal or pressure transient occurs that is not bounded by the transient parameters described in the procedure, the event will be documented in the corrective action program and an engineering evaluation will be performed to determine the impact on applicable components and analyses. In its response to part (c), the applicant stated that thermal and pressure transients listed in LRA Table 4.3-1 have been monitored and tracked since initial plant operation in 1973. In its response to part (d), the applicant provided histograms of cycles accrued for plant heatup and cooldown transients.

Based on its review, the staff finds the applicant's response to RAI B3.2-1 acceptable because: (1) for parts (a) and (b), the applicant has demonstrated the effectiveness of its program on transient cycle capturing and counting, as well as keeping all transients being bounded within the design specifications; (2) for part (c), the applicant confirmed that transient events have been continuously monitored since the plant startup; and (3) for part (d), the applicant provided the transient cycle histograms for the plant heatup and cooldown transients, covering the plant operating history thus far. Based on the applicant's response, the staff confirmed that: (a) all transients are bounded within the design specifications, and (b) all transient cycles that had occurred were captured and counted since the startup of the plant. The staff noted that these two requirements are the essence and technical bases of the cycle-based fatigue (CBF) management methodology. The staff's concern described in RAI B3.2-1 is resolved.

The staff noted that the applicant's program relies on nonconforming software, FatiguePro™, to perform some of the fatigue usage calculations. LRA Section B3.2 states that its fatigue managing program uses all three modules of the EPRI software, FatiguePro™, to perform cycle counting, CBF monitoring, and stress-based fatigue (SBF) monitoring. However, the staff noted that in its SBF monitoring module, FatiguePro™ does not use all six components of a transient stress tensor to perform fatigue analysis in accordance with the ASME Code Section III NB-3200. NRC Regulatory Issue Summary (RIS) 2008-30 recommends that the license renewal applicants that have used this simplified methodology to calculate fatigue usage should perform confirmatory analyses to demonstrate that the simplified analyses provide acceptable results.

By letter dated July 13, 2009, the staff issued RAI B3.2-2 requesting that the applicant: (a) make appropriate adjustments and corrections regarding the use of the "stress-based monitoring" and "SBF" terminologies, and reliance on the SBF monitoring methodology for fatigue usage calculations; and (b) re-evaluate the cumulative usage factor (CUF), in accordance with the guidelines described in the ASME Code Section III NB-3200 guidance, for those components whose CUFs were calculated using the FatiguePro™ SBF monitoring methodology.

In its response dated August 17, 2009, the applicant stated that the reanalysis of locations subject to evaluation of the environmental effects on fatigue usage in accordance with NUREG/CR-6260 that were initially evaluated using SBF monitoring methods, was in progress but not complete. The applicant further stated that the response to RAI B3.2-2 would be provided following completion of the reanalysis.

In an updated response dated February 2, 2010, the applicant stated that the reanalysis of the surge line hot leg nozzle and charging line nozzle in accordance with the guidance in ASME Code Section III, Subsection NB-3200, was still in progress and not yet complete. The staff noted that these two locations were the only locations that the applicant evaluated with SBF monitoring methods. The applicant committed (Commitment No. 41) to perform a fatigue analysis of the surge line hot leg nozzle and the charging line nozzle in accordance with ASME Code Section III, Subsection NB-3200 guidance and determine the CUF, considering the effects of the reactor coolant environment, and confirm that the CUF is less than 1.0 at the end of 60 years of plant operation. The staff noted that a summary of results for the reanalysis of the surge line hot leg nozzle and charging line nozzle, in accordance with the guidance in ASME Code Section III, Subsection NB-3200, will be submitted to the staff. This staff identified this as **Open Item 3.0.3.2.20-1**.

By letter dated June 1, 2010, the applicant submitted a vendor-prepared summary report of the 60-year environmentally-assisted fatigue (EAF) analysis. The applicant provided the analysis results for the two locations, the surge line hot leg nozzle and the charging line nozzle, for which the SBF monitoring method (EPRI FatiguePro™) was originally used in the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The applicant stated that the results show acceptable fatigue usage for the NUREG/CR-6260 locations for which SBF monitoring methods (EPRI FatiguePro™) were originally used considering the reactor coolant environment. The staff noted that the applicant completed this analysis to fulfill Commitment No. 41. The staff noted that the applicant provided a detailed finite element model along with fatigue usage calculations that were performed in accordance with ASME Code Section III, Subsection NB-3200. The staff reviewed the applicant's submitted vendor-prepared summary report and noted that all six components of the transient stress tensor were used throughout the evaluation for the surge line hot-leg nozzle and the charging line nozzle, in accordance with ASME Code Section III requirements, which addressed the staff's concern expressed in RIS 2008-30. The staff noted that the vendor-prepared summary report concluded that, including the consideration of environmental effects, the fatigue usage factors for the two locations are less than the ASME Code Section III allowable limit of 1.0.

The staff noted that for the charging line nozzle, the thermal analysis was simplified by lumping some transients together into single conservative sets, while transients such as plant heatup, plant cooldown, and inadvertent RCS depressurization were analyzed separately due to their large temperature or pressure changes. The staff noted that the bounding RCS transients were selected based on maximum cold leg temperature changes and ramp rates. Furthermore, four stress linearization paths within the nozzle were chosen for fatigue analysis. The staff noted that this feature allowed the analysis results to capture high stress intensity levels at various locations inside the nozzle; the 60-year CUF calculated for the bounding location was 0.0302. The staff noted that the maximum EAF usage factor, which accounted for the reactor water environment, was obtained by multiplying the maximum environmental fatigue life correction factor, F_{en}, of 15.35, calculated consistent with NUREG/CR-5704 for stainless steel, to the CUF. The staff noted that the resulting 60-year EAF usage factor was 0.4636, which is below the design limit of 1.0.

The staff noted that for the surge line hot leg nozzle, the thermal analysis was simplified by lumping transients together into a single conservative set. Furthermore, seven stress linearization paths were selected to capture high stress intensity levels at various locations inside the nozzle; the 60-year CUF in the fatigue analysis for the bounding location was 0.085. The applicant refined the EAF usage factor calculation by accounting for the strain rate and dissolved oxygen content of the environment. For the level of dissolved oxygen, the applicant assumed a value of 0.05 ppm or less. The staff noted that this is a conservative assumption with the F_{en} formulation for stainless steel materials because higher dissolved oxygen concentration would result in a lower and non-conservative F_{en} value. The applicant also incorporated the effect of strain concentration factor (penalty factor applied to alternating total stress intensity) into the analysis, which resulted in an increase in the strain rate of the transient and lowered the F_{en} value. However, the staff noted that while this removed some of the conservatism in the analysis, the staff finds this acceptable because (1) there is sufficient conservatism (such as transient lumping) that is built into in the analysis, and (2) there is margin between the CUF_{en} and the design limit. The staff noted that the resulting 60-year EAF usage factor was 0.7467, which is below the design limit of 1.0.

The vendor-prepared summary report concluded that, including the consideration of environmental effects, the fatigue usage factors for the two locations are less than the ASME Code Section III allowable value. However, the staff noted that the applicant's letter and the vendor-prepared summary report did not describe or demonstrate that the simplified analysis based on FatiguePro's™ SBF monitoring methods will provide acceptable results. In particular, the staff noted that, for the surge line hot-leg nozzle, the CUF and environmentally-assisted usage factor in the vendor-prepared summary report are greater than the CUF values presented in LRA Table 4.3-2. The staff also noted that for the charging line nozzle, the CUF and environmentally-assisted usage factor in the vendor-prepared summary report are less than those presented in LRA Table 4.3-2. The staff noted that the vendor-prepared summary report did not demonstrate or justify that the input parameters and assumptions are the same as those in the FatiguePro™ SBF monitoring. The staff was also not clear on whether the FatiguePro™ SBF monitoring module will be used by the applicant in the Metal Fatigue of Reactor Coolant Pressure Boundary Program during the period of extended operation.

By letter dated September 10, 2010, the staff issued follow-up RAI B3.2-2a, requesting that the applicant clarify whether the SBF monitoring module in EPRI FatiguePro™ will be used in the

Metal Fatigue of Reactor Coolant Pressure Boundary Program. The staff further requested that if this module will be used, justify its use for monitoring fatigue usage for the charging line nozzle and the surge line hot leg nozzle. Specifically, the staff requested that the applicant demonstrate that the fatigue analyses performed by the FatiguePro™ software are conservative when compared to the fatigue analyses that were performed consistent with ASME Code Section III, Subsection NB-3200, for the charging line nozzle and the surge line hot leg nozzle. The applicant was further requested to clarify if relevant input parameters and assumptions used in both fatigue analyses (those performed by the FatiguePro™ software and those performed consistent with ASME Code Section III, Subsection NB-3200) are the same; if not, the applicant should provide justification for any differences. The staff also requested that if this module will not be used, clarify the monitoring method (including but not limited to software that incorporates a six-component stress tensor method consistent with ASME Code Section III NB-3200 requirements) that will be used to manage the effects of fatigue for the charging line nozzle and the surge line hot leg nozzle, and justify the use of this method.

In its response dated September 23, 2010, the applicant stated that the EPRI FatiguePro™ software is used as part of the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The applicant also stated that the SBF monitoring module will not be used to monitor fatigue usage for either the surge line hot-leg nozzle or the charging line nozzle. The applicant stated that these locations were analyzed in accordance with ASME Code Section III, Subsection NB-3200, and that a summary of the analysis was provided for NRC staff review by letter dated June 1, 2010. The staff noted that the results of this evaluation for these two components, including environmental effects, demonstrated that the design limit of 1.0 would not be exceeded during the period of extended operation if the actual number of transient occurrences does not exceed the number of cycles used in the analysis. The applicant stated that the results of analysis for these two components provide the basis that these components are acceptable for the period of extended operation, subject to transient occurrences being within the limits of the analysis as confirmed through the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The staff finds it acceptable that the applicant will use its Metal Fatigue of Reactor Coolant Pressure Boundary Program to manage the effects of aging for these two components because it will continue to monitor the number of transient occurrences to ensure the limits used in the analysis are not exceeded and that the analysis remains valid.

Based on its review, the staff finds the responses to RAI B3.2-2 and B3.2-2a acceptable because: (1) the fatigue usage factor analysis was performed in accordance with ASME Code Section III, Subsection NB-3200, which utilizes six components of a transient stress tensor, thus addressing the staff's concern expressed in RIS 2008-30; (2) the CUFs and the EAF usage factors for both the surge line hot leg nozzle and the charging line nozzle are below the ASME Code Section III allowable limit of 1.0; (3) the applicant will manage the effects of aging for the surge line hot-leg nozzle and for the charging line nozzle, without the use of SBF; and (4) the applicant will use its Metal Fatigue of Reactor Coolant Pressure Boundary Program to monitor the number of transient occurrences to ensure the limits used in the analysis are not exceeded and the analysis remains valid. The staff's concerns are resolved and Open Item 3.0.3.2.20-1 is closed.

The staff also reviewed the portions of the "preventive actions," "detection of aging effects," "acceptance criteria," and "corrective actions" program elements associated with an enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement. LRA Section B3.2 states an enhancement to the "preventive actions," "detection of aging effects," "acceptance criteria," and "corrective actions" program elements. The applicant stated that its program will be enhanced to include a routine assessment of the transient cycle count totals and fatigue usage status for monitored locations. The applicant also stated that the enhancement includes an "action limit" provision, which will initiate corrective action if the current cycle counts or the CUF values exceed 80 percent of the design limits. In addition, the applicant stated that the current totals will be compared to the 60-year projections to confirm that the projections are accurate, and if short-term trends are not consistent with the 60-year projections, the 60-year projection will be re-evaluated and adjusted as necessary.

Based on its review, the staff finds the applicant's enhancement is consistent with the recommendations of the "preventive actions," "detection of aging effects," "acceptance criteria," and "corrective actions" program elements of GALL AMP X.M1 because the program will be enhanced to maintain the fatigue usage factor below the design code limit, update the status of the fatigue usage, initiate corrective action if necessary, and ensure the CUF is below the design code limit of 1.0, as recommended in GALL AMP X.M1.

Based on its audit and review of the applicant's responses to RAIs B3.2-1, B3.2-2, and B3.2-2a, the staff finds that elements one through six of the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program, with an enhancement, are consistent with the corresponding program elements of GALL AMP X.M1 and are, therefore, acceptable.

Operating Experience. LRA Section B3.2 summarizes OE related to the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The applicant provided two examples of internal OE, as summarized below:

- In June 2001, KPS engineering personnel identified that a potential challenge to charging line and reactor coolant loop piping nozzle fatigue limits may have occurred due to a letdown line isolation during a reactor trip recovery operation with high initial charging flow.
- In August 2006, during a review of historical heatup and cooldown transient data recorded in the transient cycle counting surveillance procedure, KPS engineering personnel discovered unusually high differential temperatures (ΔT) between the pressurizer surge line and RCS hot leg have been mistakenly logged.

The applicant stated that both incidences were satisfactorily resolved because its program demonstrated that the fatigue limits remained valid and it had taken the required corrective actions. The applicant also stated that the OE showed that its program is effective in monitoring and evaluating fatigue, and implementing corrective actions, when necessary. The applicant further stated that its program ensures that the intended functions of the ASME Code Class 1 components are maintained.

During its review, the staff identified the need for additional clarifications on the applicant's OE, which resulted in the issuance of RAIs.

The staff noted that the 2001 incident involved a potential challenge to the charging line and reactor coolant loop piping nozzle fatigue limits caused by an incidental transient. The staff further noted that the applicant stated that effects of the 2001 incident were satisfactorily evaluated without discussing how the evaluations were performed. By letter dated July 13, 2009, the staff issued RAI B3.2-3 requesting that the applicant describe the engineering analysis that was performed for the incidental transient during 2001.

In its response dated August 17, 2009, the applicant stated that the 2001 event described above was a letdown flow isolation that occurred with continued charging flow to the reactor coolant loop. The applicant also stated that this incident resulted in a thermal transient in the charging line, because without letdown flow, there was no pre-heating of charging flow in the regenerative heat exchanger. The applicant further stated that this incident was entered into the corrective action program and the thermal transient was evaluated for its effect on the charging line and reactor coolant loop piping and nozzle. The applicant stated that it performed a qualitative engineering evaluation considering the applicable requirements of the design code of record, USAS B31.1 (1967 Ed.). The applicant also stated that there is no requirement within this code for a detailed fatigue analysis; however, the code dictates a full range temperature cycle limit of 7,000 occurrences. The applicant further stated that the evaluation concluded that the charging line and reactor coolant loop piping nozzle did not experience temperature cycles approaching this limit, and the thermal sleeve would shield the nozzle from severe thermal stresses. The applicant concluded that there was no adverse effect on piping or nozzle structural integrity due to this incident and the design code requirements remain satisfied.

Based on its review, the staff finds the applicant's response to RAI B3.2-3 and the engineering analysis performed by the applicant acceptable because: (1) there is ample margin to 7,000 cycles, (2) the applicant's evaluation determined that there was no adverse impact to the piping or the nozzle from this transient, and (3) the thermal sleeve protected the nozzle from severe thermal stresses during transients. Therefore, the concern described in RAI B3.2-3 is resolved.

The staff noted that the 2006 incident involved an unusually high differential temperature between the pressurizer surge line and RCS hot leg that had been mistakenly logged. The staff further noted that the applicant attributed the erroneous records to a mistaken use of the "subcooling" data when the pressurizer was in a water-solid condition. In addition, the applicant stated that the water solid condition will be formed during the heatup and cooldown process under the "Modified Steam Bubble" method. By letter dated July 13, 2009, the staff issued RAI B3.2-4 requesting that the applicant: (a) describe the "Modified Steam Bubble" heatup and cooldown methodology, (b) explain at what stage of the heatup or cooldown process the water-solid condition will be established under the "Modified Steam Bubble" method, and (c) describe how it determines ΔT now since the mistake has been corrected.

In its response dated August 17, 2009, the applicant responded to part (a) by stating that the "Modified Steam Bubble" operating method was one of the plant start-up and shutdown methods defined during the Westinghouse Owner's Group (WOG) investigations into pressurizer insurge/outsurge and surge line thermal stratification issues. The applicant also stated that this operating method provides guidelines to increase pressurizer spray flow and reduce differential temperature between the pressurizer and the reactor coolant loop during plant heatup and cooldown, thereby reducing the potential metal fatigue effects of pressurizer insurge/outsurge. The applicant stated that this method had been used at KPS for start-up and shutdown since the initial plant operation in 1973 until it was replaced by the "Water Solid" method at the end of cycle 28 (March 2008). The applicant stated that the "Water Solid" method will provide even greater reduction in ΔT between the pressurizer and the hot leg during plant heatup and cooldown than the "Modified Steam Bubble" method. The applicant responded to part (b) by stating that under the "Modified Steam Bubble" operating method, water solid conditions were established in the pressurizer at the beginning of the plant heatup process and maintained until a steam bubble was formed at reactor coolant loop conditions of approximately 200 to 250 °F and 400 pounds per square inch (psig). During the cooldown process, the pressurizer steam bubble was collapsed at reactor coolant conditions of approximately 180 °F and 450 psig. In its response, the applicant responded to part (c) by stating that the ΔT between the pressurizer and the reactor coolant loop is determined through a calculated plant computer data point that subtracts the greater of reactor coolant loop A or loop B wide range temperature from the pressurizer water temperature.

The staff noted that the applicant attributed the root cause of the 2006 incident to the use of the calculated subcooling data as an approximation of the temperature differential between the pressurizer and the reactor coolant loop. The applicant stated that the subcooling-data-based analysis, which calculates the margin to boiling in the core based on the RCS pressure and the maximum in-core thermocouple reading, works only when the plant is operating with steam bubbles in the pressurizer (i.e., saturated P-T condition). However, since the applicant adopted the "Modified Steam Bubble" method of heatup and cooldown operation, the pressurizer was not in the saturated condition during those portions of heating up or cooling down under consideration. In its LRA, the applicant stated that the identified condition was documented in the corrective action program, the differential temperature data between the pressurizer surge line and RCS hot leg were corrected, and the erroneous data were evaluated to ensure that no pressurizer surge line thermal cycling or fatigue limits were exceeded.

The staff noted that additional clarification was required related to the applicant's calculation of ΔT. The staff also required confirmation as to whether the results of WCAP-12841/12842, which assisted the applicant in the closure of the thermal stratification issue identified in NRC Bulletin 88-11, remains valid since WCAP-12841/12842 was completed in 1991, whereas the ΔT data incident occurred in 2006.

Therefore, by letter dated December 3, 2009, the staff issued follow-up RAI B3.2-4a requesting that the applicant: (1) demonstrate that the formula as described for the ΔT calculation is conservative, and (2) justify that the WCAP-12841/12842 analyses remain valid.

In its response dated January 21, 2010, the applicant stated that the pressurizer-to-reactor coolant loop differential temperature is used to indicate the relative severity of plant heatup and cooldown transients for thermal cycle tracking purposes. The applicant further stated that the ΔT value is not used directly as an input to pipe or component stress determinations and the ΔT is normally measured between the pressurizer and reactor coolant loop B hot leg since that is where the surge line connects the pressurizer to the RCS. However, in the event that the reactor coolant loop B hot leg temperature data point is out of service (as indicated by an abnormally low or zero reading), an acceptable approximation can be obtained by substituting the reactor coolant loop A hot leg temperature data point. The applicant stated that the evaluations performed and documented in WCAP-12841 and WCAP-12842 (non-proprietary version), "Structural Evaluation of the Kewaunee Pressurizer Surge Line, Considering the Effects of Thermal Stratification," did not use the subject pressurizer-to-reactor coolant loop ΔT data as an input. Therefore, the erroneously high ΔT indications had no effect on the results of these evaluations or the resolution of NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification."

Based on its review, the staff finds the applicant's responses to RAIs B3.2-4 and B3.2-4a acceptable because the applicant: (1) identified the root cause of the 2006 incident and corrected the situation, (2) took corrective actions to evaluate the erroneous data to ensure that the pressurizer surge line thermal cycling or fatigue limits were not exceeded, (3) clarified that the pressurizer-to-reactor coolant loop ΔT is not used for the calculation of pipe or component stress determinations, (4) clarified and demonstrated that taking the greater of the reactor coolant loop A or loop B temperature from the pressurizer water temperature will provide a reasonable indication of pressurizer insurge and outsurge, and (5) confirmed that the subject pressurizer-to-reactor coolant loop ΔT data and erroneously high ΔT indications were not inputs used in the evaluations for the resolution of NRC Bulletin 88-11. The staff's concerns described in RAIs B3.2-4 and B3.2-4a are resolved.

Based on its audit and review of the application, and review of the applicant's responses to RAIs B3.2-3, B3.2-4, and B3.2-4a, the staff finds that OE related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program, and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

USAR Supplement. LRA Section A3.2 provides the USAR supplement for the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The staff reviewed this USAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 4.3-2.

The staff also notes that the applicant committed (Commitment No. 28) to enhance the Metal Fatigue of Reactor Coolant Pressure Boundary Program prior to entering the period of extended operation. Specifically, the applicant committed to enhance its program to include routine assessments of the transient cycle count totals and fatigue usage status for monitored locations, including an action limit for the initiation of corrective action.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancement and confirmed that its implementation through Commitment No. 28, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 AMPs That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Appendix B, the applicant identified that one AMP is plant-specific. A second program was revised from being a plant-specific program to a new program that is consistent with the GALL Report, with exceptions and enhancements (this is discussed in Section 3.0.3.3.2). For any AMP that is not consistent with or not addressed by the GALL Report, the staff performed a complete review of that AMP to determine whether it was adequate to monitor or manage aging. The staff's review of this plant-specific AMP is documented below.

3.0.3.3.1 Alloy 600 Inspections Program

Summary of Technical Information in the Application. LRA Section B2.1.1 provides a plant-specific Alloy 600 Inspections Program that manages cracking due to primary water stress-corrosion cracking (PWSCC) for Ni-alloy component locations. The program meets the GALL Report expectation to have a plant-specific program for managing Ni-alloy materials to comply with the applicable NRC publications and industry guidelines.

The Alloy 600 Inspections Program performs visual, bare metal, liquid penetrant, eddy current, and ultrasonic examinations to detect cracking of the in-scope components. The program implementing procedures define the requirements and scope of the program. The procedures identify the specific base metal and dissimilar metal weld locations included in the program, and the susceptibility of each location to PWSCC.

The program proactively addressed the industry OE for PWSCC of the Alloy 600 and dissimilar metal welds. Based on the industry experience, the reactor vessel head was replaced during the fall 2004 refueling outage. The Alloy 600 Inspections Program activities for the pressure boundary base metal and dissimilar metal weld locations are performed in accordance with the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The Alloy 600 Inspections Program provides verification that the Primary Water Chemistry Program has been effective in mitigating PWSCC and supports the Boric Acid Corrosion Program.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in the applicant's Alloy 600 Inspections Program to ensure 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.

During its review, the staff identified an area that required further information in order to complete its evaluation. The staff noted that it could not determine whether the applicant's program ensured augmented ISI inspections of Alloy 600-based components in accordance with current regulatory requirements of 10 CFR 50.55a. By letter dated October 13, 2009, the staff issued RAI B2.1.1 requesting that the applicant provide an update to state compliance with these requirements.

By letter dated November 13, 2009, the applicant provided its response to RAI B2.1.1. The applicant stated that, due to NRC rulemaking activities to establish new regulatory requirements for Ni-based alloy inspections during the review process of the LRA, the Alloy 600 Inspections Program was updated to be consistent with these new regulatory requirements, identified in the following table:

Locations	Additional Inspection Bases
Reactor vessel closure head penetrations (control rod drive mechanisms, reactor vessel level instrument system, and head vent) and associated J-groove welds	ASME Code Case N-729-1
Reactor vessel bottom head instrumentation tube penetrations and associated J-groove welds	ASME Code Case N-722
Reactor vessel safety injection nozzles buttering weld	EPRI MRP-139
Steam generator primary nozzles safe end/buttering	ASME Code Case N-722 EPRI MRP-139

Additionally, the applicant stated that, while the ASME Code Case N-770 had not yet been incorporated into the Alloy 600 Inspections Program, it would be incorporated into the program once the code case has been incorporated into 10 CFR 50.55a.

The applicant also stated that its AMP was developed using the industry guidance document EPRI 1009561 (MRP-126), "Materials Reliability Program: Generic Guidance for Alloy 600 Management," and NRC First Revised Order EA-03-009, "Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors."

The staff finds the applicant's response acceptable, because the applicant explained that, in accordance with these documents and as demonstrated by the applicant's expected inclusion of ASME Code Case N-770, the Alloy 600 Inspections Program is maintained consistent with current regulations and is a living program that will be revised periodically to reflect the latest plant configurations. The staff's concern described in RAI B2.1.1 is resolved.

SRP-LR, Revision 1, contains the staff's generic evaluation of existing plant programs and documents the technical basis for determining where existing programs are adequate without modification for the period of extended operation. Guidance for the aging management of Ni-alloy material components, of which Alloy 600 components fall within, is provided in SRP-LR Section A.1, "Aging Management Review." The staff reviewed the applicant's Alloy 600 Inspections Program against the AMP elements found in Section A.1.2.3 based on the applicant's submittal.

(1) Scope of the Program – Element 1 of the applicant's Alloy 600 Inspections Program will manage cracking due to PWSCC for the following Ni-alloy component locations:

- reactor vessel closure head penetrations (control rod drive mechanisms (CRDMs), reactor vessel level instrumentation system (RVLIS), and head vent) and associated j-groove welds
- reactor vessel bottom head instrument tube penetrations and associated j-groove welds
- reactor vessel safety injection nozzles buttering weld
- reactor vessel core support guide lug/weld
- steam generator primary nozzles safe end/buttering

These items are identified in the LRA in the Alloy 600 Inspections Program and as line items in Table 3.1.2, "Reactor Vessel, Internals, and Reactor Coolant System – Reactor Vessel – Aging Management Evaluation." Further, these items correspond to the following GALL Report, Volume 2 references:

- IV.A2-09 closure head CRDM head penetrations
- IV.A2-12 core support guides
- IV.A2-15 safety injection nozzle (cladding and buttering)

- IV.A2-18 closure head instrument tube, spare CRDM penetrations, closure head vent, and RVLIS head penetrations
- IV.A2-19 bottom head instrument tube penetrations
- IV.D1-04 primary nozzles safe end/buttering

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1. The staff finds this program element acceptable.

(2) Preventive Actions – The staff found that the preventive actions usable under the applicant's Alloy 600 Inspections Program are inspection, repair, replacement, and mitigation. Inspection uses nondestructive and visual examination methods to monitor the aging of the Ni-alloy components as required by the applicant's ISI program and as augmented by the requirements of 10 CFR 50.55a and recommendations of applicable bulletins, GLs, and staff-approved industry guidance. In this manner, it is a condition or performance monitoring program and, in accordance with SRP-LR Section A.1.2.3.2, no additional review is required.

The applicant noted several repair activities that have been performed to address preventative actions against PWSCC aging effects of Ni-based alloys. Specifically, the staff noted that the RPV head has been replaced with materials that are less susceptible to PWSCC. The staff finds this action demonstrates a proactive approach to preventive actions in addressing the aging effects of Ni-based alloys.

Additionally, implementation of the industry initiative MRP-139 and noting the incorporation of the ASME Code Case N-770 upon its inclusion within 10 CFR 50.55a into the Alloy 600 Inspections Program demonstrates that the program is a living program, updated with the latest requirements for various mitigation techniques that are available for use to address Ni-alloy components and numerous other options which are being explored to address the mitigation of active degradation mechanisms for these components. The staff found that the applicant's program demonstrates effective consideration of various mitigation techniques available.

Based on this review, the staff confirmed that the "preventive actions" program element satisfies the guidance in SRP-LR Section A.1.2.3.2. The staff finds this program element acceptable.

(3) Parameters Monitored or Inspected – The applicant's Alloy 600 Inspections Program detects degradation by using the examination and inspection requirements of 10 CFR 50.55a or accepted industry guidelines. "The parameters monitored are the presence and extent of cracking."

For condition monitoring programs, SRP-LR Section A.1.2.3.3 states:

> The parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function(s), [and] [f]or a condition monitoring program, the parameter monitored or inspected should detect the presence and extent of aging effects. Some examples are measurements of wall thickness and detection and sizing of cracks.

The staff noted that the applicant's Alloy 600 Inspections Program uses the appropriate volumetric, surface, and visual NDE techniques for detection of degradation of the components identified in the scope of the program, as required by 10 CFR 50.55a and industry guidance.

Based on this review, the staff confirmed that the "parameters monitored or inspected" program element satisfies the guidance in SRP-LR Section A.1.2.3.3. The staff finds this program element acceptable.

(4) Detection of Aging Effects – The applicant's Alloy 600 Inspections Program uses the 10 CFR 50.55a inspection requirements for the ISI and staff accepted industry guidance. The staff has approved, in accordance with 10 CFR 50.55a, the specific techniques and frequencies for monitoring Ni-alloy components for those components examined in accordance with the ISI Program. In addition, for other items included in the scope of the applicant's Alloy 600 Inspections Program, the methods and frequencies of examination are recommended in industry guidance. Each of these programs for the detection of aging effects has been analyzed by the staff to provide adequate detection capability.

The staff's review confirmed that the applicant's "detection of aging effects" program element satisfies the guidance in SRP-LR Section A.1.2.3.4. The staff finds this program element acceptable.

(5) Monitoring and Trending – The applicant's Alloy 600 Inspections Program uses the 10 CFR 50.55a inspection requirements for ISI and staff-accepted industry guidance. In general, the tools for monitoring and trending of Ni-alloy component inspection programs are based on the scope and reporting requirements established by the ASME Code, as required by 10 CFR 50.55a. The staff noted that the ASME Code Section XI requires, "recording of examination and test results that provide a basis for evaluation and facilitate comparison with the results of subsequent examinations." The ASME Code Section XI also requires, "retention of all inspection, examination, test, and repair or replacement activity records and flaw evaluation calculations for the service lifetime of the component or system." The ASME Code Section XI additionally provides rules for "additional examinations" (i.e., sample expansion), when flaws or relevant conditions are found that exceed the applicable acceptance criteria, to assist in determination of an extent of condition and causal analysis.

Specific monitoring or trending requirements may be created under staff-accepted industry guidance. Each of these programs for the detection of aging effects has been analyzed by the staff to provide adequate detection capability. In addition, for some of these programs, NRC temporary instructions for the staff inspection of these industry programs have been developed, such as the case of Temporary Instruction 2525/172 which defines NRC inspection of applicant actions to complete the MRP-139 program noted within the scope of the applicant's Alloy 600 Inspections Program.

Based on its review, the staff confirmed that the "monitoring and trending" program element satisfies the guidance in SRP-LR Section A.1.2.3.5. The staff finds this program element acceptable.

(6) Acceptance Criteria – The applicant's Alloy 600 Inspections Program uses the 10 CFR 50.55a inspection requirements for ISI and staff-accepted industry guidance. In general, the acceptance criteria of Alloy 600 component inspection programs are based on the scope and reporting requirements established by the ASME Code, as required by 10 CFR 50.55a. The staff noted that the ASME Code Section XI, IWB-3000 contains

acceptance criteria appropriate for the RCPB components examined in accordance with Section XI. Also, the ASME Code Section XI, IWA-5250 was verified to contain acceptable steps for evaluation and corrective measures for sources of leakage identified by visual examinations for leakage. These requirements ensure that Alloy 600 components in the RCPB maintain their designed function under all required design conditions.

Additional specific acceptance criteria can be found in staff-accepted industry guidance. MRP-139 establishes acceptance criteria for the inspection of dissimilar metal butt welds fabricated with Alloy 600 weld materials. NRC RIS 2008-025 states, in part, that the staff finds that MRP-139, with certain considerations, provides adequate protection of public health and safety for addressing PWSCC in butt welds for the near term, pending incorporation by reference into 10 CFR 50.55a of an ASME Code Case containing comprehensive inspection requirements.

Based on its review, the staff confirmed that the "acceptance criteria" program element satisfies the guidance in SRP-LR Section A.1.2.3.6. The staff finds this program element acceptable.

(7) Corrective Actions – The applicant has available several repair alternatives that address corrective actions to address PWSCC aging effects of Ni-based alloys. Specifically, the applicant's Alloy 600 Inspections Program uses the repair and replacement requirements of the ASME Code Section XI for ISI and staff-accepted industry guidance. The staff endorses the use of these repair and replacement activities through incorporation into the requirements of 10 CFR 50.55a.

The staff noted that the RPV head has been replaced with materials that are less susceptible to PWSCC. The staff finds, while no PWSCC or degradation was identified in the KPS RPV upper head, this action demonstrates a proactive approach as a corrective action addressing industry OE regarding the aging effects of Ni-based alloys.

In addition, LRA Section B1.3 states that the applicant's corrective action program is described in Topical Report DOM-QA-1, "Dominion Nuclear Facility Quality Assurance Program Description," and implements the requirements of 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." As stated in SER Section 3.0.4, the staff finds the applicant's quality assurance program (QAP) is consistent with SRP-LR Appendix A.2.

Based on this review, the staff confirmed that the "corrective actions" program element satisfies the guidance in SRP-LR Section A.1.2.3.7. The staff finds this program element acceptable.

(8) Confirmation Process – The confirmation process for the applicant's Alloy 600 Inspections Program uses the ASME Code Section XI inspection requirements for ISI and staff-accepted industry guidance. Reinspection of each Alloy 600 component is specified through these programs. The reinspection frequency of these programs is adjusted based on flaw identification, repair technique, replacement, and mitigation. Through these reinspections, the confirmation of reasonable assurance of structural integrity is verified for each component. Additionally, if any of these techniques fails to meet its acceptance criteria, additional corrective actions will be implemented by the applicant through its programs.

In addition, LRA Section B1.3 states that the confirmation process for this program is under the QAP, which is described in Topical Report DOM-QA-1, and implements the requirements of 10 CFR 50, Appendix B. As stated in SER Section 3.0.4, the staff finds the applicant's QAP is consistent with SRP-LR Appendix A.2.

Based on this review, the staff confirmed that the "confirmation process" program element satisfies the guidance in SRP-LR Section A.1.2.3.8. The staff finds this program element acceptable.

(9) Administrative Controls – The administrative controls for the applicant's Alloy 600 Inspections Program uses the ASME Code Section XI inspection requirements for ISI and staff-accepted industry guidance. In addition, LRA Section B1.3 identifies responsibilities for this program under the QAP, which is described in Topical Report DOM-QA-1, and implements the requirements of 10 CFR 50, Appendix B. As stated in SER Section 3.0.4, the staff finds the applicant's QAP is consistent with SRP-LR Appendix A.2.

Based on this review, the staff confirmed that the "administrative controls" program element satisfies the guidance in SRP-LR Section A.1.2.3.9. The staff finds this program element acceptable.

(10) Operating Experience – The staff's review of the applicant's Alloy 600 Inspections Program finds that while no indications of PWSCC degradation had been found at KPS, the applicant has incorporated inspection methodologies based on industry experience regarding PWSCC and associated reactor coolant leakage incidents, and finds that the applicant's OE demonstrates a proactive and living program. Specifically, the applicant noted multiple inspections and examinations that have been performed with no indications of leakage, as well as replacement of several RCS components, as a conservative measure or for reasons other than RCS pressure boundary leakage. Further, insulation packages have been replaced or modified to allow ease of access for future inspections. These actions demonstrate to the staff that the Alloy 600 Inspections Program and the applicant's monitoring of OE are effective.

Based on this review, the staff confirmed that the "operating experience" program element satisfies the guidance in SRP-LR Section A.1.2.3.10. The staff finds this program element acceptable.

USAR Supplement. In LRA Section A2.1.1, as revised by letter dated November 13, 2009, the applicant provided the USAR supplement for the Alloy 600 Inspections Program. The staff reviewed this section and finds the USAR supplement information an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. The staff has reviewed LRA Section B2.1.1, which describes the Alloy 600 Inspections Program as a plant-specific program and finds that the program, in conjunction with the commitments made by the applicant, meets the guidance as established in the GALL Report, Volume 2, Revision 1, for structures and/or components made of Ni-alloy material.

On the basis of its technical review of the applicant's Alloy 600 Inspections Program, the staff concludes that the applicant 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). The staff also reviewed the USAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.2 Deletion of the Plant-Specific Version of Work Control Process and Amendment of the LRA to Make the Work Control Process Consistent with the GALL Report.

In the applicant's letter of September 25, 2009, the applicant amended the WCP Program from being a plant-specific AMP for the LRA to a new AMP that will be consistent with the program elements in GALL AMP XI.M32, "One-Time Inspection," with an enhancement, and with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," with noted exceptions and an enhancement. The staff evaluates the applicant's WCP Program in SER Section 3.0.3.2.19.

3.0.3.3.3 Protective Coatings Monitoring and Maintenance Program

Summary of Technical Information in the Application. In LRA Table B2.0, item XI.S8, the applicant stated that the Protective Coatings Monitoring and Maintenance Program is "not applicable."

Staff Evaluation. The staff reviewed LRA Section B2.0, "Aging Management Programs Correlation," item XI.S8, "Protective Coatings Monitoring and Maintenance Program," using GALL AMP XI.S8 as guidance.

In RAI XI.S8 dated August 28, 2009, the staff requested that the applicant provide details on the Protective Coatings Monitoring and Maintenance Program to provide adequate assurance that the protective coatings in containment will be adequately managed, such that they will not degrade and become a debris source that would challenge the emergency core cooling system (ECCS).

In the applicant's response dated September 28, 2009, the applicant described its Protective Coatings Monitoring and Maintenance Program. The applicant stated that the program conforms to RG 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants," dated June 1973 (Revision 0), and that it incorporates ASTM D5144, "Guide for the Use of Protective Coating Standards in Nuclear Power Plants," and ASTM D5163, "Standard Guide for Establishing Procedures to Monitor the Performance of Safety-Related Coatings in an Operating Nuclear Power Plant." The applicant stated that the scope of the program includes coatings inside and outside containment, and that a condition assessment is required to be performed every refueling outage.

The applicant also stated that the acceptance criteria are described in, and are based on, the following industry guidance: ASTM D610, "Evaluating Degree of Rusting of Painted Steel Surfaces"; ASTM D714, "Evaluating Degree of Blistering of Paints"; ASTM D1186, "Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coating Applied to a Ferrous Base"; ASTM D1400, "Nondestructive Measurement of Dry Film Thickness of Nonconductive Coating Applied to a Non-Ferrous Metal Base"; and ASTM D3359, "Method for Measuring Adhesion by Tape." The applicant also stated that personnel qualifications for coatings inspectors, coating applicators, and surface preparation personnel are governed by approved procedures. The applicant stated further that, "the Protective Coating program implemented during the current licensing period ensures that coatings inside Containment will be properly maintained during the period of extended operation."

The staff reviewed the response to RAI XI.S8. The staff found the frequency of the inspection of the coatings in containment to be acceptable since inspecting every refueling outage would provide adequate assurance that there is proper maintenance of the protective coatings in containment, such that they will not degrade and become a debris source that may challenge the ECCS. The staff also found: (1) that the scope of the program is acceptable since it includes coatings inside and outside containment; (2) the acceptance criteria are acceptable since the staff has accepted and confirmed the acceptability of ASTMs D610, D714, and D3359; (3) the method of performing the coatings inspection is acceptable since the staff has confirmed that ASTM D5163 is acceptable; (4) the qualification of personnel who perform the inspection is acceptable since they are qualified in accordance with approved station procedures and are knowledgeable in coating-related installation specifications, procedures, and engineering standards, in addition to relevant industry standards, good practices, failure modes, and industry OE common to protective coatings. In addition, the staff also finds the Protective Coatings Monitoring and Maintenance Program to be acceptable since the program conforms to RG 1.54, Revision 0, and incorporates ASTMs D5144 and D5163, which are endorsed by the staff.

Based on its review, the staff finds the applicant's response to RAI XI.S8 acceptable. The staff's concern described in RAI XI.S8 is resolved.

Conclusion. On the basis of its technical review of the applicant's Protective Coatings Monitoring and Maintenance Program, the staff concludes that the applicant 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)(2).

3.0.4 Quality Assurance Program Attributes Integral to Aging Management Programs

3.0.4.1 Summary of Technical Information in the Application

In LRA Appendix A, "USAR Supplement"; Section A1.0, "Introduction"; and Appendix B, "Aging Management Programs," Section B1.3, "Quality Assurance Program and Administrative Controls," the applicant described the elements of corrective action, confirmation process, and administrative controls that are applied to the AMPs for both safety-related and nonsafety-related components. The KPS QAP includes the elements of corrective action, confirmation process, and administrative controls. Corrective actions, confirmation process, and administrative controls are applied in accordance with the QAP regardless of the safety classification of the components. LRA Sections A1.0 and B1.3 state that the QAP implements the requirements of 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and is consistent with SRP-LR, Revision 1.

3.0.4.2 Staff Evaluation

Pursuant to 10 CFR 54.21(a)(3), an applicant is required to demonstrate that the effects of aging on SCs subject to an AMR will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation. The SRP-LR, Branch Technical Position (BTP) RLSB-1, "Aging Management Review – Generic," describes 10 attributes of an acceptable AMP. Three of these ten attributes are associated with the quality assurance (QA) activities of corrective action, confirmation process, and administrative controls. Table A.1-1, "Elements of an Aging Management Program for License Renewal," of BTP RLSB-1 provides the following description of these quality attributes:

- Attribute No. 7 – Corrective Actions, including root cause determination and prevention of recurrence, should be timely
- Attribute No. 8 – Confirmation Process, which should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective
- Attribute No. 9 – Administrative Controls, which should provide a formal review and approval process

The SRP-LR, BTP IQMB-1, "Quality Assurance for Aging Management Programs," states that those aspects of the AMP that affect quality of safety-related SSCs are subject to the QA requirements of 10 CFR Part 50, Appendix B. Additionally, for nonsafety-related SCs subject to an AMR, the applicant's existing 10 CFR Part 50, Appendix B, QAP may be used to address the elements of corrective action, confirmation process, and administrative control. BTP IQMB-1 provides the following guidance with regard to the QA attributes of AMPs:

> Safety-related SCs are subject to Appendix B to 10 CFR Part 50 requirements which are adequate to address all quality related aspects of an AMP consistent with the CLB of the facility for the period of extended operation. For nonsafety-related SCs that are subject to an AMR for license renewal, an applicant has an option to expand the scope of its Appendix B to 10 CFR Part 50 program to include these SCs to address corrective action, confirmation process, and administrative control for aging management during the period of extended operation. In this case, the applicant should document such a commitment in the Final Safety Analysis Report supplement in accordance with 10 CFR 54.21(d).

The staff reviewed the applicant's AMPs described in LRA Appendix A and Appendix B, and the associated implementing procedures. The purpose of this review was to ensure that the QA attributes (i.e., corrective action, confirmation process, and administrative controls) were consistent with the staff's guidance described in BTP IQMB-1. Based on the staff's evaluation, the descriptions of the AMPs and their associated quality attributes provided in LRA Appendix A, Section A1.0, and Appendix B, Section B1.3, are consistent with the staff's position regarding QA for aging management.

3.0.4.3 Conclusion

On the basis of the staff's evaluation the descriptions and applicability of the plant-specific AMPs and their associated quality attributes provided in LRA Appendix A, Section A1.0 and Appendix B, Section B1.3, were determined to be consistent with the staff's position regarding QA for aging management. The staff concludes that the QA attributes (i.e., corrective action, confirmation process, and administrative control) of the applicant's AMPs are consistent with 10 CFR 54.21(a)(3).

3.1 Aging Management of Reactor Coolant System

This section of the SER documents the staff's review of the applicant's AMR results for the RCS components and component groups of the following:

- reactor vessel
- reactor vessel internals
- reactor coolant system
- steam generator

3.1.1 Summary of Technical Information in the Application

LRA Section 3.1 provides AMR results for the reactor vessel, RVIs, RCS, and steam generator. LRA Table 3.1.1, "Summary of Aging Management Programs for Reactor Vessel, Internals and Reactor Coolant System Evaluated in Chapter IV of NUREG 1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the reactor vessel, RVIs, RCS, and steam generator components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry OE in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry OE included a review of the GALL Report and OE issues identified since the issuance of the GALL Report.

3.1.2 Staff Evaluation

Table 3.1-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.1 and addressed in the GALL Report.

The staff reviewed LRA Section 3.1 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for the reactor vessel, RVIs, RCS, and steam generator components, within the scope of license renewal and subject to an AMR, 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).

The staff conducted two onsite audits of AMPs to confirm the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of these audits was to examine the applicant's AMPs and related documentation, and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.1.2.1 and 3.1.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.1.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's OE to verify the applicant's claims.

Table 3.1-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.1 and addressed in the GALL Report.

Table 3.1-1 Staff Evaluation for Reactor Vessel, Reactor Vessel Internals, and Reactor Coolant System Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel pressure vessel support skirt and attachment welds (3.1.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with Ni-alloy or stainless steel cladding; Ni-alloy reactor vessel components: flanges; nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads, and welds (3.1.1-2)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA	Boiling water reactor (BWR) only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel; stainless steel; steel with Ni-alloy or stainless steel cladding; Ni-alloy RCPB piping, piping components, and piping elements exposed to reactor coolant (3.1.1-3)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel pump and valve closure bolting (3.1.1-4)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) check Code limits for allowable cycles (less than 7,000 cycles) of thermal stress range	Yes, TLAA	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and Ni-alloy RVI components (3.1.1-5)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Ni-alloy tubes and sleeves in a reactor coolant and secondary feedwater/steam environment (3.1.1-6)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel and stainless steel RCPB closure bolting, head closure studs, support skirts and attachment welds, pressurizer relief tank components, steam generator components, piping and components external surfaces and bolting (3.1.1-7)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel; stainless steel; and Ni-alloy RCPB piping, piping components, piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; thermal sleeves (3.1.1-8)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with Ni-alloy or stainless steel cladding; Ni-alloy reactor vessel components: flanges; nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads, and welds (3.1.1-9)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Fatigue is a TLAA (See SER Section 3.1.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel; stainless steel; steel with Ni-alloy or stainless steel cladding; Ni-alloy steam generator components (flanges; penetrations; nozzles; safe ends, lower heads, and welds) (3.1.1-10)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes, TLAA	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel top head enclosure (without cladding) top head nozzles (vent, top head spray or reactor core isolation cooling (RCIC), and spare) exposed to reactor coolant (3.1.1-11)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel steam generator shell assembly exposed to secondary feedwater and steam (3.1.1-12)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	Once-through steam generator (OTSG) only	Applicable to OTSGs, therefore, not applicable to KPS (See SER Section 3.1.2.1.1)
Steel and stainless steel isolation condenser components exposed to reactor coolant (3.1.1-13)	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel, Ni alloy, and steel with Ni-alloy or stainless steel cladding reactor vessel flanges, nozzles, penetrations, safe ends, vessel shells, heads and welds (3.1.1-14)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel, steel with Ni-alloy or stainless steel cladding, and Ni-alloy RCPB components exposed to reactor coolant (3.1.1-15)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam (3.1.1-16)	Loss of material due to general, pitting, and crevice corrosion	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry. For Westinghouse Model 44 and 51 steam generators, if general and pitting corrosion of the shell is known to exist, additional inspection procedures are to be developed.	Yes, detection of aging effects is to be evaluated	ASME Section XI ISI (IWB, IWC, and IWD) and Secondary Water Chemistry programs	Consistent with the GALL Report (See SER Section 3.1.2.2.2.4)
Steel (with or without stainless steel cladding) reactor vessel beltline shell, nozzles, and welds (3.1.1-17)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	Yes, TLAA	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	Loss of fracture toughness is a TLAA (See SER Sections 3.1.2.2.3.1 and 4.2)
Steel (with or without stainless steel cladding) reactor vessel beltline shell, nozzles, and welds; safety injection nozzles (3.1.1-18)	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor Vessel Surveillance	Yes, plant-specific	Reactor Vessel Surveillance Program	Consistent with the GALL Report (See SER Section 3.1.2.2.3.2)
Stainless steel and Ni-alloy top head enclosure vessel flange leak detection line (3.1.1-19)	Cracking due to SCC and intergranular stress-corrosion cracking (IGSCC)	A plant-specific AMP is to be evaluated.	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel isolation condenser components exposed to reactor coolant (3.1.1-20)	Cracking due to SCC and IGSCC	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and plant-specific verification program	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Reactor vessel shell fabricated of SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process (3.1.1-21)	Crack growth due to cyclic loading	TLAA	Yes, TLAA	TLAA	Crack growth due to cyclic loading is a TLAA (See SER Sections 3.1.2.2.5 and 4.7.4)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and Ni-alloy RVI components exposed to reactor coolant and neutron flux (3.1.1-22)	Loss of fracture toughness due to neutron irradiation embrittlement, void swelling	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Consistent with the GALL Report (See SER Section 3.1.2.2.6)
Stainless steel reactor vessel closure head flange leak detection line and bottom-mounted instrument guide tubes (3.1.1-23)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes, plant-specific	Primary Water Chemistry, WCP, and ASME Section XI ISI (IWB, IWC, and IWD) programs	Consistent with the GALL Report (See SER Section 3.1.2.2.7 for RPV)
Class 1 CASS piping, piping components, and piping elements exposed to reactor coolant (3.1.1-24)	Cracking due to SCC	Water Chemistry and, for CASS components that do not meet the NUREG-0313 guidelines, a plant-specific AMP	Yes, plant-specific	Primary Water Chemistry, WCP and, for CASS components that do not meet the NUREG-0313 guidelines, ASME Section XI ISI (IWB, IWC, and IWD) Program	Consistent with the GALL Report (See SER Section 3.1.2.2.7 for CASS piping)
Stainless steel jet pump sensing line (3.1.1-25)	Cracking due to cyclic loading	A plant-specific AMP is to be evaluated.	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel and stainless steel isolation condenser components exposed to reactor coolant (3.1.1-26)	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD) and plant-specific verification program	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and Ni-alloy RVI screws, bolts, tie rods, and hold down springs (3.1.1-27)	Loss of preload due to stress relaxation	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Consistent with the GALL Report (See SER Section 3.1.2.2.9)
Steel steam generator feedwater impingement plate and support exposed to secondary feedwater (3.1.1-28)	Loss of material due to erosion	A plant-specific AMP is to be evaluated.	Yes, plant-specific	Not applicable to KPS	Not applicable to KPS (See SER Section 3.1.2.2.10)
Stainless steel steam dryers exposed to reactor coolant (3.1.1-29)	Cracking due to flow-induced vibration	A plant-specific AMP is to be evaluated.	Yes	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel RVI components (e.g., upper internals assembly, rod cluster control assembly (RCCA) guide tube assemblies, baffle/former assembly, lower internal assembly, shroud assemblies, plenum cover and plenum cylinder, upper grid assembly, control rod guide tube assembly, core support shield assembly, core barrel assembly, lower grid assembly, flow distributor assembly, thermal shield, instrumentation support structures) (3.1.1-30)	Cracking due to SCC and irradiation-assisted stress-corrosion cracking (IASCC)	Water Chemistry and USAR supplement commitment to: (1) participate in industry, RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	No, but licensee commitment needs to be confirmed	Primary Water Chemistry Program and USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Consistent with the GALL Report (See SER Section 3.1.2.2.12)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Ni alloy and steel with Ni-alloy cladding piping, piping component, piping elements, penetrations, nozzles, safe ends, and welds (other than reactor vessel head); pressurizer heater sheaths, sleeves, diaphragm plate, manways, and flanges; core support pads/core guide lugs (3.1.1-31)	Cracking due to PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and USAR supplement commitment to implement applicable plant commitments to: (1) NRC orders, bulletins, and GLs associated with Ni alloys and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed	ASME XI ISI (IWB, IWC, and IWD), Primary Water Chemistry, and Alloy 600 Inspections programs	Consistent with the GALL Report (See SER Sections 3.1.2.2.13 and 3.1.2.1.7)
Steel steam generator feedwater inlet ring and supports (3.1.1-32)	Wall thinning due to flow-accelerated corrosion	A plant-specific AMP is to be evaluated.	Yes, plant-specific	Not applicable to KPS	Not applicable to KPS (See SER Section 3.1.2.2.14)
Stainless steel and Ni-alloy RVI components (3.1.1-33)	Changes in dimensions due to void swelling	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	No, but licensee commitment to be confirmed	USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Consistent with the GALL Report (See SER Section 3.1.2.2.15)
Stainless steel and Ni-alloy reactor control rod drive (CRD) head penetration pressure housings (3.1.1-34)	Cracking due to SCC and PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry. For Ni alloy, USAR supplement commitment to implement applicable plant commitments to: (1) NRC orders, bulletins, and GLs associated with Ni alloys and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed	ASME XI ISI (IWB, IWC, and IWD) and Primary Water Chemistry programs	Consistent with the GALL Report (See SER Section 3.1.2.2.16)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel with stainless steel or Ni-alloy cladding primary side components; steam generator upper and lower heads, tubesheets, and tube-to-tubesheet welds (3.1.1-35)	Cracking due to SCC and PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry. For Ni alloy, USAR supplement commitment to implement applicable plant commitments to: (1) NRC orders, bulletins, and GLs associated with Ni alloys and (2) staff-accepted industry guidelines.	No, but licensee commitment needs to be confirmed	OTSG only	Applicable to OTSGs, therefore, not applicable to KPS, except for tube-to-tubesheet welds between Ni-alloy cladding and Ni-alloy tubes in the steam generator – see SER Section 3.1.2.2.16.1. (See SER Sections 3.1.2.1.1 and 3.1.2.2.16)
Ni-alloy, stainless steel pressurizer spray head (3.1.1-36)	Cracking due to SCC and PWSCC	Water Chemistry and One-Time Inspection. For Ni-alloy welded spray heads, provide commitment in USAR supplement to submit AMP delineating commitments to NRC orders, bulletins, or GLs that inspect stipulated components for cracking of wetted surfaces.	No, unless licensee commitment needs to be confirmed	Not applicable	Not applicable to KPS (See SER Section 3.1.2.1.1)
Stainless steel and Ni-alloy RVI components (e.g., upper internals assembly, RCCA guide tube assemblies, lower internal assembly, CEA shroud assemblies, core shroud assembly, core support shield assembly, core barrel assembly, lower grid assembly, flow distributor assembly) (3.1.1-37)	Cracking due to SCC, PWSCC, and IASCC	Water Chemistry and USAR supplement commitment to: (1) participate in industry RVI aging programs; (2) implement applicable results; and (3) submit for staff approval, greater than 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	No, but licensee commitment needs to be confirmed	Primary Water Chemistry Program and ASME Section XI ISI (IWB, IWC, and IWD) Program, including its Commitment No. 1	Consistent with the GALL Report (See SER Section 3.1.2.2.17)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel (with or without stainless steel cladding) CRD return line nozzles exposed to reactor coolant (3.1.1-38)	Cracking due to cyclic loading	BWR Control Rod Drive Return Line Nozzle	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel (with or without stainless steel cladding) feedwater nozzles exposed to reactor coolant (3.1.1-39)	Cracking due to cyclic loading	BWR Feedwater Nozzle	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel and Ni-alloy penetrations for CRD stub tubes instrumentation, jet pump instrumentation, standby liquid control, flux monitor, and drain line exposed to reactor coolant (3.1.1-40)	Cracking due to SCC, IGSCC, and cyclic loading	BWR Penetrations and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel and Ni-alloy piping, piping components, and piping elements ≥ 4" NPS; nozzle safe ends and associated welds (3.1.1-41)	Cracking due to SCC and IGSCC	BWR Stress-Corrosion Cracking and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel and Ni-alloy vessel shell attachment welds exposed to reactor coolant (3.1.1-42)	Cracking due to SCC and IGSCC	BWR Vessel ID Attachment Welds and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel fuel supports and CRD assemblies and CRD housing exposed to reactor coolant (3.1.1-43)	Cracking due to SCC and IGSCC	BWR Vessel Internals and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and Ni-alloy core shroud, core plate, core plate bolts, support structure, top guide, core spray lines, spargers, jet pump assemblies, CRD housing, and nuclear instrumentation guide tubes (3.1.1-44)	Cracking due to SCC, IGSCC, and IASCC	BWR Vessel Internals and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel piping, piping components, and piping elements exposed to reactor coolant (3.1.1-45)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Ni-alloy core shroud and core plate access hole cover (mechanical covers) (3.1.1-46)	Cracking due to SCC, IGSCC, and IASCC	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Stainless steel and Ni-alloy RVIs exposed to reactor coolant (3.1.1-47)	Loss of material due to pitting and crevice corrosion	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel and stainless steel Class 1 piping, fittings, and branch connections less than 4" NPS exposed to reactor coolant (3.1.1-48)	Cracking due to SCC, IGSCC (for stainless steel only), and thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water chemistry, and One-Time Inspection of ASME Code Class 1 Small-Bore Piping	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Ni-alloy core shroud and core plate access hole cover (welded covers) (3.1.1-49)	Cracking due to SCC, IGSCC, and IASCC	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and, for BWRs with a crevice in the access hole covers, augmented inspection using UT or other demonstrated acceptable inspection of the access hole cover welds	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
High-strength low-alloy steel top head closure studs and nuts exposed to air with reactor coolant leakage (3.1.1-50)	Cracking due to SCC and IGSCC	Reactor Head Closure Studs	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
CASS jet pump assembly castings; orificed fuel support (3.1.1-51)	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	BWR only	Not applicable to PWRs (See SER Section 3.1.2.1.1)
Steel and stainless steel RCPB pump and valve closure bolting, manway and holding bolting, flange bolting, and closure bolting in high-pressure and high-temperature systems (3.1.1-52)	Cracking due to SCC, loss of material due to wear, loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-53)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program	Consistent with the GALL Report
Copper alloy piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-54)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
CASS Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant > 250 °C (482 °F) (3.1.1-55)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, ISI requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	No	ASME Section XI ISI (IWB, IWC, and IWD) Program. Thermal aging susceptibility screening is not necessary; ISI requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	Consistent with the GALL Report
Copper alloy > 15% Zn piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-56)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.1.2.3.2)
CASS Class 1 piping, piping components, and piping elements and CRD pressure housings exposed to reactor coolant > 250 °C (482 °F) (3.1.1-57)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	Thermal Aging Embrittlement of CASS Program	Consistent with the GALL Report (See SER Section 3.1.2.1.2)
Steel RCPB external surfaces exposed to air with borated water leakage (3.1.1-58)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Steel steam generator steam nozzle and safe end, feedwater nozzle and safe end, AFW nozzles and safe ends exposed to secondary feedwater/steam (3.1.1-59)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Not applicable to KPS	Not applicable (See SER Section 3.1.2.1.1)
Stainless steel flux thimble tubes (with or without chrome plating) (3.1.1-60)	Loss of material due to wear	Flux Thimble Tube Inspection	No	Flux Thimble Tube Inspection Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel, steel pressurizer integral support exposed to air with metal temperature up to 288 °C (550 °F) (3.1.1-61)	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD)	No	ASME Section XI ISI (IWB, IWC, and IWD) Program	Consistent with the GALL Report
Stainless steel, steel with stainless steel cladding RCS cold leg, hot leg, surge line, and spray line piping and fittings exposed to reactor coolant (3.1.1-62)	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD)	No	ASME Section XI ISI (IWB, IWC, and IWD) Program	Consistent with the GALL Report
Steel reactor vessel flange, stainless steel and Ni-alloy RVIs exposed to reactor coolant (e.g., upper and lower internals assembly, CEA shroud assembly, core support barrel, upper grid assembly, core support shield assembly, and lower grid assembly) (3.1.1-63)	Loss of material due to wear	Inservice Inspection (IWB, IWC, and IWD)	No	ASME Section XI ISI (IWB, IWC, and IWD) Program	Consistent with the GALL Report
Stainless steel and steel with stainless steel or Ni-alloy cladding pressurizer components (3.1.1-64)	Cracking due to SCC and PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry	No	ASME Section XI ISI (IWB, IWC, and IWD) and Water Chemistry programs	Consistent with the GALL Report
Ni-alloy reactor vessel upper head and CRD penetration nozzles, instrument tubes, head vent pipe (top head), and welds (3.1.1-65)	Cracking due to PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry and Ni-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	No	ASME Section XI ISI (IWB, IWC, and IWD), Primary Water Chemistry, and Alloy 600 Inspections programs	Consistent with the GALL Report (See SER Section 3.1.2.1.8)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel steam generator secondary manways and handholds (cover only) exposed to air with leaking secondary-side water and/or steam (3.1.1-66)	Loss of material due to erosion	Inservice Inspection (IWB, IWC, and IWD) for Class 2 components	No	OTSG only	Applicable to OTSGs, therefore, not applicable to KPS (See SER Section 3.1.2.1.1)
Steel with stainless steel or Ni-alloy cladding; or stainless steel pressurizer components exposed to reactor coolant (3.1.1-67)	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry	No	ASME Section XI ISI (IWB, IWC, and IWD) and Water Chemistry programs	Consistent with the GALL Report
Stainless steel, steel with stainless steel cladding Class 1 piping, fittings, pump casings, valve bodies, nozzles, safe ends, manways, flanges, CRD housing; pressurizer heater sheaths, sleeves, diaphragm plate; pressurizer relief tank components, RCS cold leg, hot leg, surge line, and spray line piping and fittings (3.1.1-68)	Cracking due to SCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry	No	ASME Section XI ISI (IWB, IWC, and IWD) and Water Chemistry programs	Consistent with the GALL Report (See SER Section 3.1.2.1.4)
Stainless steel, Ni-alloy safety injection nozzles, safe ends, and associated welds and buttering exposed to reactor coolant (3.1.1-69)	Cracking due to SCC and PWSCC	Inservice Inspection (IWB, IWC, and IWD) and Water Chemistry	No	ASME Section XI ISI (IWB, IWC, and IWD) Alloy 600 Inspections, and Water Chemistry programs	Consistent with the GALL Report (See SER Section 3.1.2.1.9)
Stainless steel; steel with stainless steel cladding Class 1 piping, fittings, and branch connections less than 4" NPS exposed to reactor coolant (3.1.1-70)	Cracking due to SCC; thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and One-Time Inspection of ASME Code Class 1 Small-Bore Piping	No	ASME Section XI ISI (IWB, IWC, and IWD) and Water Chemistry programs. Inspections of small-bore piping performed by the ASME Section XI ISI (IWB, IWC, and IWD) Program.	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
High-strength low-alloy steel closure head stud assembly exposed to air with reactor coolant leakage (3.1.1-71)	Cracking due to SCC and loss of material due to wear	Reactor Head Closure Studs	No	Reactor Head Closure Studs Program	Consistent with the GALL Report
Ni-alloy steam generator tubes and sleeves exposed to secondary feedwater/steam (3.1.1-72)	Cracking due to outside-diameter stress-corrosion cracking (ODSCC) and intergranular attack; loss of material due to fretting and wear	Steam Generator Tube Integrity and Water Chemistry	No	Steam Generator Tube Integrity and Secondary Water Chemistry programs	Consistent with the GALL Report
Ni-alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant (3.1.1-73)	Cracking due to PWSCC	Steam Generator Tube Integrity and Water Chemistry	No	Steam Generator Tube Integrity and Water Chemistry programs	Consistent with the GALL Report
Chrome plated steel, stainless steel, Ni-alloy steam generator anti-vibration bars exposed to secondary feedwater/steam (3.1.1-74)	Cracking due to SCC; loss of material due to crevice corrosion and fretting	Steam Generator Tube Integrity and Water Chemistry	No	Steam Generator Tube Integrity and Water Chemistry programs	Consistent with the GALL Report
Ni-alloy OTSG-tubes exposed to secondary feedwater/steam (3.1.1-75)	Denting due to corrosion of carbon steel tube support plate	Steam Generator Tube Integrity and Water Chemistry	No	OTSG only	Applicable to OTSGs, therefore, not applicable to KPS (See SER Section 3.1.2.1.1)
Steel steam generator tube support plate and tube bundle wrapper exposed to secondary feedwater/steam (3.1.1-76)	Loss of material due to erosion, general, pitting, and crevice corrosion; ligament cracking due to corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Steam Generator Tube Integrity and Water Chemistry programs	Consistent with the GALL Report. Ligament cracking due to corrosion is not applicable to the tube support plates since they are stainless steel.
Ni-alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary feedwater/steam (3.1.1-77)	Loss of material due to wastage and pitting corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable to KPS	Not applicable (See SER Section 3.1.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel steam generator tube support lattice bars exposed to secondary feedwater/steam (3.1.1-78)	Wall thinning due to flow-accelerated corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable to KPS	Not applicable (See SER Section 3.1.2.1.1)
Ni-alloy steam generator tubes exposed to secondary feedwater/steam (3.1.1-79)	Denting due to corrosion of steel tube support plate	Steam Generator Tube Integrity and Water Chemistry. For plants that could experience denting at the upper support plates, evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02.	No	Not applicable to KPS	Not applicable (See SER Section 3.1.2.1.1)
CASS RVIs (e.g., upper internals assembly, lower internal assembly, CEA shroud assemblies, control rod guide tube assembly, core support shield assembly, lower grid assembly) (3.1.1-80)	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	ASME Section XI ISI (IWB, IWC, and IWD) Program, with enhancement	Consistent with the GALL Report (See SER Section 3.1.2.1.3)
Ni alloy or Ni-alloy clad steam generator divider plate exposed to reactor coolant (3.1.1-81)	Cracking due to PWSCC	Water Chemistry	No	Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.1.2.1.7)
Stainless steel steam generator primary side divider plate exposed to reactor coolant (3.1.1-82)	Cracking due to SCC	Water Chemistry	No	Water Chemistry Program	Consistent with the GALL Report, for steam generator manway cover diaphragm. KPS' steam generator divider plate is fabricated from Ni alloy and is evaluated in Table 3.1.1, item 3.1.1-81.

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel; steel with Ni-alloy or stainless steel cladding; and Ni-alloy RVIs and RCPB components exposed to reactor coolant (3.1.1-83)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Water Chemistry Program	Consistent with the GALL Report
Ni-alloy steam generator components, such as secondary-side nozzles (vent, drain, and instrumentation) exposed to secondary feedwater/steam (3.1.1-84)	Cracking due to SCC	Water Chemistry and One-Time Inspection or Inservice Inspection (IWB, IWC, and IWD)	No	OTSG only	Applicable to OTSGs, therefore, not applicable to KPS (See SER Section 3.1.2.1.1)
Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.1.1-85)	None	None	NA – No AERM or AMP	None	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to air-indoor uncontrolled (external); air with borated water leakage; concrete; gas (3.1.1-86)	None	None	NA – No AERM or AMP	None	Consistent with the GALL Report
Steel piping, piping components, and piping elements in concrete (3.1.1-87)	None	None	NA – No AERM or AMP	None	Not applicable to KPS (See SER Section 3.1.2.1.1)

The staff's review of the RCS component groups followed several approaches. One approach, documented in SER Section 3.1.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.1.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.1.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the RCS components is documented in SER Section 3.0.3.

3.1.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.1.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the reactor vessel, RVIs, RCS, and steam generator components:

- Alloy 600 Inspections Program
- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Bolting Integrity Program
- Boric Acid Corrosion Program
- Closed-Cycle Cooling Water System Program
- External Surfaces Monitoring Program
- Flux Thimble Tube Inspection Program
- Lubricating Oil Analysis Program
- Primary Water Chemistry Program
- Reactor Head Closure Studs Program
- Reactor Vessel Surveillance Program
- Secondary Water Chemistry Program
- Steam Generator Tube Integrity Program
- Work Control Process Program

LRA Tables 3.1.2-1 through 3.1.2-4 summarize the results of AMRs for the reactor vessel, RVIs, RCS, and steam generator components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item describing how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report and that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report. The staff confirmed whether the AMR line item of the different component was applicable to the component under review and whether the exceptions to the GALL Report AMPs had been reviewed and accepted by the staff. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff reviewed these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the reactor vessel, RVIs, RCS, and steam generator components that are subject to an AMR.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.1.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

3.1.2.1.1 AMR Results Identified as Not Applicable

Based on its initial review, the staff identified several line items of LRA Table 3.1.1 in which the applicant stated the line items were not applicable to KPS. This subsection discusses the evaluation of those line items.

LRA Table 3.1.1, items 2–4, 11, 13-15, 19, 20, 25, 26, 29, and 38–51 discuss the applicant's determination on GALL Report AMR items that are applicable only to BWR-designed reactors. In the applicant AMR discussions for these items, no additional information is provided. The staff confirmed that these AMR items in Table 1 of the GALL Report, Volume 1 are only applicable to BWR-designed reactors, and that KPS is a PWR with a dry ambient containment. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding AMR items 2–4, 11, 13–15, 19, 20, 25, 26, 29, and 38–51 in Table 1 of the GALL Report, Volume 1 are not applicable to KPS.

LRA Table 3.1.1, items 12, 66, 75, and 84 discuss the applicant's determination on GALL Report AMR items that are applicable only to OTSGs. The staff confirmed that these AMR items in Table 1 of the GALL Report, Volume 1 are only applicable to OTSGs and confirmed, by reviewing various sections of the LRA and USAR, that KPS has recirculating steam generators. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding AMR items 12, 35, 66, 75, and 84 in Table 1 of the GALL Report, Volume 1 are not applicable to KPS.

LRA Table 3.1.1, item 3.1.1-35 addresses cracking due to SCC and PWSCC in steel with stainless steel or Ni-alloy cladding primary side components and steam generator upper and lower heads, tubesheets, and tube-to-tubesheet welds. The staff confirmed, with one exception noted below, that this AMR item in Table 1 of the GALL Report, Volume 1 is only applicable to OTSGs, and confirmed, by reviewing various sections of the LRA and the USAR, that KPS has recirculating steam generators. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding AMR item 35 in Table 1 of the GALL Report, Volume 1 is not applicable to KPS with one exception: the tube-to-tubesheet welds for the steam generators. This issue is discussed and resolved in SER Section 3.1.2.2.16.1.

LRA Table 3.1.1, item 3.1.1-59 addresses wall thinning due to flow-accelerated corrosion in steel steam generator steam nozzle and safe end, feedwater nozzle and safe end, and AFW nozzles and safe ends exposed to secondary feedwater and steam. The applicant stated that this item is not applicable because in 2001, the original Westinghouse Model 51 steam generators were replaced with Westinghouse Model 54F. The applicant explained that this was accomplished by replacing the lower portion of the steam generator and refurbishing the upper steam generator internals. Furthermore, included in the upper internals refurbishment was the installation of a flow-accelerated, corrosion-resistant, Ni-alloy welded thermal sleeve in the feedwater nozzle that isolates the carbon steel nozzle from the fluid flow. Additionally, a steam flow limiting device was installed in the existing steam nozzle. This steam flow limiting device isolates the steam flow from the carbon steel steam nozzle, and the surfaces of the steam flow limiting device that are exposed to steam flow are constructed of a flow-accelerated, corrosion-resistant, Ni-alloy material.

The staff reviewed the steam generator description in LRA Sections 2.3.1.4 and B2.1.30 and the applicant's USAR in order to verify the design of the plant's steam generators and confirmed that the applicant's replacement steam generators (Westinghouse Model 54F replacement steam generators installed in 2001) have refurbished upper portions, including steam nozzle and safe end, feedwater nozzle and safe end, and AFW nozzles and safe ends exposed to secondary feedwater and steam that should be flow-accelerated and corrosion-resistant. Therefore, the staff finds that this item is not applicable.

LRA Table 3.1.1, item 3.1.1-76 addresses, in part, ligament cracking due to corrosion of steel tube support plates exposed to secondary feedwater or steam. The applicant stated that such ligament cracking is not applicable because its steam generator tube support plates are made of stainless steel.

The staff reviewed the steam generator description in LRA Section 2.3.1.4 in order to verify the design of the plant's steam generators and confirmed that the applicant's steam generators (Westinghouse Model 54F replacement steam generators installed in 2001) have tube support plates made of stainless steel. Therefore, the staff finds that this item is not applicable.

LRA Table 3.1.1, item 3.1.1-77 addresses the loss of material due to wastage and pitting corrosion in Ni-alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary feedwater and steam. The applicant stated that this item is not applicable because it does not use phosphate chemistry.

The staff reviewed the description of the applicant's Secondary Water Chemistry Program in LRA Section B2.1.28 in order to verify which water chemistry is used for the plant's steam generators and confirmed that the applicant's plant does not use a phosphate chemistry program. Therefore, the staff finds that this item is not applicable.

LRA Table 3.1.1, item 3.1.1-78 addresses the wall thinning due to flow-accelerated corrosion in steel steam generator tube support lattice bars exposed to secondary feedwater and steam. The applicant stated that this item is not applicable because the steam generators do not contain tube support lattice bars.

The staff reviewed the steam generator description in LRA Section 2.3.1.4 in order to verify the design of the plant's steam generators and confirmed that the applicant's plant steam generators (Westinghouse Model 54F replacement steam generators installed in 2001) do not contain tube support lattice bars. Therefore, the staff finds that this item is not applicable.

LRA Table 3.1.1, item 3.1.1-79 addresses the denting due to corrosion of steel tube support plates in Ni-alloy steam generator tubes exposed to secondary feedwater and steam. The applicant stated that this item is not applicable because the steam generator tube support plates are made of stainless steel.

The staff reviewed the steam generator description in LRA Section 2.3.1.4 in order to verify the design of the plant's steam generators and confirmed that the applicant's plant steam generators (Westinghouse Model 54F replacement steam generators installed in 2001) have tube support plates made of stainless steel. Therefore, the staff finds that this item is not applicable.

LRA Table 3.1.1, item 3.1.1-85 addresses Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external). The GALL Report indicates that there is no aging effect or mechanism and, therefore, does not recommend an AMP. The applicant stated that item 3.1.1-85 is consistent with the GALL Report and that there were no aging effects associated with this combination. Based on its review of the LRA, the staff confirmed that there are no Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) in the reactor vessel, RVIs, and RCS. The staff finds the applicant's determination acceptable.

LRA Table 3.1.1, item 3.1.1-87 addresses steel piping, piping components, and piping elements in concrete. The GALL Report does not identify an aging effect or mechanism and there is no GALL Report-recommended AMP program to manage aging for this component group. The applicant stated that this item is not applicable because there are no reactor vessel, RVI, and RCS components in concrete within the scope of license renewal. The staff reviewed LRA Sections 2.3.3 and 3.1 and confirmed that the applicant's LRA does not have any AMR results for the RCS that include steel piping, piping components, and piping elements exposed to concrete. Based on its review of the LRA, the staff confirmed that there are no in-scope steel piping, piping components, and piping elements exposed to concrete in the RCS and, therefore, finds the applicant's determination acceptable.

LRA Table 3.1.1, item 3.1.1-36 addresses cracking due to SCC and PWSCC in Ni-alloy or stainless steel pressurizer spray heads. The GALL Report recommends the use of the Water Chemistry Program and the One-Time Inspection Program. In addition, for Ni-alloy spray heads, the GALL Report recommends that the applicant, "provide [a] commitment in [the] FSAR supplement to submit AMP delineating commitments to Orders, Bulletins, or Generic Letters that inspect stipulated components for cracking of wetted surfaces." The applicant stated that this item is not applicable because the spray head assembly does not perform an intended function in accordance with 10 CFR 54.4(a); thus, the item is not applicable to KPS.

The staff reviewed LRA Section 3.1.2.2.16.2 and USAR Sections 14.1.12, "Anticipated Transients Without Scram," and 14.2.4, "Steam Generator Tube Rupture," as well as WCAP-8330, "Westinghouse Anticipated Transients without Trip Analysis" (ADAMS Accession No. ML0617902740), since USAR Section 14.1.12 uses this document to show that anticipated transients without trip will not result in RCS failure nor fuel failure. The staff finds that the pressurizer spray heads do not perform an intended function under 10 CFR 54.4(a) and, therefore, the applicant's determination is acceptable.

3.1.2.1.2 Loss of Fracture Toughness Due to Thermal Aging Embrittlement of Cast Austenitic Stainless Steel

LRA Table 3.1.1, item 3.1.1-57 describes the aging effect in CASS Class 1 piping, piping components, piping elements, and CRD pressure housings exposed to reactor coolant greater than 250 °C (482 °F). However, the aging management evaluation of these items is not described in LRA Table 3.1.2-3. The applicant stated that the CASS Class 1 RCS loop piping has been evaluated for the effects of aging and found to be not susceptible to thermal aging embrittlement, as discussed in SER Section 4.7.5, "Reactor Coolant Loop Piping Flaw Tolerance Evaluation." The applicant further stated that it is, therefore, not necessary to manage the effects of thermal aging embrittlement of CASS reactor coolant loop piping for the period of extended operation. The applicant also stated that AMR item 3.1.1-57 is not applicable for the CRD pressure housings because they are fabricated from stainless steel forgings and not castings.

The staff reviewed LRA Section 4.7.5 to evaluate the flaw tolerance evaluation for the reactor coolant loop piping. The staff's evaluation is discussed in SER Section 4.7.5 of this report. The applicant stated that the loop piping is constructed of ASME SA-351 Grade CF8M with less than 25 percent ferrite, and consisted of centrifugally-cast piping segments and statically-cast elbows. Based on the screening criteria recommended in GALL AMP XI.M12, four statically-cast elbows and one centrifugally-cast pipe were identified to be potentially susceptible to thermal aging embrittlement (i.e., contained more than 14 percent and more than 20 percent ferrite, respectively). The applicant stated that because the delta ferrite content of the CASS materials does not exceed 25 percent, flaw evaluation was performed in accordance with the principles associated with IWB-3640 procedures for submerged arc welds (SAW), discarding the code restriction of 20 percent delta ferrite content in IWB-3641(b)(1). The staff finds this to be an acceptable approach consistent with the GALL Report.

The applicant further stated that the results indicated that the limiting initial flaw depth for an aspect ratio of 6 was in the crossover leg (i.e., 28 percent through-wall), and that flaw of this initial size would not grow to critical size (i.e., a size that could result in piping failure at design-basis loading conditions) during an additional 30 years of service. Based on these results, the applicant concluded that even with thermal aging embrittlement of CASS loop piping materials to the fully-aged condition, the susceptible piping locations are tolerant of large flaws.

Therefore, there is no requirement to manage the effects of thermal aging embrittlement of CASS reactor coolant loop piping for the period of extended operation. The staff found this to be consistent with GALL AMP XI.M12 and is, therefore, acceptable.

Based on its review of the program to manage the loss of fracture toughness due to thermal aging embrittlement of CASS Class 1 piping, piping components, and piping elements in the RCS, the staff finds that all program elements are consistent with GALL AMP XI.M12 and are, therefore, acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.3 Loss of Fracture Toughness Due to Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel

LRA Table 3.1.1, item 3.1.1-80 addresses the loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS RVI components. The AMR items corresponding to item 3.1.1-80 are described in LRA Table 3.1.2-2 and include the CASS cruciform top end piece of the bottom-mounted instrumentation (BMI) column, CASS base of the upper support columns and upper instrumentation columns, and CASS flow mixing base of the RCCA guide tubes. The applicant stated in LRA Table 3.1.1 that the loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS RVI components is managed by an enhancement to the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to include the recommendations of GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)," following participation in the industry programs for investigating and managing aging effects on reactor internals.

The staff reviewed LRA item 3.1.1-80 in comparison with the GALL Report, Volume 1, Table 1, ID 80. The staff noted that the generic note for the AMR items was E, which means that the component, material, environment, and aging effect or mechanism are consistent with the GALL Report, but a different AMP is credited to manage the aging effects. In its review and comparison, the staff found that the LRA AMR items were consistent with the GALL Report in component, material, environment, and aging effect. The applicant stated that the program to manage the loss of fracture toughness of CASS vessel internal components consists of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, with an enhancement to include identification of the limiting susceptible CASS RVI components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking. The applicant further stated that for each identified component, a plan will be developed to manage the aging effects, either through supplemental examination or a component-specific evaluation. The applicant stated that this program will be consistent with the GALL Report.

The staff reviewed the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and its evaluation is documented in SER Section 3.0.3.2.1. In its review, the staff found that the applicant committed (Commitment No. 2) to develop and implement an AMP for managing the loss of fracture toughness due to thermal and neutron irradiation embrittlement of CASS RVI components that will be consistent with GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)." The applicant further stated that the plan will be submitted for staff review and approval not less than 24 months before entering the period of extended operation. The staff finds this acceptable because the applicant has made a commitment to develop and submit for staff review and approval a program to manage loss of fracture toughness of CASS vessel internal components that is consistent with the recommendations of GALL AMP XI.M13.

On the basis of its review of the applicant's program to manage the loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS RVI components, the staff finds that all program elements of the applicant's program are consistent with GALL AMP XI.M13 and are, therefore, acceptable. The staff concludes that the applicant 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).

3.1.2.1.4 Cracking Due to Stress-Corrosion Cracking

LRA Table 3.1.1, item 3.1.1-68 addresses the cracking due to SCC of austenitic stainless steel RCS components. The AMR items corresponding to item 3.1.1-68 are described in LRA Table 3.1.2-3 and include austenitic stainless steel RCP thermal barriers heat exchanger, pressurizer manway, and RCS thermal sleeves. The applicant stated that the cracking due to SCC of these stainless steel components is managed by the Primary Water Chemistry Program. The applicant further stated that the program is consistent with the GALL Report.

The staff reviewed LRA item 3.1.1-68 in comparison with the GALL Report, Volume 1, Table 3, ID 68. The staff noted that the consistency note for the AMR item was E, which means that the combination of component, material, environment, and aging effect or mechanism was consistent with the combination in the GALL Report, but a different AMP is credited to manage the effects of cracking due to SCC during the period of extended operation. The applicant stated that the Primary Water Chemistry Program is used to manage the effects of cracking due to SCC, instead of the ASME Section XI ISI, Subsections IWB, IWC, and IWD and Primary Water Chemistry programs recommended in the GALL Report. In its review and comparison, the staff found that the LRA AMR items were consistent with the GALL Report in component, material, environment, and aging effect. However, it was not clear how the applicant's program for stainless steel RCP thermal barriers heat exchanger, pressurizer manway, and RCS thermal sleeves is consistent with the GALL Report AMP. In LRA Table 3.1.2-3, the applicant stated that the cracking of these components due to SCC was managed by the Water Chemistry Program, whereas SCC cracking of stainless steel piping, fittings, pump casings, valve bodies, nozzles, etc. is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, as well as the Primary Water Chemistry Program. By letter dated October 13, 2009, the staff issued RAI 3.1.2.1.3-1 requesting that the applicant explain how its program to manage cracking due to SCC is consistent with the programs recommended in the GALL Report. Also, describe how the effectiveness of the program is verified to ensure that cracking does not occur and the structural and functional integrity of the components will be maintained during the period of extended operation.

In its response dated November 13, 2009, the applicant stated that for the RCP thermal barriers heat exchanger and pressurizer manway (including stainless steel insert), the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program is added as an additional AMP and would provide verification of the effectiveness of the Primary Water Chemistry Program for management of cracking due to SCC. The applicant stated this change provides consistency with the GALL Report (item 3.1.1-68).

The applicant also stated that for the non-pressure boundary thermal sleeves, the One-Time Inspection Program within the WCP Program, as described in its letter dated September 25, 2009, is added as an additional AMP for management of cracking due to SCC. The One-Time Inspection Program, within the WCP Program, uses NDE techniques that have been determined to be effective for the identification of SCC in stainless steel. The applicant further stated that the inspections would verify that unacceptable degradation is not occurring for material and environment combinations that include stainless steel in primary treated water. The applicant further added that indications of degradation would result in an engineering review of the condition through the corrective action program and could result in further corrective actions, such as an expansion of the inspection scope.

The staff noted that the non-pressure boundary thermal sleeves are not Class 1 components and, therefore, are not within the scope of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The staff noted that the applicant has credited its Primary Water Chemistry Program to provide periodic monitoring and control of known detrimental contaminants that can result in cracking due to SCC. The staff further noted that the applicant has credited its WCP Program with confirming the effectiveness of its Primary Water Chemistry Program to ensure that cracking due to SCC does not occur for these non-pressure boundary thermal sleeves.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.1.3-1 acceptable because: (1) the applicant credited its Primary Water Chemistry and ASME Section XI ISI, Subsections IWB, IWC, and IWD programs to manage cracking due to SCC for the RCP thermal barrier heat exchangers and pressurizer manway (including stainless steel insert), consistent with the GALL Report; and (2) for the non-pressure boundary thermal sleeves, the applicant is controlling primary water chemistry to ensure the environment is not conducive to cracking due to SCC and will confirm its effectiveness with the WCP Program. The staff's concern described in RAI 3.1.2.1.3-1 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.5 Cracking Due to Outside-Diameter Stress-Corrosion Cracking and Intergranular Attack, and Loss of Material Due to Fretting and Wear

LRA Table 3.1.1, item 3.1.1-72 addresses the cracking due to ODSCC and/or intergranular attack and loss of material due to fretting and wear for Ni-alloy steam generator tubes and sleeves exposed to secondary feedwater/steam.

The GALL Report differentiates the cracking due to intergranular attack (item IV.D1-22) from the cracking due to ODSCC (item IV.D1-23). In its review of LRA Table 3.1.1, item 3.1.1-72, the staff noted that the applicant did not credit the GALL Report AMR item IV.D1-23 in LRA Table 3.1.2-4 for cracking due to ODSCC as an aging effect or mechanism for Ni-alloy steam generator tubes and sleeves exposed to secondary feedwater and steam. The staff further noted that the applicant only addressed cracking due to intergranular attack in its LRA.

By letter dated August 28, 2009, the staff issued RAI B2.1.30-14 requesting that the applicant clarify why ODSCC is not an AERM for its steam generators. The staff also requested that the applicant provide an AMP for addressing this aging effect, if the applicant has concluded that the aging management of ODSCC in its steam generators is required.

In its response dated September 28, 2009, the applicant recognized that it incorrectly omitted GALL AMR item IV.D1-23 for cracking due to ODSCC from LRA Table 3.1.2-4, but this item is applicable to the component group "Tubes and Sleeves" exposed to a secondary feedwater and steam environment (treated water and/or steam-secondary) in LRA Table 3.1.2-4. It further clarified that as currently indicated in LRA Table 3.1.1, item 72, cracking due to ODSCC and intergranular attack for Ni-alloy steam generator tubes and sleeves exposed to secondary feedwater and steam is managed with the Secondary Water Chemistry Program and the Steam Generator Tube Integrity Program.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-14 acceptable because the applicant: (1) identified the aging effect of cracking due to ODSCC as an aging effect or mechanism for Ni-alloy steam generator tubes and sleeves exposed to secondary feedwater and steam as being omitted from LRA Table item 3.1.1-72 and (2) confirmed that it credits the Secondary Water Chemistry Program and the Steam Generator Tube Integrity Program to manage this aging effect, consistent with GALL AMR item IV.D1-23. The staff's concern described in RAI B2.1.30-14 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.6 Cracking Due to Stress-Corrosion Cracking and Loss of Material Due to Crevice Corrosion and Fretting

LRA Table 3.1.1, item 3.1.1-74 addresses the cracking due to SCC and loss of material due to crevice corrosion and fretting for chrome plated steel, stainless steel, and Ni-alloy steam generator anti-vibration bars exposed to secondary feedwater and steam.

LRA Table 3.1.2-4 addresses AMR items of cracking due to SCC for steam generator Ni-alloy components exposed to treated water and/or steam-secondary. In LRA Table 3.1.2-4, the applicant proposed to extend this aging management mechanism designed for anti-vibration bars to other components of the steam generators, in relation to the material, the environment, and the aging effect, for which the applicant credited GALL AMR item IV.D1-14, corresponding to LRA Table 3.1.1, item 3.1.1-74.

The staff reviewed the corresponding item from the SRP-LR, which states that the aging effects associated with this item are managed by the Steam Generator Tube Integrity Program and Water Chemistry Program. The staff noted that for most additional components, the applicant credited the above two AMPs. However, for the feedwater nozzle (and Ni-alloy cladding), feedwater nozzle thermal sleeve, and steam nozzle flow restrictor, the applicant does not credit the Steam Generator Tube Integrity Program. For these three components, the applicant credited only the Secondary Water Chemistry Program, while it stated that these items are consistent with the GALL Report in all aspects except a different AMP is credited (note E).

In its review of LRA Table 3.1.1, item 3.1.1-74, the staff noted that for the three components listed above, the applicant did not cover all the AMPs recommended by the GALL Report in item IV.D1-14. In LRA Table 3.1.1, item 3.1.1-74, the applicant stated that the aging effects identified for the anti-vibration bars are managed by the Steam Generator Tube Integrity Program and/or the Secondary Water Chemistry Program. The staff noted that GALL AMP XI.M19 states that the scope of the program is specific to steam generator tubes, plugs, sleeves, and tube supports. The staff finds that the three previous components do not strictly belong to the components described in the scope of GALL AMP XI.M19. Nevertheless, the staff noted that the applicant did not explain when and why it applies only one program among the two recommended by the GALL Report, whereas it stated in its LRA that item 3.1.1-74 is consistent with the GALL Report.

By letter dated August 28, 2009, the staff issued RAI B2.1.30-15 requesting that the applicant verify whether the Steam Generator Tube Integrity Program is needed for the three steam generator secondary-side components listed above to be consistent with the GALL Report. The staff also requested that the applicant explain how LRA Table 3.1.1, item 3.1.1-74 is consistent with the GALL Report, since it credits only one program among the two recommended by the GALL Report.

In its response dated September 28, 2009, the applicant referred to LRA Section B2.1.30, where it states that the Steam Generator Tube Integrity Program encompasses secondary-side components whose failure could prevent the steam generator from fulfilling its intended safety function. The applicant also clarified that it includes the Ni-alloy cladding of the feedwater nozzle, the feedwater nozzle thermal sleeve, and the steam nozzle flow restrictor. As noted by the staff, the applicant explained that LRA Table 3.1.2-4 identifies the Secondary Water Chemistry Program as the AMP used to manage SCC for these Ni-alloy components in a treated water and/or steam-secondary environment. However, the applicant further stated that the Steam Generator Tube Integrity Program was incorrectly omitted from LRA Table 3.1.2-4 to manage SCC of these components, and LRA Table 3.1.1, item 3.1.1-74 should have specified both programs for managing aging. The applicant further concluded that the application of both programs for managing SCC for these Ni-alloy components in a treated water and/or steam-secondary environment is consistent with SRP-LR Table 3.1.1, item 74 and the GALL Report, Volume 2, item IV.D1-14.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-15 acceptable because the applicant amended its LRA to credit the Steam Generator Tube Integrity Program and its Secondary Water Chemistry Program, in order to manage the aging effect of cracking due to SCC, consistent with the GALL Report, Volume 1, ID 74 for steam generator secondary-side components. The staff's concern described in RAI B2.1.30-15 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.7 Cracking Due to Primary Water Stress-Corrosion Cracking (Steam Generator Divider Plate)

LRA Table 3.1.1, item 3.1.1-81 addresses cracking due to PWSCC for Ni alloy or Ni-alloy clad steam generator divider plates exposed to reactor coolant. The applicant stated in item 3.1.1-82 that the steam generator divider plate is fabricated from Ni-alloy. The applicant credited its Primary Water Chemistry Program to manage the cracking due to PWSCC.

The staff noted that, from recent foreign OE in steam generators with a similar design to that of the applicant, extensive cracking due to PWSCC has been identified in steam generator divider plates, even with proper primary water chemistry. The staff noted that, specifically, cracks have been detected in the stub runner, very close to the tubesheet/stub runner weld and with depths of almost a quarter of the divider plate thickness. Therefore, the staff noted that the Primary Water Chemistry Program alone may not be effective in managing the aging effect of cracking due to PWSCC in steam generator divider plates.

The staff noted that although these steam generator divider plate cracks may not have a significant safety impact in themselves, such cracks could impact adjacent items, such as the tubesheet and the channel head, if they propagate to the boundary with these items. The staff further noted that for the tubesheet, PWSCC cracks in the divider plate could propagate to the tubesheet cladding with possible consequences to the integrity of the tube/tubesheet welds. Furthermore, for the channel head, the PWSCC cracks in the divider plate could propagate to the steam generator triple point and potentially affect the pressure boundary of the steam generator channel head.

By letter dated March 11, 2010, the staff issued RAI 3.1.2.2.13-1 requesting that the applicant discuss the materials of construction of the steam generator divider plate assembly; furthermore, if these materials are susceptible to cracking (e.g., Alloy 600 or the associated Alloy 600 weld materials), the staff requested that the applicant discuss the possibility that cracking in the divider plate might propagate into other components (e.g., tubesheet cladding). The staff further requested that if propagation into these other components cannot be ruled out, the applicant should describe an inspection program (examination technique and frequency) for ensuring that there are no cracks propagating into other items (e.g., tubesheet and/or channel head) that could challenge the integrity of these other items. The staff identified this as **Open Item 3.1.2.1.7-1.**

In its response dated July 22, 2010, the applicant described the materials of its steam generator divider plate assembly, which are Alloy 600 for the stub runner and the divider plate, and Alloy 52/152 for the welds between the divider plate and the stub runner, as well as between the stub runner and the tubesheet. The applicant also offered additional explanation in order to justify why such cracks could not propagate to adjoining elements of the steam generator divider plate assembly and, consequently, why no inspection would be required.

Based on its review of the applicant's response, the staff noted that the applicant's response provided essentially qualitative arguments for concluding that divider plate crack growth is not a concern. The staff considered that this response did not provide a reasonable and sufficient basis for justifying the applicant's conclusions. Further, the staff noted that the use of purely analytical tools to predict the behavior of service-induced cracking (in other components) has not always bounded actual service performance of those cracks. In addition, the staff noted that the likely presence of cracks in Alloy 600 steam generator divider plate assemblies may result in a condition where these cracks could propagate into surrounding pressure boundary areas, such as the tube-to-tubesheet welds and the channel head.

Therefore, by letter dated September 10, 2010, the staff issued follow-up RAI 3.1.2.2.13-1a, requesting that the applicant provide an AMP, changes to an existing AMP, or a commitment to inspection(s) that would demonstrate the condition of the steam generator divider plate assemblies to support a conclusion that there will be no adverse consequences of divider plate assembly degradation during the period of extended operation.

In its response dated September 23, 2010, the applicant stated that the lower portions of its steam generators, including the divider plate assembly and welds, have accumulated less than 10 years of service time since having been replaced in 2001. The applicant further stated that the cited foreign OE involved approximately 20 years of service time before PWSCC became detectable, and that this provides high confidence that detectable cracks do not currently exist in its steam generator divider plate assemblies. The applicant further explained that the industry plans to study the potential for divider plate crack growth and develop an industry-applied resolution to the concern through the EPRI Steam Generator Management Program (SGMP) Engineering and Regulatory Technical Advisory Group. The applicant stated that, recognizing that the EPRI SGMP resolution is still under development, it will commit to perform an inspection of each of the steam generators to assess the condition of the divider plate assembly. The applicant also stated that the examination technique(s) used will be capable of detecting PWSCC in the steam generator divider plate assembly and associated welds. Moreover, the applicant stated that steam generator divider plate inspections will be completed prior to exceeding 10 years into the period of extended operation (i.e., prior to 2023). In addition, the applicant stated that it also plans to remain involved with the ongoing industry studies related to divider plate cracking to ensure that any inspection requirements or other resolution actions promulgated to the industry are evaluated and implemented, as appropriate. Finally, the applicant stated that Commitment No. 49, covering the above inspection of each steam generator to assess the condition of the divider plate assembly, will be added to LRA Appendix A, USAR Supplement, Table A6.0-1.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.2.13-1a and associated Commitment No. 49 acceptable because the applicant will assess the condition of the divider plate assembly in each steam generator by inspection during the period of extended operation, in a time period consistent with the detection of potential PWSCC cracks, and with appropriate examination techniques. The staff also notes that the applicant will remain involved with ongoing industry efforts related to the divider plate cracking issue. The staff's concerns described in RAIs 3.1.2.2.13-1 and 3.1.2.2.13-1a are resolved. Open Item 3.1.2.1.7-1 is closed. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.8 Cracking Due to Primary Water Stress-Corrosion Cracking

LRA Table 3.1.1, item 3.1.1-65 addresses the cracking due to PWSCC of Ni-alloy reactor vessel upper head and CRD penetration nozzles, instrument tubes, head vent pipe (top head), and welds exposed to primary water. LRA Table 3.1.2-1 further addresses the AMR items corresponding to item 3.1.1-65 and indicates that the components of the AMR items are closure head CRDM head penetrations, closure head instrument tube and spare CRDM penetrations, and closure head vent and RVLIS head penetrations.

The applicant indicated that the cracking due to PWSCC of these Ni-alloy components is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD; Primary Water Chemistry; and Alloy 600 Inspections programs, where the GALL Report recommends GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"; GALL AMP XI.M2, "Water Chemistry," for primary water; and GALL AMP XI.M11A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)." LRA Table 3.1.1, item 3.1.1-65 also states that the AMR results are consistent with the GALL Report.

The staff reviewed the AMR results in the LRA in comparison with the GALL Report, Volume 1, Table 1, ID 65 and GALL Report, Volume 2, items IV.A2-9 and IV.A2-18. In its review and comparison, the staff noted that the applicant claimed LRA note E, which means the AMR item is consistent with the GALL Report for component, material, environment, and aging effect, but a different AMP is credited. The staff noted that the applicant credited the Alloy 600 Inspections Program instead of GALL AMP XI.M11A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)." The applicant further stated that the Alloy 600 Inspections Program is a plant-specific program that encompasses the recommendations of GALL AMP XI.M11A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)."

LRA Section B2.1.1 states that the Alloy 600 Inspections Program is a plant-specific program that manages the aging effects of PWSCC in Alloy 600 base metal and Alloy 82/182 dissimilar metal welds and Alloy 690 base metal and Alloy 52/152 dissimilar metal welds. The applicant further stated that the program performs visual/bare metal, liquid penetrant, eddy current, and ultrasonic examinations to detect cracking of the in-scope components. The staff's evaluation of the AMP is documented in SER Section 3.0.3.3.1. Based on its review, the staff finds the use of the proposed LRA AMPs acceptable because: (1) the applicant credited the Primary Water Chemistry Program and ASME Section XI ISI, Subsections IWB, IWC, and IWD Program consistent with the GALL Report; (2) the inspections of the Alloy 600 Inspections Program are performed in accordance with the requirements of industry guidance, ASME Code Section XI, and 10 CFR 50.55a so that the inspections can ensure the detection of the aging effect; (3) the acceptance criteria of the Alloy 600 Inspections Program are consistent with the industry guidance, ASME Code Section XI, and 10 CFR 50.55a such that the use of the acceptance criteria can ensure that the intended functions of the components are adequately maintained; and (4) the program elements of the Alloy 600 Inspections Program satisfy the criteria in SRP-LR Section A.1.2.3 for a plant-specific program such that the program is acceptable to manage the aging effect.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.9 Cracking Due to Stress-Corrosion Cracking and Primary Water Stress-Corrosion Cracking

LRA Table 3.1.1, item 3.1.1-69 addresses the cracking due to SCC and PWSCC of stainless steel or Ni-alloy safety injection nozzles, safe ends, and associated welds and buttering exposed to reactor coolant. LRA Table 3.1.2-1 further addresses the AMR item corresponding to item 3.1.1-69 and indicates that the component of the AMR item is the safety injection nozzle (cladding and buttering). The applicant indicated, using LRA note 2, that since the identified material for the component under the AMR item is Ni-based alloy, the applicable aging mechanism for this item is PWSCC and not SCC.

The applicant further indicated that the cracking due to PWSCC of the component is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program; Primary Water Chemistry Program; and Alloy 600 Inspections Program, where the GALL Report recommends GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and GALL AMP XI.M2, "Water Chemistry," for primary water. LRA Table 3.1.1, item 3.1.1-69 also states that the AMR results are consistent with the GALL Report.

The staff reviewed the AMR results in the LRA in comparison with the GALL Report, Volume 1, Table 1, ID 69 and GALL Report, Volume 2, item IV.A2-15. In its review and comparison, the staff noted that the applicant claimed LRA note E, which means the AMR item is consistent with the GALL Report for component, material, environment, and aging effect, but a different AMP is credited. The staff noted that the applicant credited the Alloy 600 Inspections Program, in addition to the Primary Water Chemistry Program and ASME Section XI ISI, Subsections IWB, IWC, and IWD Program that are recommended by the GALL Report. The applicant further stated that the Alloy 600 Inspections Program is a plant-specific program that encompasses the recommendations of GALL AMP XI.M11A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)."

LRA Section B2.1.1 states that the Alloy 600 Inspections Program is a plant-specific program that manages the aging effects of PWSCC in Alloy 600 base metal and Alloy 82/182 dissimilar metal welds and Alloy 690 base metal and Alloy 52/152 dissimilar metal welds. The applicant further stated that the program performs visual/bare metal, liquid penetrant, eddy current, and ultrasonic examinations to detect cracking of the in-scope components. The staff's evaluation of the AMP is documented in SER Section 3.0.3.3.1. Based on its review, the staff finds the use of the proposed LRA AMPs acceptable because: (1) the applicant credited the Primary Water Chemistry Program and ASME Section XI ISI, Subsections IWB, IWC, and IWD Program consistent with the GALL Report; (2) the inspections of the Alloy 600 Inspections Program are performed in accordance with the requirements of industry guidance, ASME Code Section XI, and 10 CFR 50.55a so that the inspections can ensure the detection of the aging effect; (3) the acceptance criteria of the Alloy 600 Inspections Program are consistent with the industry guidance, ASME Code Section XI, and 10 CFR 50.55a such that the use of the acceptance criteria can ensure that the intended functions of the components are adequately maintained; and (4) the program elements of the Alloy 600 Inspections Program satisfy the criteria in SRP-LR Section A.1.2.3 for a plant-specific program such that the program is acceptable to manage the aging effect.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.10 Conclusion for AMRs Consistent with the GALL Report

The staff evaluated the applicant's claim of consistency with the GALL Report. The staff also reviewed information pertaining to the applicant's consideration of recent OE and proposals for managing the associated aging effects. On the basis of its review, the staff concludes that the AMR results which the applicant claimed to be consistent with the GALL Report, are consistent with the GALL Report AMRs. Therefore, the staff concludes that the applicant has demonstrated that the aging effects for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.1.2.2 provides further evaluation of aging management as recommended by the GALL Report for the RCS components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to general, pitting, and crevice corrosion
- loss of fracture toughness due to neutron irradiation embrittlement
- cracking due to SCC and IGSCC
- crack growth due to cyclic loading
- loss of fracture toughness due to neutron irradiation embrittlement and void swelling
- cracking due to SCC
- cracking due to cyclic loading
- loss of preload due to stress relaxation
- loss of material due to erosion
- cracking due to flow-induced vibration
- cracking due to SCC and IASCC
- cracking due to PWSCC
- wall thinning due to flow-accelerated corrosion
- changes in dimensions due to void swelling
- cracking due to SCC and PWSCC
- cracking due to SCC, PWSCC, and IASCC

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the report recommends further evaluation, the staff audited and reviewed the applicant's evaluation. The staff determined whether the applicant adequately addressed the issues for which further evaluation is recommended. The staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.1.2.2. The staff's review of the applicant's further evaluation follows.

3.1.2.2.1 Cumulative Fatigue Damage

In LRA Section 3.1.2.2.1, the applicant stated that fatigue is a TLAA, as defined in 10 CFR 54.3, which must be evaluated in accordance with 10 CFR 54.21(c)(1). In LRA Table 3.1.1, the applicant identified AMR lines 3.1.1-1 and 3.1.1-5 through 3.1.1-10 as TLAA items for the RCS, reactor vessel, RVIs, and steam generator. The applicant performed cumulative fatigue evaluations for these components. SER Section 4.3 documents the staff's review of the applicant's evaluation of TLAA for these components.

The applicant stated that LRA Table 3.1.1, items 3.1.1-2, 3.1.1-3, and 3.1.1-4 are applicable to BWRs only. The staff reviewed these AMR items in the SRP-LR and in the GALL Report and found that these items are not applicable because KPS is a PWR design.

In its review, the staff noted that LRA Section 4.3 does not include TLAA for RVIs because the applicant stated that the vessel was designed to the 1968 Code Edition and there were no requirements for a fatigue analysis of vessel internals. Instead, the applicant stated it will manage aging for the RVI components with its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The staff reviewed the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and its evaluation is documented in SER Section 3.0.3.2.1.

3.1.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

The staff reviewed LRA Section 3.1.2.2.2 against the criteria in SRP-LR Section 3.1.2.2.2. LRA Section 3.1.2.2.2 addresses loss of material due to general, pitting, and crevice corrosion for certain portions (for PWRs) of the steam generators.

Item 1. Table 3.1.1, item 3.1.1-12 is only applicable to Babcock & Wilcox Co. (B&W) OTSGs. Therefore, it is not applicable to KPS.

Item 2. Table 3.1.1, item 3.1.1-13 is applicable to BWRs only, as discussed in SER Section 3.1.2.1.1 above.

Item 3. Table 3.1.1, items 3.1.1-14 and 3.1.1-15 are applicable to BWRs only, as discussed in SER Section 3.1.2.1.1 above.

Item 4. LRA Section 3.1.2.2.2.4 addresses the loss of material due to general, pitting, and crevice corrosion in the upper and lower shell and transition cone made of steel and exposed to secondary feedwater and steam. The applicant stated that aging for the steam generator shell and transition cone is managed with a combination of the Secondary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program for Class 2 components. The applicant stated that, prior to the issuance of IN 90-04, "Cracking of Upper Shell-To-Transition Cone Girth Welds in Steam Generators," flaw indications were detected and reported in the girth weld between the upper shell and transition cone at KPS. The applicant stated that, based on experience at other plants, uncertainties in the test techniques at that time, and the potential for significant service induced cracking, augmented volumetric inspections to confirm that the indications were not surface connected cracks were required.

The applicant stated that in 1992, based on a subsequent review of the related industry data, NDE methodology, augmented inspection results, and fracture analyses that showed no significant service growth, the staff agreed with the conclusion that the indications were embedded slag or voids, and approved a request to discontinue the augmented inspections. The applicant stated that in 2001, the original Westinghouse Model 51 steam generators were replaced with Westinghouse Model 54Fs, and this was partly accomplished by replacing the lower portion of the steam generator. Furthermore, a cut was made in the middle of the transition cone and the upper original girth weld was inspected from the inside during that time. The applicant stated that previously identified indications were evaluated and it was determined that there had been no service growth. Therefore, the applicant concluded that the augmented inspection recommended by Table 3.1.1, item 3.1.1-16 has been completed and no further action was required beyond the inspections required by the ASME Section XI ISI, Subsections IWB, IWC, or IWD Program.

The staff reviewed LRA Section 3.1.2.2.2.4 against the criteria of SRP-LR Section 3.1.2.2.2.4 (SRP-LR Table 3.1.1, item 3.1.1-16), which states that, according to NRC IN 90-04, the existing program may not be sufficient to detect pitting and crevice corrosion, and that if general and pitting corrosion of the shell is known to exist, an augmented inspection is recommended to manage this aging effect. The GALL Report (AMR IV.D1-12) clarifies that this issue is limited to Westinghouse Model 44 and 51 steam generators, which the applicant replaced with Westinghouse Model 54Fs in 2001. Moreover, as stated by the applicant and approved by the staff in 1992, the augmented inspections were no longer required for the original upper shell-to-transition cone girth weld that remains in the replacement steam generators.

Nevertheless, the staff noted that SRP-LR Section 3.1.2.2.2.4 states that loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam. The SRP-LR further states that 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.

In its review of LRA Section 3.1.2.2.2.4, the staff found that the applicant did not provide any information or discussion of inspections of the new weld generated by the cut made in the middle of the transition cone at the time of steam generator replacement, specified as the "transition weld" in USAR Section 4.2.2.6 and license renewal drawing LRXK-100-10. The staff noted that the applicant did not discuss whether loss of material due to general, pitting, and crevice corrosion could occur in the transition weld. The staff noted that this weld could experience the same operating conditions as the upper shell-to-transition cone girth weld and, therefore, could be affected by the same aging effect (even if the shell geometry is less severe). The staff noted that from license renewal drawing LRXK-100-10, the new transition weld appears to be located in a "gross structural discontinuity" because the transition cone is, by definition, a junction between shells of different diameters (as defined in ASME Code Section XI, Subsection NB-3213.2).

By letter dated November 20, 2009, the staff issued RAI 3.1.2.2.2.4-2 requesting that the applicant describe the inspections that will be performed on the transition weld during the period of extended operation.

In its response dated December 28, 2009, the applicant stated that the new weld, generated by the cut made in the transition cone at the time of steam generator replacement, received a radiography examination in accordance with the requirements of ASME Code Section III. The applicant explained that there were no unacceptable indications (i.e., no indications exceeded the acceptance criteria of ASME Code Section III).

The applicant further clarified that the new transition cone closure weld is not a gross structural discontinuity in accordance with the definition in ASME Code Section III, NB-3213.2 (ASME Code Section XI, Table IWC-2500-1 and Figure IWC-2500-1 provide applicable examples of gross structural discontinuities) and that the closure weld is located a sufficient distance from the structural discontinuity at the transition cone-to-upper shell junction such that the resulting stresses do not affect the weld area (i.e., the closure weld is not a high-stress region). The applicant determined that the new transition cone closure weld does not require volumetric examination in accordance with ASME Code Section XI ISI requirements and stated that the new transition cone closure weld receives a VT-2 visual examination as part of the system pressure test, in accordance with IWC 2500-1, Category C-H.

The applicant further explained that the concerns identified in NRC IN 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," which are further clarified in the GALL Report as being limited to Westinghouse Model 44 and 51 steam generators where a high-stress region exists at the shell-to-transition cone weld, are not applicable to the new transition cone closure weld based on: (1) the new transition cone closure weld is not located at a structural discontinuity since it is a plate-to-plate weld configuration with a 0.02-inch maximum plate thickness difference, (2) the weld is located away from the locally stressed area associated with the original existing upper shell-to-transition cone weld, and (3) the weld is not a high-stress region. Therefore, the applicant concluded that, consistent with ASME Code Section XI requirements, and since the issues identified in IN 90-04 are not applicable, no inspections other than a system pressure test leakage examination are required for the new transition cone closure weld during the period of extended operation.

The staff reviewed the applicant's response to RAI 3.1.2.2.2.4-2. Since a gross structural discontinuity is intended to address discontinuity which affects the stress or strain distribution through the entire wall thickness of the pressure-retaining member, the staff noted that the applicant has demonstrated that its steam generator new transition cone closure weld should not be considered as a "gross structural discontinuity" because: (1) the applicant has determined that this weld is not a high-stress region, and (2) the configuration of this weld does not correspond to a geometrical discontinuity (i.e., plate-to-plate weld with no significant plate thickness difference).

However, the staff found the applicant's answer unacceptable because the staff noted that GALL AMR item 3.1.1-16 was included in the GALL Report to ensure that volumetric examinations performed, in accordance with the requirements of ASME Code Section XI IWC-2500-1, Examination Category C-A, Inspection Item C1.10, for upper shell- and lower shell-to transition cones with gross structural discontinuities would be capable of managing loss of material due to general, pitting, and crevice corrosion in the welds. The staff noted that the new continuous circumferential weld in the applicant's steam generator transition cone design should not be aligned to the intent of GALL AMR item 3.1.1-16 because the intent of this GALL Report item was to address problems in the steam generator transition cone welds containing geometric discontinuities, and the new steam generator transition cone weld does not meet this design description.

The staff also noted that the new transition area weld is a field weld as opposed to having been made in a controlled manufacturing facility, and the surface conditions of the transition weld may result in flow conditions more conducive to the initiation of general, pitting, and crevice corrosion than those of the upper and lower transition cone welds.

The staff noted that SRP-LR Section A.1.2.3.4 states that a program based solely on detecting SC failure should not be considered an effective AMP for license renewal, as would be the case using detection of leakage as the aging management for the transition weld. Thus, the staff determined the crediting of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program for the new steam generator transition cone weld to be an ineffective basis for managing loss of material in this weld because: (1) the ISI criteria would only perform a VT-2 visual leakage examination of the weld as part of the system leakage test performed pursuant to ASME Code Section XI, Table IWC 2500-1, Examination Category C-H requirements, and (2) this type of examination would allow leakage to occur before appropriate corrective actions would be initiated on the weld. In addition, the staff noted that ASME Code Section XI, IWA-5242 does not require licensees to remove insulation when performing visual examination on non-borated treated water systems.

As a result, the staff found the applicant's response to RAI 3.1.2.2.2.4-2 did not completely resolve the request in the RAI. Therefore, the staff issued a follow-up RAI.

By letter dated March 11, 2010, the staff issued RAI 3.1.2.2.2.4-2a requesting that the applicant describe the surface condition and the resultant flow near the transition weld (e.g., weld crown, ground flush, etc.) and how these parameters could affect the susceptibility of this weld to these aging mechanisms, relative to that of the upper and lower transition welds. The staff further requested that the applicant, based on this information, justify if any additional aging management of the transition weld is necessary and if additional aging management is necessary, describe an AMP for the steam generator transition weld (including examination frequency and technique) that will be effective in managing an aging effect, such as the loss of material due to general, pitting, and crevice corrosion, during the period of extended operation.

In its response dated March 26, 2010, the applicant stated that although the transition cone closure was field welded, there were controls in place to ensure a high-quality weld. These controls included welder qualifications, welding in accordance with a qualified and approved welding procedure, pre- and post-weld heat treatment in accordance with engineering specifications, and NDEs of the weld. The applicant also clarified the configuration of the transition weld and stated that the ASME Code limits on projection from the surrounding surface (7/32 inch) and the contour necessary to support NDE resulted in a weld profile that is not expected to cause significant flow disturbance or other fluid conditions that may increase susceptibility to general, pitting, and crevice corrosion in the area of the weld.

The applicant further described the conditions in which its new steam generator transition cone closure welds were fabricated during the steam generator replacement in order to avoid the cracking issue identified in IN 90-04 and in accordance with the EPRI-issued technical report TR-103498, "Review of Steam Generator Girth Weld Cracking."

The applicant further stated that during normal operation and shutdown conditions, its secondary water chemistry controls (described in LRA Section B2.1.28, "Secondary Water Chemistry") minimize exposure of this weld to oxidizing conditions such that significant general, pitting, and crevice corrosion is not expected. The applicant explained that as an indication of the effectiveness of secondary water chemistry controls, the results of a surface examination (magnetic particle test) of the original steam generator transition cone-to-upper shell girth welds, that was performed during steam generator replacement in 2001 (after 27 years of service), identified no reportable indications on the inside surface of the weld.

The applicant further referred to industry OE and explained that the generation of a new steam generator transition cone closure weld is not unique to its replacement steam generators, and has been employed for other steam generator replacement projects in the industry. Field welded transition cone closure welds (similar to the KPS welds) have been in service for up to approximately 30 years with no reported OE to indicate that the welds have an increased susceptibility to general, pitting, and crevice corrosion. The applicant stated that ASME B&PV Code Section XI requirements for weld examinations have not been changed to require additional or more rigorous inspection of these welds and there are no current industry issues that might require additional inspections of inside surface conditions in the vicinity of the transition cone closure welds.

The applicant further stated that the steam generator transition cone closure weld is included within the subcomponent shell-upper, lower, and transition cone identified in LRA Table 3.1.2-4, along with the other steam generator welds associated with the upper and lower shell and the transition cone, to be consistent with the recommendations of the GALL Report for the AMPs.

The applicant further stated that the inspections performed in accordance with the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program ensure the absence of aging effects by examining the most likely locations for degradation, such as the shell-to-tubesheet, transition cone-to-shell, and shell-to-dome junctions, using volumetric examination. The applicant explained that any degradation identified during these inspections requires an engineering evaluation for disposition, and corrective actions would include evaluation of the extent of the condition, evaluation of necessary repairs, the need for expansion of inspection scope, and the need for enhancements to secondary water chemistry controls.

The applicant concluded that no additional aging management is necessary to provide reasonable assurance that the function of the steam generator transition cone closure weld will be maintained for the period of extended operation.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.2.2.4-2a acceptable because the applicant justified why the conditions of fabrication and operation of the new transition cone closure weld should prevent the aging effect of loss of material due to general, pitting, and crevice corrosion from occurring before the end of the period of extended operation, at which time the replacement steam generators would be 33 years old. This is also consistent with the current industry OE, including the applicant's own OE. Moreover, the staff noted that more susceptible welds (i.e., upper shell-cone shell and cone shell-lower shell welds) would continue to be inspected by a volumetric examination leading to corrective actions if degradation is identified. The staff's concerns described in RAIs 3.1.2.2.2.4-2 and 3.1.2.2.2.4-2a are resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.1.2.2.2.4 criteria. For those line items that apply to LRA Section 3.1.2.2.2.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB 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

Item 1: Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement (TLAA). The staff reviewed LRA Section 3.1.2.2.3.1 and Table 3.1.1, item 3.1.1-17 against the criteria in SRP-LR Section 3.1.2.2.3.1. LRA Section 3.1.2.2.3.1 addresses loss of fracture toughness due to certain aspects of neutron irradiation embrittlement as an aging effect that the applicant will manage through conducting TLAAs, consistent with the SRP-LR. The evaluation of these TLAAs is discussed in LRA Section 4.2. SRP-LR Section 3.1.2.2.3.1 states that, "[c]ertain 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). This TLAA is addressed separately in Section 4.2 of this SRP-LR."

As discussed in Section 4.2 of this SER, loss of fracture toughness due to neutron irradiation embrittlement is limited to RPV beltline and extended beltline materials having a neutron fluence greater than 1×10^{17} neutrons per square centimeter (n/cm^2) (E > 1.0 million electron volts (MeV)) at the end of the period of extended operation. SER Section 4.2 accepted the applicant's evaluation of RPV neutron embrittlement in terms of USE, PTS, and P-T limits, which represent a complete set of analytical means for predicting and managing loss of fracture toughness due to neutron irradiation embrittlement. Therefore, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.3.1 criteria. The staff also confirmed that LRA Table 3.1.2-1 identified all GALL AMR Table IV.A2 items under this aging mechanism (IV.A2-16 and IV.A2-23).

Item 2: Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement (Surveillance). The staff reviewed LRA Section 3.1.2.2.3.2 and Table 3.1.1, item 3.1.1-18 against the criteria in SRP-LR Section 3.1.2.2.3.2. LRA Section 3.1.2.2.3.2 addresses loss of fracture toughness due to neutron irradiation embrittlement as an aging effect that the applicant will manage, consistent with the SRP-LR, by the applicant's Reactor Vessel Surveillance Program. The materials outside of the RPV beltline region, which are expected to receive neutron fluence greater than 1×10^{17} n/cm^2 (E > 1.0 MeV), were evaluated to be not limiting during the period of extended operation.

SRP-LR Section 3.1.2.2.3.2 states that:

> [l]oss of fracture toughness due to neutron irradiation embrittlement could occur in BWR and PWR vessel beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further staff evaluation is required for license renewal. Specific recommendations for an acceptable AMP are provided in Chapter XI, Section M31 of the GALL Report.

The staff noted that LRA Table 3.1.2-1 subcomponents, "Primary Nozzles (and cladding)" and "Upper, Intermediate and Lower Shell (and cladding)," credit the Reactor Vessel Surveillance Program for managing loss of fracture toughness. They represent GALL AMR item IV.A2-17 for RPV nozzles and GALL AMR item IV.A2-24 for RPV shells, including beltline welds. However, "beltline welds," which are mentioned in GALL AMR items IV.A2-17 and IV.A2-24 and SRP-LR Section 3.1.2.2.3.2, have not been specified explicitly as part of the LRA Table 3.1.2-1 subcomponents discussed above. This requires clarification because regardless of the selected methodology (Charpy V-notch or Master Curve) for evaluating embrittlement and the planned capsule withdrawal date, a Reactor Vessel Surveillance Program is needed for managing the loss of fracture toughness aging effect on RPV materials, including welds. Hence, the staff issued RAI 3.1.2.2.3.2-1 by letter dated October 13, 2009.

> RAI 3.1.2.2.3.2-1:
>
> The staff noted that LRA Table 3.1.2-1 subcomponents, "Primary Nozzles (and cladding)" and "Upper, Intermediate and Lower Shell (and cladding)," credit the Reactor Vessel Surveillance Program for managing loss of fracture toughness aging effect on them. They represent GALL AMR item IV.A2-17 for [RPV] nozzles and GALL AMR Item IV.A2-24 for RPV shells, including beltline welds. "Beltline welds," which are mentioned in GALL AMR items IV.A2-17 and IV.A2-24 and SRP-LR Section 3.1.2.2.3.2, have not been specified explicitly as part of the LRA Table 3.1.2-1 subcomponents discussed above. Please resolve this discrepancy because regardless of the selected methodology (Charpy V-notch or Master Curve) for evaluation of material embrittlement, a Reactor Vessel Surveillance Program is needed for managing loss of fracture toughness aging effect on relevant RPV materials, including welds.

The applicant's response dated November 13, 2009, to RAI 3.1.2.2.3.2-1 clarified that the LRA Table 3.1.2-1 subcomponents "Primary Nozzles (and cladding)" and "Upper, Intermediate and Lower Shell (and cladding)," include the associated component welds. Thus, the staff concludes that the applicant's AMR evaluation of RPV primary nozzles and upper, intermediate, and lower shell in LRA Table 3.1.2-1 is consistent with the recommendations for GALL AMR items IV.A2-17 and IV.A2-24. The staff accepted the applicant's Reactor Vessel Surveillance Program as indicated in SER Section 3.0.3.2.16. Furthermore, as a supplement to the Reactor Vessel Surveillance Program, the applicant has evaluated the materials outside the beltline region which are expected to receive fluence values greater than 1 x 10^{17} n/cm^2 (E > 1.0 MeV) and determined that none of these materials are limiting. Hence, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.3.2 criteria. The staff also confirmed that LRA Table 3.1.2-1 identified all GALL AMR Table IV.A2 items under this aging mechanism (IV.A2-17 and IV.A2-24).

Based on the TLAA and the program identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.1.2.2.3.1 and Section 3.1.2.2.3.2 criteria. For those AMR items that apply to LRA Section 3.1.2.2.3, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.4 Cracking Due to Stress-Corrosion Cracking and Intergranular Stress-Corrosion Cracking

Table 3.1.1, items 3.1.1-19 and 3.1.1-20 are not applicable to KPS, as they are applicable to BWRs only. See SER Section 3.1.2.1.1 above.

3.1.2.2.5 Crack Growth Due to Cyclic Loading

LRA Section 3.1.2.2.5 and Table 3.1.1, item 3.1.1-21 discuss reactor vessel underclad cracking. This is a TLAA and is discussed in SER Section 4.7.4, "Reactor Vessel Underclad Cracking."

3.1.2.2.6 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement and Void Swelling

The staff reviewed LRA Section 3.1.2.2.6 and Table 3.1.1, item 3.1.1-22 against the criteria in SRP-LR Section 3.1.2.2.6. LRA Section 3.1.2.2.6 addresses loss of fracture toughness due to neutron irradiation embrittlement and void swelling as an aging effect that the applicant will manage, consistent with the SRP-LR, by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. This AMP is enhanced with Commitment No. 1 (LRA Table A6.0-1) to: "(1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval to augment the current inspections." Commitment No. 1 is also identified in the USAR supplement description of the program.

SRP-LR Section 3.1.2.2.6 states that:

> [l]oss of fracture toughness due to neutron irradiation embrittlement and void swelling could occur in stainless steel and nickel alloy reactor vessel internals components exposed to reactor coolant and neutron flux. The GALL Report recommends no further aging management review if the applicant commits in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the

> results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

As described in LRA Sections 3.1.2.2.6, A.2.1.2, and B.2.1.2, the applicant made Commitment No. 1 to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, incorporating all three GALL Report requirements stated above to manage this aging mechanism. Therefore, the staff concludes that the applicant's program meets the SRP-LR Section 3.1.2.2.6 criteria because using the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program with Commitment No. 1 to manage the aging effects due to neutron irradiation embrittlement and void swelling is consistent with the SRP-LR guidance. The staff also examined LRA Table 3.1.2-2 to find out whether the RPV internals subjected to these aging effects are consistent with those listed in GALL AMR Table IV.B2. The staff confirmed that LRA Table 3.1.2-2 identified all GALL AMR Table IV.B2 items under this aging mechanism (IV.B2-3, IV.B2-6, IV.B2-9, IV.B2-17, IV.B2-18, and IV.B2-22). However, unlike GALL AMR Table IV.B2, LRA Table 3.1.2-2 also identified nine additional components under item IV.B2-9. Hence, the staff issued RAI 3.1.2.2.6-1 by letter dated October 13, 2009.

> RAI 3.1.2.2.6-1:
>
> [LRA] Table 3.1.2-2 references [GALL AMR] item IV.B2-9 and lists loss of fracture toughness due to neutron irradiation embrittlement and void swelling (an aging mechanism discussed in LRA Section 3.1.2.2.6) as one of the aging mechanisms affecting the following [RPV] internals: head & vessel alignment pins, rod cluster control assembly (RCCA) guide tube bolts, RCCA guide tube support pins, upper core plate alignment pins, upper fuel alignment pins, upper support column bolts, upper support plate assembly, upper core plate, and hold-down spring. However, GALL Table IV.B2 (Item IV.B2-9 and other items relevant to these [RPV] internals) does not consider the above-mentioned aging mechanism applicable to these [RPV] internals. Please indicate if the listing of aging mechanisms (loss of fracture toughness due to neutron irradiation embrittlement and void swelling) for the above mentioned [RPV] internals was prompted by plant-specific experience or if this was due to a conservative approach.

The staff reviewed the applicant's response, dated November 13, 2009, to RAI 3.1.2.2.6-1. The applicant stated that the identification of loss of fracture toughness due to neutron irradiation embrittlement and void swelling for the subject RPV internals was due to a conservative approach, and there is no plant-specific OE that indicates these aging mechanisms are actually occurring for these components. Therefore, the staff's concern described in RAI 3.1.2.2.6-1 is resolved. Based on this and the staff's evaluation presented earlier, the staff concludes that the applicant's program meets the SRP-LR Section 3.1.2.2.6 criteria. For those AMR items that apply to LRA Section 3.1.2.2.6, the staff concludes that the LRA exceeds the GALL Report recommendations by including nine additional components under GALL AMR item IV.B2-9 and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.7 Cracking Due to Stress-Corrosion Cracking

Item 1. The staff reviewed LRA Section 3.1.2.2.7.1 and Table 3.1.1, item 3.1.1-23 against the criteria in SRP-LR Section 3.1.2.2.7.1. LRA Section 3.1.2.2.7.1 addresses cracking due to SCC in the stainless steel RPV flange leak detection lines and the BMI guide tubes. It further states that the RPV flange leak detection line SCC is managed by the Primary Water Chemistry Program and the WCP Program, and the BMI guide tube SCC is managed by the Primary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

SRP-LR Section 3.1.2.2.7.1 states that, "[c]racking due to SCC could occur in the PWR stainless steel reactor vessel flange leak detection lines and [BMI] guide tubes exposed to reactor coolant. The GALL Report recommends that a plant-specific AMP be evaluated to ensure that this aging effect is adequately managed."

LRA Table 3.1.2-1 credits the Primary Water Chemistry Program and the WCP Program for managing cracking due to SCC for vessel flange leak detection lines that are fabricated from stainless steel and exposed to borated water. The vessel flange leak detection lines serve no safety-related function and, therefore, need management only so leakage has no adverse impact on other components inside containment. Based on evaluation and acceptance of the Primary Water Chemistry Program documented in SER Section 3.0.3.1.9, the staff considers this AMP adequate to mitigate SCC in vessel flange leak detection lines. However, although the staff accepted the applicant's WCP Program as indicated in SER Section 3.0.3.2.19, it is not clear that the WCP Program, using the One-Time Inspection Program, is sufficient to ensure no leakage in vessel flange leak detection lines during the period of extended operation. Hence, the staff issued RAI 3.1.2.2.7-1 by letter dated December 3, 2009.

RAI 3.1.2.2.7-1:

In LRA Table 3.1.2-1, the applicant proposes to manage cracking/SCC in the stainless steel vessel flange leakage monitor lines exposed to primary reactor coolant water through the use of its AMPs, "Primary Water Chemistry" and "Work Control Process (WCP)" (LRA B2.1.24 and B2.1.32). The vessel flange leak monitor lines require management so leakage from them, if it occurred, has no adverse impact on other components inside containment. SRP-LR Section 3.1.2.2.7 requires that a plant-specific AMP be evaluated to ensure this aging effect is adequately managed, since existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak monitor line.

LRA Section 3.1.2.2.7.1 utilizes the Primary Water Chemistry and the WCP AMPs. Hence, leakage occurring after a one-time inspection will not be discovered and its impact on other components will not be assessed. Provide additional justification to demonstrate that the applicant's WCP AMP is effective on an ongoing basis in detecting cracks in the vessel flange leakage monitor lines exposed to treated primary coolant water. The justification should include a summary of industry experience with flawed vessel flange leak detection lines to demonstrate that failure of these lines is unlikely to occur.

The staff reviewed the applicant's response to RAI 3.1.2.2.7-1, dated January 21, 2010. The applicant stated that industry OE indicated two instances of cracking due to transgranular SCC in these lines, caused by high concentrations of chlorides coupled with stagnant water at high temperatures. KPS procedures require draining the lines prior to plant heatup, and so far, the RPV flange leakage monitor lines have not experienced SCC. Therefore, the staff agrees with the applicant's conclusion that the One-Time Inspection Program, within the WCP Program, provides an inspection that either verifies that unacceptable degradation is not occurring or results in additional actions that assure the intended function of affected components will be maintained during the period of extended operation. Hence, RAI 3.1.2.2.7-1 is resolved, and the staff considers that using the Primary Water Chemistry Program and the WCP Program through the One-Time Inspection Program for managing cracking due to SCC for vessel flange leak detection lines is acceptable.

LRA Table 3.1.2-1 credits the Primary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program for managing cracking due to SCC for BMI guide tubes and seal table that are fabricated from stainless steel and exposed to borated water. On the basis of the staff's review and acceptance of these two AMPs, documented in SER Sections 3.0.3.1.9 and 3.0.3.2.1, the staff finds that the applicant's use of the Primary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program is adequate to mitigate and manage cracking due to SCC in stainless steel BMI guide tubes. The staff also confirmed that the applicant's evaluation is consistent with GALL AMR items IV.A2-5 and IV.A2-1. The Ni-alloy BMI penetrations are reviewed separately under SER Section 3.1.2.2.13.

Item 2. LRA Section 3.1.2.2.7.2 states that cracking due to SCC of CASS RCS components is managed by a combination of the Primary Water Chemistry Program together with the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The applicant also stated that its Primary Water Chemistry Program monitors and controls primary water chemistry in accordance with the guidelines in EPRI 1002884 (formerly TR-105714) to minimize the potential for SCC, and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program has been shown to be effective in managing aging effects in Class 1, 2, and 3 components and their integral attachments in light-water cooled power plants.

The staff reviewed LRA Section 3.1.2.2.7.2 and Table 3.1.1, item 3.1.1-24 against the criteria in SRP-LR Section 3.1.2.2.7.2 and GALL Report, item IV.C2-3, which recommend control of water chemistry to mitigate SCC. Furthermore, for CASS components that do not meet the NUREG-0313 guidelines with regard to a minimum of 7.5 percent ferrite and maximum of 0.035 percent carbon content, a plant-specific program is to include: (a) adequate inspection methods to ensure detection of cracks and (b) flaw evaluation methodology for CASS components that are susceptible to thermal aging embrittlement. LRA Section 3.1.2.2.7.2 states that the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program has been shown to be effective in managing aging effects in Class 1, 2, and 3 components. The reactor coolant loop piping flaw tolerance evaluation to account for susceptibility of the CASS piping materials to thermal aging embrittlement is discussed in LRA Section 4.7.5.

The staff reviewed the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and Primary Water Chemistry Program and its evaluations are documented in SER Sections 3.0.3.2.1 and 3.0.3.1.9, respectively. The staff's evaluation of the applicant's flaw tolerance analysis is documented in SER Section 4.7.5.2. The applicant stated that the flaw evaluation analysis is based on the methods described in the ASME B&PV Code Section XI, Subsection IWB-3640. In addition, an environmental factor of 2 is applied to the crack growth reference curves for austenitic stainless steel in air to account for the effect of a PWR environment on growth rates. The applicant further stated that because the delta ferrite content of the CASS materials does not exceed 25 percent, flaw evaluation is performed in accordance with the principles associated with IWB-3640 procedures for SAW, discarding the ASME Code restriction of 20 percent delta ferrite content in IWB-3641(b)(1). The staff finds this to be an acceptable approach consistent with the GALL Report.

Based on its review of the programs to manage cracking due to SCC in CASS Class 1 piping, piping components, and piping elements exposed to reactor coolant greater than 140 °F, the staff finds that all program elements are consistent with the GALL Report and are, therefore, acceptable.

Conclusion. Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.1.2.2.7 criteria. For those items that apply to LRA Section 3.1.2.2.7, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.8 Cracking Due to Cyclic Loading

Table 3.1.1, items 3.1.1-25 and 3.1.1-26 are applicable to BWRs only, as discussed in SER Section 3.1.2.1.1 above.

3.1.2.2.9 Loss of Preload Due to Stress Relaxation

The staff reviewed LRA Section 3.1.2.2.9 and Table 3.1.1, item 3.1.1-27 against the criteria in SRP-LR Section 3.1.2.2.9. LRA Section 3.1.2.2.9 addresses loss of preload due to stress relaxation that could occur in stainless steel and Ni-alloy PWR RVIs screws, bolts, and hold down springs exposed to reactor coolant as an aging effect that the applicant will manage, consistent with the SRP-LR, by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. This AMP is enhanced with Commitment No. 1, which is also identified in the USAR supplement description of the program.

SRP-LR Section 3.1.2.2.9 states that:

> [l]oss of preload due to stress relaxation could occur in stainless steel and nickel alloy PWR reactor vessel internals screws, bolts, tie rods, and holddown springs exposed to reactor coolant. The GALL Report recommends no further [AMR] if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

As described in LRA Sections 3.1.2.2.9, A.2.1.2, and B.2.1.2, the applicant made Commitment No. 1 to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to incorporate all three GALL Report requirements stated above regarding managing aging effects on reactor internals. Therefore, the staff concludes that the applicant's program meets the

SRP-LR Section 3.1.2.2.9 criteria because using the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program with Commitment No. 1 to manage the aging effects of loss of preload due to stress relaxation is consistent with the SRP-LR guidance. The staff also confirmed that LRA Table 3.1.2-2 identified all GALL AMR Table IV.B2 items under this aging mechanism (IV.B2-5, IV.B2-14, IV.B2-25, IV.B2-33, and IV.B2-38). The staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.10 Loss of Material Due to Erosion

LRA Section 3.1.2.2.10 states that this item is not applicable as the installed steam generators do not have feedwater impingement plates and associated supports.

The staff reviewed the documentation supporting the applicant's AMR evaluation and its USAR supplement and confirmed that the installed steam generators do not contain steel steam generator feedwater impingement plates as specified in SRP-LR Section 3.1.2.2.10. Therefore, the staff finds that Table 3.1.1, item 3.1.1-28 and SRP-LR Section 3.1.2.2.10 are not applicable to KPS.

3.1.2.2.11 Cracking Due to Flow-Induced Vibration

Table 3.1.1, item 3.1.1-29 is applicable to BWRs only, as discussed in SER Section 3.1.2.1.1 above.

3.1.2.2.12 Cracking Due to Stress-Corrosion Cracking and Irradiation-Assisted Stress-Corrosion Cracking

The staff reviewed LRA Section 3.1.2.2.12 and Table 3.1.1, item 3.1.1-30 against the criteria in SRP-LR Section 3.1.2.2.12. LRA Section 3.1.2.2.12 addresses cracking due to SCC and IASCC that may occur in stainless steel PWR RVIs exposed to reactor coolant as an aging effect that the applicant will manage, consistent with the SRP-LR, by the Primary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The ASME Section XI ISI, Subsections IWB, IWC, and IWD Program is enhanced with Commitment No. 1, which is also identified in the USAR supplement description of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

SRP-LR Section 3.1.2.2.12 states that:

> [c]racking due to SCC and IASCC could occur in PWR stainless steel reactor internals exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate these effects. The GALL Report recommends no further [AMR] if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

As indicated in SER Section 3.0.3.1.9, the staff accepts the Primary Water Chemistry Program for mitigating the aging effects due to SCC and IASCC, meeting one of the requirements mentioned in SRP-LR Section 3.1.2.2.12. Furthermore, the applicant made Commitment No. 1 in LRA Sections 3.1.2.2.12, A.2.1.2, and B.2.1.2 to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to incorporate all three GALL Report requirements stated above regarding managing aging effects on reactor internals. Therefore, the staff concludes that the applicant's program meets the SRP-LR Section 3.1.2.2.12 criteria because, in addition to the Water Chemistry Program, using the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program with Commitment No. 1 to manage the aging effects due to SCC and IASCC is consistent with the SRP-LR guidance. The staff also confirmed that LRA Table 3.1.2-2 identified all GALL AMR Table IV.B2 items under this aging mechanism (IV.B2-2, IV.B2-8, IV.B2-10, IV.B2-12, IV.B2-24, IV.B2-30, IV.B2-36, and IV.B2-42). The staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.13 Cracking Due to Primary Water Stress-Corrosion Cracking

The staff reviewed LRA Section 3.1.2.2.13 and Table 3.1.1, item 3.1.1-31 against the criteria in SRP-LR Section 3.1.2.2.13. (**Note**: the specific case of cracking due to PWSCC for the Ni-alloy steam generator divider plates is reviewed in SER Section 3.1.2.1.7.) The applicant stated that cracking due to PWSCC could occur in PWR components made with Ni alloy and steel with Ni-alloy cladding exposed to reactor coolant. Cracking due to SCC (including PWSCC) of Ni alloy and low-alloy steel with Ni-alloy cladding, including RCPB components and penetrations inside the RCS, such as nozzle safe ends, core support guides, and bottom head instrument tube penetrations, is managed by a combination of the Primary Water Chemistry Program; ASME Section XI ISI, Subsections IWB, IWC, and IWD Program; and Alloy 600 Inspections Program.

Based on its review of the programs identified above, the staff concludes that the applicant 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). As each of these programs was reviewed in detail within this safety evaluation, no further discussion under this section is deemed necessary.

3.1.2.2.14 Wall Thinning Due to Flow-Accelerated Corrosion

LRA Section 3.1.2.2.14 states that in 2001, the original Westinghouse Model 51 steam generators were replaced with Westinghouse Model 54Fs. The applicant stated that this was accomplished by replacing the lower portion of the steam generator and refurbishing the upper steam generator internals. The applicant further stated that the Model 54F steam generator incorporated a number of design improvements in response to OE with recirculating-type steam generators, and as part of the upper internals refurbishment, the total redesign and replacement of the feedwater inlet ring and supports. The applicant stated that design improvements included the use of flow-accelerated corrosion-resistant materials, support system based on a detailed feedwater ring stress analysis, and top discharge through Alloy 690 J tubes.

The applicant stated that IN 91-19, "Steam Generator Feedwater Distribution Piping Damage," describes the root cause as inadequate design of the feedring and feedring support system resulting from inadequate consideration of the potential for erosion and corrosion (i.e., flow-accelerated corrosion) and lack of a detailed stress analysis. Furthermore, these items have been addressed in the redesigned feedwater inlet ring and supports in the installed steam generators. Therefore, the applicant has determined that based on the design and construction of the feedwater inlet ring and supports, wall thinning due to flow-accelerated corrosion is not expected to occur and this item is not applicable.

The staff reviewed LRA Section 3.1.2.2.14 and Table 3.1.1, item 3.1.1-32 against the criteria of SRP-LR Section 3.1.2.2.14, which states that wall thinning due to flow-accelerated corrosion could occur in steel feedwater inlet rings and supports. The GALL Report references IN 91-19, "Steam Generator Feedwater Distribution Piping Damage," for evidence of flow-accelerated corrosion in steam generators and recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting wall thinning due to flow-accelerated corrosion.

The staff reviewed LRA Sections 3.1.2.2.14, 2.3.1.4, and B2.1.30 and IN 91-19. The staff noted that the IN documented OE of degradation in feedwater inlet ring and supports, and recommends modification and redesign of feedwater inlet ring and supports. The staff noted that the applicant identified causal factors described in IN 91-19. In LRA Sections B2.1.30 and 2.3.1.4, the applicant provided a description of some modifications in the upper steam generator. However, the staff noted that additional information is required to clarify why the aging effect of wall thinning due to flow-accelerated corrosion is not expected to occur. By letter dated August 28, 2009, the staff issued RAI 3.1.2.2.14-1 requesting that the applicant provide additional information regarding the new design and construction of the steam generator feedwater inlet ring and supports, and explain why the wall thinning due to flow-accelerated corrosion is not expected to occur.

In its response dated September 28, 2009, the applicant explained that the new design and construction of the feedwater inlet ring for each of the steam generators used Ni-based alloys and chrome-moly alloys (A335 Grade P11 and A234 Grade WP11), which are not susceptible to flow-accelerated corrosion. The applicant also clarified that, regarding the supports, the feedwater distribution system was analyzed as acceptable for thermal and seismic conditions, as documented in WCAP-15324, Volume 1, "Model 54F Replacement Steam Generator, Feedwater Nozzle and Thermal Sleeve Analysis," and Volume 2, "Model 54F Replacement Steam Generator, Modified Upper Assembly Stress Report, Feedring Seismic and Steam Line Break Analysis." The applicant concluded that, based on the above, aging management for the loss of material due to flow-accelerated corrosion for the refurbished steam generator feedwater inlet rings and supports is not required.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.2.14-1 acceptable because according to the additional elements about the design improvements (materials and stress analysis) for steam generator feedwater inlet ring and supports, these components are not susceptible to flow-accelerated corrosion. The staff's concern described in RAI 3.1.2.2.14-1 is resolved.

Based on its review, the staff concludes that the applicant has met the SRP-LR Section 3.1.2.2.14 criteria. The staff finds that the applicant's determination that this aging effect does not apply to KPS is acceptable, and that the applicant has demonstrated that aging management is not necessary to ensure that these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.15 Changes in Dimensions Due to Void Swelling

The staff reviewed LRA Section 3.1.2.2.15 and Table 3.1.1, item 3.1.1-33 against the criteria in SRP-LR Section 3.1.2.2.15. LRA Section 3.1.2.2.15 addresses changes in dimensions due to void swelling that could occur in stainless steel and Ni-alloy PWR RVI components exposed to reactor coolant as an aging effect that the applicant will manage, consistent with the SRP-LR, by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. This AMP is enhanced with Commitment No. 1, which is also identified in the USAR supplement description of the program.

SRP-LR Section 3.1.2.2.15 states that:

> [c]hanges in dimensions due to void swelling could occur in stainless steel and nickel alloy PWR reactor internal components exposed to reactor coolant. The GALL Report recommends no further [AMR] if the applicant provides a commitment in the FSAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

As described in LRA Sections 3.1.2.2.15, A.2.1.2, and B.2.1.2, the applicant made Commitment No. 1 to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to incorporate all three GALL Report requirements stated above regarding managing aging effects on RVIs. Therefore, the staff concludes that the applicant's program meets the SRP-LR Section 3.1.2.2.15 criteria because using the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program with Commitment No. 1 to manage the aging effects due to SCC and IASCC is consistent with the SRP-LR guidance. The staff also confirmed that LRA Table 3.1.2-2 identified all GALL AMR Table IV.B2 items under this aging mechanism (IV.B2-1, IV.B2-4, IV.B2-7, IV.B2-11, IV.B2-15, IV.B2-19, IV.B2-23, IV.B2-27, IV.B2-29, IV.B2-35, IV.B2-39, and IV.B2-41). The staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.16 Cracking Due to Stress-Corrosion Cracking and Primary Water Stress-Corrosion Cracking

The staff reviewed LRA Section 3.1.2.2.16 against the criteria in SRP-LR Section 3.1.2.2.16.

Item 1. The staff reviewed LRA Section 3.1.2.2.16.1 against the criteria in SRP-LR Section 3.1.2.2.16. LRA Table 3.1.1, item 3.1.1-34 describes the cracking due to SCC and PWSCC of austenitic stainless steel reactor vessel components that were exposed to reactor coolant. The AMR items corresponding to item 3.1.1-34 include the CRDM pressure housing and the stainless steel portion of the closure head instrument tubes and spare CRDM penetrations, bottom head instrument tube penetrations, and closure head CRDM penetrations (Table 3.1.2-1). The applicant stated that cracking due to SCC of these components is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and Primary Water Chemistry Program. The applicant further stated that the programs are consistent with the GALL Report.

The staff reviewed LRA item 3.1.1-34 in comparison with the GALL Report, Volume 1, Table 1, ID 34. In its review, the staff noted that for these components or portion of the components constructed of austenitic stainless steel, the GALL Report recommends a combination of ASME Section XI ISI and control of primary water chemistry to manage the effect of cracking due to SCC. The staff's reviews of the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and the Primary Water Chemistry Program are discussed in SER Sections 3.0.3.2.1 and 3.0.3.1.9, respectively. In its review, the staff found that the applicant's programs are consistent with the GALL Report and are, therefore, acceptable.

On the basis of its review, the staff determines that the applicant's proposed program is acceptable for managing the cracking due to SCC in austenitic stainless steel reactor vessel components corresponding to item 3.1.1-34. The staff concludes that the applicant has demonstrated that the effects of aging for these components 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).

Steam generator components associated with LRA Section 3.1.2.2.16.1. The components covered in GALL Report Table 3.1.1, item 3.1.1-35 are applicable to B&W model OTSGs. KPS has Westinghouse recirculating steam generators, so this item is not applicable to KPS, except for the case discussed in the following paragraphs.

SRP-LR Section 3.1.2.2.16.1 identifies that cracking due to PWSCC could occur on the primary coolant side of PWR steel steam generator tube-to-tubesheet welds made or clad with Ni-alloy. The GALL Report recommends controls of the ASME Code Section XI ISI, Subsections IWB, IWC, and IWD and Water Chemistry programs to manage this aging, and recommends no further AMR for PWSCC of Ni-alloy if the applicant complies with applicable NRC orders and provides a commitment in its USAR supplement to implement applicable NRC bulletins, GLs, and staff-accepted industry guidelines. GALL Report Revision 1, Volume 2 addresses this aging in item IV.D2-4, stating the item is applicable to OTSGs, but not to recirculating steam generators.

USAR Section 4.2.2.6 states that the applicant's steam generator tubes are fabricated from Alloy 690TT (Thermally Treated), that the side of the tubesheet in contact with the reactor coolant is clad with Inconel (Alloy 600 in USAR Table 4.2-1), and that the tube-to-tubesheet joints are welded.

The staff noted that the ASME Code Section XI does not require inspection of the tube-to-tubesheet welds. In addition, no specific NRC orders or bulletins address inspection requirements for these welds. The staff's concern is that, if the tubesheet cladding is Alloy 600, autogenous tube-to-tubesheet welds may not have sufficient chromium content to prevent initiation of PWSCC, even when the steam generator tubes are made from Alloy 690TT, which is the configuration of the applicant's steam generator tubes. Consequently, such a PWSCC crack initiated in this region, close to a tube, could propagate into or through the weld, causing a failure of the weld and of the RCPB, even for recirculating steam generators such as those of the applicant. Therefore, because the NRC has not approved a redefinition of the pressure boundary for these steam generators in which the autogenous tube-to-tubesheet weld is no longer included, the staff considers that the effectiveness of the primary water chemistry program should be verified to ensure PWSCC cracking is not occurring.

In a conference call on October 13, 2010, between the staff and the applicant, the staff questioned how cracking in the applicant's steam generator tube-to-tubesheet welds will be managed if that material is susceptible to PWSCC. The applicant agreed to provide information on its management of this issue.

In its response dated October 20, 2010, the applicant stated that it will commit to developing a plan to address potential failure of the steam generator primary-to-secondary pressure boundary due to PWSCC cracking of tube-to-tubesheet welds. The applicant further stated that the plan will consist of two resolution options:

- In the first option, the applicant stated that it would perform an analytical evaluation of the steam generator tube-to-tubesheet welds in order to establish a technical basis for concluding that the structural integrity of the steam generator tube-to-tubesheet interface is adequately maintained even with the presence of tube-to-tubesheet weld cracking, and that the steam generator tube-to-tubesheet weld is not required for the RCPB.
- In the second option, the applicant stated that it would perform a one-time inspection of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. The applicant also stated that if weld cracking is identified, the condition will be resolved through repair or engineering evaluation for continued service, as appropriate, and that an ongoing monitoring program will be established to perform routine inspections of tube-to-tubesheet welds for the remaining life of the steam generators.

Moreover, the applicant stated that it will develop its plan prior to the period of extended operation. As described in its response to RAI 3.1.2.2.13-1a dated September 23, 2010, the applicant explained that the lower portions of its steam generators, including the tubes and tubesheets, have accumulated less than 10 years of service time since having been replaced in 2001. Considering this limited service time of the replaced portions of the steam generators, the applicant further stated that the implementation of its plan, including weld inspections for the presence of PWSCC cracking if necessary, will be completed prior to 50 years of plant operation (i.e., prior to 2023). Finally, the applicant stated that Commitment No. 53, covering the above plan to manage the aging effect due to PWSCC of steam generator tube-to-tubesheet welds, will be added to LRA Appendix A, USAR Table A6.0-1.

Based on its review, the staff finds the applicant's plan and associated Commitment No. 53 acceptable because the applicant stated that it will manage the aging effect of cracking due to PWSCC in the steam generator tube-to-tubesheet welds either by demonstrating that those welds do not have a structural integrity or pressure boundary function, or by implementing a one-time inspection capable of detecting PWSCC cracking on a representative number of tube-to-tubesheet welds of each steam generator, in a time period consistent with the detection of potential PWSCC cracks and the period of extended operation. The staff finds that the timing of this inspection prior to 50 years of plant operation is acceptable because at that time, the replaced lower portion of the steam generator will have been in operation for less than 22 years, and it is unlikely that significant PWSCC cracking will have initiated. The staff also notes that, in case the aging effect is revealed, this one-time inspection program is accompanied by an appropriate corrective action process, including an evaluation of the degradation and the implementation of routine inspections for the remaining life of the steam generators. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. The components covered by Table 3.1.1, item 3.1.1-36 are not applicable to KPS. See SER Section 3.1.2.1.1.

3.1.2.2.17 Cracking Due to Stress-Corrosion Cracking, Primary Water Stress-Corrosion Cracking, and Irradiated-Assisted Stress-Corrosion Cracking

The staff reviewed LRA Section 3.1.2.2.17 and Table 3.1.1, item 3.1.1-37 against the criteria in SRP-LR Section 3.1.2.2.17. LRA Section 3.1.2.2.17 addresses cracking due to SCC, PWSCC, and IASCC that could occur in stainless steel and Ni-alloy PWR reactor internal components exposed to reactor coolant as an aging effect that the applicant will manage, consistent with the SRP-LR, with the Primary Water Chemistry Program and the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program. The ASME Section XI ISI, Subsections IWB, IWC, and IWD Program is enhanced with Commitment No. 1, which is also identified in the USAR supplement description of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

SRP-LR Section 3.1.2.2.17 states that:

> [c]racking due to [SCC, PWSCC, and IASCC] could occur in PWR stainless steel and nickel alloy reactor vessel internals components. The existing program relies on control of water chemistry to mitigate these effects. However, the existing program should be augmented to manage these aging effects for reactor vessel internals components. The GALL Report recommends no further AMR if the applicant provides a commitment in the USAR Supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.

As indicated in SER Section 3.0.3.1.9, the staff accepts the Primary Water Chemistry Control Program for mitigating the aging effects due to SCC, PWSCC, and IASCC, meeting one of the requirements mentioned in SRP-LR Section 3.1.2.2.17. Furthermore, the applicant made Commitment No. 1 in LRA Sections 3.1.2.2.17, A.2.1.2, and B.2.1.2 to enhance its ASME Section XI ISI, Subsections IWB, IWC, and IWD Program to incorporate all three GALL Report requirements stated above regarding managing aging effects on reactor internals. Therefore, the staff concludes that the applicant's program meets the SRP-LR Section 3.1.2.2.17 criteria because, in addition to the required Water Chemistry Control Program, using the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program with Commitment No. 1 to manage the aging effects due to SCC, PWSCC, and IASCC is consistent with the SRP-LR guidance. The staff also confirmed that LRA Table 3.1.2-2 identified all GALL AMR Table IV.B2 items under this aging mechanism (IV.B2-16, IV.B2-20, IV.B2-28, and IV.B2-40). The staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.18 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.1.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.1.2-1 through 3.1.2-4, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.1.2-1 through 3.1.2-4, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to an item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, note F indicates that the material for the AMR item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.1.2.3.1 Reactor Vessel, Reactor Coolant System, and Steam Generators – Steel Components Exposed to Air-Indoor Uncontrolled Environment

In LRA Tables 3.1.2-1, 3.1.2-3, and 3.1.2-4, the applicant stated that the exterior surfaces of steel components exposed to air-indoor uncontrolled have no aging effect. The applicant also stated that no AMP is required. The AMR items cite generic note H indicating that the component, material, and environment combination is not addressed in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material is steel and the environment is air-indoor uncontrolled and noted that loss of material is the recommended aging effect. The staff also noted that the air-indoor uncontrolled environment is defined in the GALL Report as an environment where condensation can occur, but only rarely. The staff further noted that, contrary to LRA note 4, the components under consideration may routinely have temperatures above 212 °F, during operation, and be exposed to much lower temperatures approaching ambient (i.e., during outages). By letter dated December 16, 2009, the staff issued RAI 3.1.2.3-1 requesting that the applicant select an AMP appropriate for the management of steel components exposed to uncontrolled indoor air, as recommended by the GALL Report.

In its response dated January 21, 2010, the applicant stated that during an 18-month power operation cycle, the temperatures of the external surfaces of the reactor vessel, pressurizer, and steam generator are greater than the dew point of the surrounding air. The applicant also stated that refueling outages are of short duration, that significant condensation is not expected because the component external surfaces are insulated, and that any condensation on the component surface is eliminated when the surface temperature increases upon plant startup. The applicant further stated that the loss of material aging affect was determined not to be applicable and an AMP is not required. The staff finds the applicant's response acceptable because there would typically be insufficient time for any corrosion to occur from condensation that would cause the component's design function not to be met. The staff's concern described in RAI 3.1.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations. The staff finds that the applicant has demonstrated that aging management is not necessary to ensure that these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.2 Copper Alloy Piping Greater than 15 Percent Zinc, Piping Components, Piping Elements, and Heat Exchanger Components Exposed to Closed-Cycle Cooling Water

LRA Table 3.1.1, item 3.1.1-56 addresses copper alloy (with greater than 15 percent Zn) piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. The GALL Report recommends the use of GALL AMP XI.M33, "Selective Leaching of Materials," to manage loss of material due to selective leaching for this component group. The applicant stated that this item is not applicable because there are no RCS components fabricated from copper alloy greater than 15 percent Zn and exposed to closed-cycle cooling water. The staff reviewed LRA Sections 2.3.1 and 3.1 and confirmed that the applicant's LRA does not have any AMR results for the RCS that include copper alloy piping with greater than 15 percent Zn, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. Based on its review of the LRA, the staff confirmed that there are no in-scope copper alloy piping with greater than 15 percent Zn, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water in the RCS and, therefore, finds the applicant's determination acceptable.

3.1.2.3.3 Steel Components Subject to Loss of Material Due to General, Pitting, and Crevice Corrosion Exposed to Treated Water-Primary

In LRA Table 3.1.2-3, the applicant stated that the steel pressurizer relief tank exposed to treated water-primary is being managed for loss of material due general, pitting, and crevice corrosion by the Primary Water Chemistry and the WCP programs. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Primary Water Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff determined that the Primary Water Chemistry Program includes periodic monitoring and control of contaminants, such as chloride, fluoride, dissolved oxygen, and sulfate concentrations below specified levels that may result in loss of material, and that the program also maintains water quality (pH and conductivity). The staff further determined that the applicant's program specifies sampling and analysis frequencies and corrective actions if specified limits are exceeded. The staff determined that the applicant's WCP Program will manage the aging effect of loss of material through program inspections that provide verification of the effectiveness of the Primary Water Chemistry Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable of identifying this potential aging effect, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.2.3.4 Copper Alloy Components Subject to Loss of Material Due to Pitting and Crevice Corrosion Exposed to Lubricating Oil

In LRA Table 3.1.2-3, the applicant stated that the copper alloy RCP motor lower bearing oil coolers and RCP motor upper bearing oil coolers (tubes) exposed to lubricating oil (external) are being managed for loss of material due to pitting and crevice corrosion by the Lubricating Oil Analysis Program and WCP Program. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination. The staff reviewed all AMR result line items in the GALL Report where the component and material is copper alloy piping, piping components, and piping elements exposed to lubricating oil (external) and confirmed that there are aging effect entries in the GALL Report for this component, material, and environment combination.

The staff noted that GALL AMR items VII.C1-8, VII.C2-5, VII.E1-12, VII.E4-6, VII.G-11, and VII.H2-10 state that loss of material due to pitting and crevice corrosion is an AERM for copper alloy exposed to lubricating oil.

The staff finds the applicant has appropriately identified this aging effect for copper alloy components exposed to lubricating oil. The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and are adequate to manage loss of material in copper alloy components exposed to lubricating oil. The staff determined the applicant's WCP Program will provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable of identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.2.3.5 Copper Alloy Components Subject to Loss of Material Due to Microbiologically-Influenced Corrosion Exposed to Treated Water-Closed-Cycle Cooling

In LRA Table 3.1.2-3, the applicant stated that the copper alloy RCP motor lower bearing oil coolers and RCP motor upper bearing oil coolers (tubes) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC by the Closed-Cycle Cooling Water System Program and WCP Program. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination. The staff reviewed all AMR result line items in the GALL Report where the component and material is copper alloy piping, piping components, and piping elements exposed to treated water-closed-cycle cooling (internal) and confirmed that there are aging effect entries in the GALL Report for this component, material, and environment combination.

The staff noted that the applicant has identified loss of material due to pitting, crevice, and galvanic corrosion as an AERM, which is consistent with GALL AMR items V.A-5, V.D1-2, V.D2-3, V.A-20, V.B-6, V.D1-17, and V.D2-21. The staff found the applicant has conservatively identified the additional aging mechanism of MIC to be managed by its Closed-Cycle Cooling Water System Program and WCP Program.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing. The staff determined the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Closed-Cycle Cooling Water System Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.2.3.6 Nickel-Alloy Components Exposed to Borated Water Leakage

In LRA Table 3.1.2-1, the applicant stated that the Ni-alloy bottom head instrument tube penetrations, closure head CRDM head penetrations, closure head instrument tube and spare CRDM penetrations, closure head vent and RVLIS head penetrations, and safety injection nozzle exposed to borated water leakage (external) are not subject to an AERM. In LRA Table 3.1.2-3, the applicant stated that the Ni-alloy rupture discs exposed to borated water leakage (external) are not subject to an AERM. In LRA Table 3.1.2-4, the applicant stated that the Ni-alloy channel head and primary nozzle safe ends/buttering exposed to borated water leakage (external) are not subject to an AERM. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff noted that austenitic materials, such as Ni alloys, are not subject to loss of material or cracking when subjected to this environment and these materials are used as corrosion-resistant replacement materials where other materials have degraded. The staff noted that according to EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants, Volumes 1 and 2, April 1988," corrosion resistant materials, such as austenitic and martensitic stainless steels, and high-strength Ni base alloys offer good protection against boric acid corrosion. Therefore, the staff finds no AMP is necessary for Ni alloys in a borated water leakage (external) environment. The staff confirmed that the applicant is managing the aging effect of cracking of these Ni-alloy components as described above when exposed to a treated water-primary environment, consistent with the recommendations in the GALL Report.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.2.3.7 Stainless Steel Components Subject to Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion Exposed to Treated Water-Closed-Cycle Cooling

In LRA Table 3.1.2-3, the applicant stated that the stainless RCP thermal barriers (flange and heat exchanger) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to pitting, crevice, and microbiologically-influenced corrosion by the Closed-Cycle Cooling Water System Program and WCP Program. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination. The staff reviewed all AMR result line items in the GALL Report where the component and material is stainless steel piping, piping components, and piping elements exposed to treated water-closed-cycle cooling (internal) and confirmed that there are aging effect entries in the GALL Report for this component, material, and environment combination.

The staff noted that the applicant has identified loss of material due to pitting and crevice corrosion as an AERM, which is consistent with GALL AMR items V.A-7, V.D1-4, V.D2-5, V.A-23, V.C-7, V.D1-22, and V.D2-25. The staff found the applicant has conservatively identified the additional aging mechanism of MIC to be managed by its Closed-Cycle Cooling Water System Program and WCP Program.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing. The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Closed-Cycle Cooling Water System Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.2.3.8 Steel Components Subject to Loss of Material Due to Microbiologically-Influenced Corrosion Exposed to Treated Water-Closed-Cycle Cooling

In LRA Table 3.1.2-3, the applicant stated that the steel pipe (less than 4 inches NPS), RCP motor upper bearing oil coolers (channel head and tubesheet) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC by the Closed-Cycle Cooling Water System Program and WCP Program. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination. The staff reviewed all AMR result line items in the GALL Report where the component and material is steel piping, piping components, and piping elements exposed to treated water-closed-cycle cooling (internal) and confirmed that there are aging effect entries in the GALL Report for this component, material, and environment combination.

The staff noted that the applicant has identified loss of material due to general, pitting, and crevice corrosion as an AERM, which is consistent with GALL AMR item V.C-9. The staff finds the applicant has conservatively identified the additional aging mechanism of MIC to be managed by its Closed-Cycle Cooling Water System Program and WCP Program.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing. The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Closed-Cycle Cooling Water System Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.1.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the reactor vessel, RVIs, RCS, and steam generator components, within the scope of license renewal and subject to an AMR, 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).

3.2 Aging Management of Engineered Safety Features

This section of the SER documents the staff's review of the applicant's AMR results for the engineered safety features (ESF) components and component groups of the following:

- containment vessel internal spray system
- safety injection system
- residual heat removal system

3.2.1 Summary of Technical Information in the Application

LRA Section 3.2 provides AMR results for the containment vessel internal spray system, the safety injection system, and the RHR system. LRA Table 3.2.1, "Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of NUREG-1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the containment vessel internal spray, safety injection, and RHR components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry OE in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry OE included a review of the GALL Report and OE issues identified since the issuance of the GALL Report.

3.2.2 Staff Evaluation

Table 3.2-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.2 and addressed in the GALL Report.

The staff reviewed LRA Section 3.2 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for the containment vessel internal spray system, safety injection system, and RHR system components within the scope of license renewal and subject to an AMR, 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).

The staff conducted two onsite audits of AMPs to confirm the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of these audits was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluation of the AMPs is documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.2.2.1 and 3.2.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. *Details of the staff's evaluation are discussed in* SER *Section* 3.2.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's OE to verify the applicant's claims.

Table 3.2-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.2 and addressed in the GALL Report.

Table 3.2-1 Staff Evaluation for Engineered Safety Features System Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel and stainless steel piping, piping components, and piping elements in the ECCS (3.2.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA	Fatigue is a TLAA (See SER Section 3.2.2.2.1)
Steel with stainless steel cladding pump casing exposed to treated borated water (3.2.1-2)	Loss of material due to cladding breach	A plant-specific AMP is to be evaluated. Reference NRC IN 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks"	Yes, verify that plant-specific program addresses cladding breach.	Not applicable to KPS	Consistent with the GALL Report. A VT-1 visual examination of 1 safety injection pump performed prior to the period of extended operation. (See SER Sections 3.2.2.1.2 and 3.2.2.2.2)
Stainless steel containment isolation piping and components internal surfaces exposed to treated water (3.2.1-3)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Primary Water Chemistry and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.3.1)
Stainless steel piping, piping components, and piping elements exposed to soil (3.2.1-4)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes, plant-specific	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.3)
Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water (3.2.1-5)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection		BWR Only	Not applicable to PWRs (See SER Section 3.2.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.2.1-6)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.3.4)
Partially encased stainless steel tanks with breached moisture barrier exposed to raw water (3.2.1-7)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated for pitting and crevice corrosion of tank bottoms because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant-specific	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.4)
Stainless steel piping, piping components, piping elements, and tank internal surfaces exposed to condensation (internal) (3.2.1-8)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated	Yes, plant-specific	WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.3.6)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil (3.2.1-9)	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.4)
Stainless steel heat exchanger tubes exposed to treated water (3.2.1-10)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.4)
Elastomer seals and components in standby gas treatment system exposed to air-indoor uncontrolled (3.2.1-11)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel high-pressure safety injection (HPSI) (charging) pump miniflow orifice exposed to treated borated water (3.2.1-12)	Loss of material due to erosion	A plant-specific AMP is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging.	Yes, plant-specific	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.5)
Steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air-indoor uncontrolled (internal) (3.2.1-13)	Loss of material due to general corrosion and fouling	A plant-specific AMP is to be evaluated.		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
Steel piping, piping components, and piping elements exposed to treated water (3.2.1-14)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
Steel containment isolation piping, piping components, and piping elements internal surfaces exposed to treated water (3.2.1-15)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.8.2)
Steel piping, piping components, and piping elements exposed to lubricating oil (3.2.1-16)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated.	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.2.8.3)
Steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil (3.2.1-17)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.2.1-18)	Cracking due to SCC and IGSCC	BWR Stress-Corrosion Cracking and Water Chemistry		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to steam or treated water (3.2.1-19)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
CASS piping, piping components, and piping elements exposed to treated water (borated or unborated) > 250 °C (482 °F) (3.2.1-20)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
High-strength steel closure bolting exposed to air with steam or water leakage (3.2.1-21)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel closure bolting exposed to air with steam or water leakage (3.2.1-22)	Loss of material due to general corrosion	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel bolting and closure bolting exposed to air-outdoor (external), or air-indoor uncontrolled (external) (3.2.1-23)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel closure bolting exposed to air-indoor uncontrolled (external) (3.2.1-24)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water > 60 °C (140 °F) (3.2.1-25)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program and WCP Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.2.1-26)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program	Consistent with the GALL Report (See SER Section 3.2.2.1.1)
Steel heat exchanger components exposed to closed-cycle cooling water (3.2.1-27)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program and WCP Program	Consistent with the GALL Report
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-28)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program and WCP Program	Consistent with the GALL Report
Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-29)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to KPS (See SER Section 3.2.2.1.6)
Stainless steel and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.2.1-30)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System Program and WCP Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
External surfaces of steel components including ducting, piping, ducting closure bolting, and containment isolation piping external surfaces exposed to air-indoor uncontrolled (external); condensation (external) and air-outdoor (external) (3.2.1-31)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report
Steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal) (3.2.1-32)	Loss of material due to general corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Not applicable	Not applicable to KPS (See SER Section 3.2.2.1.7)
Steel encapsulation components exposed to air-indoor uncontrolled (internal) (3.2.1-33)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.3.2)
Steel piping, piping components, and piping elements exposed to condensation (internal) (3.2.1-34)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components		BWR only	Not applicable to PWRs (See SER Section 3.2.2.1.1)
Steel containment isolation piping and components internal surfaces exposed to raw water (3.2.1-35)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Not applicable for KPS ESF systems	Not applicable for KPS ESF systems (See SER Section 3.2.2.1.1)
Steel heat exchanger components exposed to raw water (3.2.1-36)	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to KPS (See SER Section 3.2.2.1.8)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel piping, piping components, and piping elements exposed to raw water (3.2.1-37)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.9)
Stainless steel containment isolation piping and components internal surfaces exposed to raw water (3.2.1-38)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Not applicable for KPS ESF systems	Not applicable for KPS ESF systems (See SER Section 3.2.2.1.1)
Stainless steel heat exchanger components exposed to raw water (3.2.1-39)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.1.17)
Steel and stainless steel heat exchanger tubes (serviced by open-cycle cooling water) exposed to raw water (3.2.1-40)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to KPS (See SER Section 3.2.2.1.10)
Copper alloy > 15% Zn piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-41)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.11)
Gray cast iron piping, piping components, piping elements exposed to closed-cycle cooling water (3.2.1-42)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials Program	Consistent with the GALL Report
Gray cast iron piping, piping components, and piping elements exposed to soil (3.2.1-43)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.12)
Gray cast iron motor cooler exposed to treated water (3.2.1-44)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.13)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Aluminum, copper alloy > 15% Zn, and steel external surfaces, bolting, and piping, piping components, and piping elements exposed to air with borated water leakage (3.2.1-45)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Steel encapsulation components exposed to air with borated water leakage (internal) (3.2.1-46)	Loss of material due to general, pitting, crevice, and boric acid corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.3.2)
CASS piping, piping components, and piping elements exposed to treated borated water > 250 °C (482 °F) (3.2.1-47)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	ASME Section XI ISI, Subsections IWB, IWC, and IWD Program	Consistent with GALL Report (See SER Section 3.2.2.1.14)
Stainless steel or stainless steel clad steel piping, piping components, piping elements, and tanks (including safety injection tanks/accumulators) exposed to treated borated water > 60 °C (140 °F) (3.2.1-48)	Cracking due to SCC	Water Chemistry	No	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.1.15)
Stainless steel piping, piping components, piping elements, and tanks exposed to treated borated water (3.2.1-49)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.2.2.1.18)
Aluminum piping, piping components, and piping elements exposed to air-indoor uncontrolled (internal/external) (3.2.1-50)	None	None	Not applicable	None	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Galvanized steel ducting exposed to air-indoor controlled (external) (3.2.1-51)	None	None	Not applicable	Not applicable	Not applicable to KPS (See SER Section 3.2.2.1.16)
Glass piping elements exposed to air-indoor uncontrolled (external), lubricating oil, raw water, treated water, or treated borated water (3.2.1-52)	None	None	Not applicable	None	Consistent with the GALL Report
Stainless steel, copper alloy, and Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.2.1-53)	None	None	Not applicable	None	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.2.1-54)	None	None	Not applicable	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.1)
Steel and stainless steel piping, piping components, and piping elements in concrete (3.2.1-55)	None	None	Not applicable	None	Consistent with the GALL Report
Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to gas (3.2.1-56)	None	None	Not applicable	None	Consistent with the GALL Report
Stainless steel and copper alloy < 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.2.1-57)	None	None	Not applicable	Not applicable to KPS	Not applicable to KPS (See SER Section 3.2.2.1.1)

The staff's review of the ESF component groups followed several approaches. One approach, documented in SER Section 3.2.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.2.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.2.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the ESF components is documented in SER Section 3.0.3.

3.2.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.2.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the ESF systems and components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Bolting Integrity Program
- Boric Acid Corrosion Program
- Closed-Cycle Cooling Water System Program
- External Surfaces Monitoring Program
- Lubricating Oil Analysis Program
- Open-Cycle Cooling Water System Program
- Primary Water Chemistry Program
- Selective Leaching of Materials Program
- Work Control Process Program

LRA Tables 3.2.2-1 through 3.2.2-3 summarize the results of AMRs for components of the containment vessel internal spray system, the safety injection system, and the RHR system and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant has claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item describing how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report and confirmed that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report. The staff confirmed whether the AMR line item of the different component was applicable to the component under review and whether the exceptions to the GALL Report AMPs had been reviewed and accepted by the staff. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff reviewed these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the containment vessel internal spray, safety injection, and RHR systems' components that are subject to an AMR.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.2.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

3.2.2.1.1 AMR Results Identified as Not Applicable

LRA Table 3.2.1, items 5, 11, 13, 14, 17-20, and 34 discuss the applicant's determination on GALL Report AMR items that are applicable only to BWR-designed reactors. In the applicant AMR discussions for these items, no additional information is provided. The staff confirmed that these AMR items in Table 1 of the GALL Report, Volume 1 are only applicable to BWR-designed reactors, and that KPS is a PWR with a dry ambient containment. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding that AMR items 5, 11, 13, 14, 17-20, and 34 in Table 1 of the GALL Report, Volume 1 are not applicable to KPS.

LRA Table 3.2.1, item 3.2.1-26 addresses steel piping, piping components, and piping elements exposed to closed-cycle cooling water. The GALL Report recommends the use of GALL AMP XI.M21, "Closed-Cycle Cooling Water System," to manage loss of material due to general, pitting, and crevice corrosion for this component group. The applicant stated that steel containment isolation piping, piping components, and piping elements exposed to closed-cycle cooling water are evaluated for aging management in their respective mechanical systems. The staff reviewed LRA Sections 2.3.3 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel piping, piping components, and piping elements exposed to closed-cycle cooling water. The staff also reviewed the AMR results for the mechanical systems, into which the components that are intended to be evaluated using this GALL Report item were placed, and confirmed that the components are evaluated for aging management in accordance with GALL AMP XI.M21. The staff noted that a search of the applicant's USAR did not find any evidence of steel piping, piping components, and piping elements in the ESF systems exposed to closed-cycle cooling water that are not included in the evaluations performed in the applicable mechanical systems. Based on its review of the LRA and USAR, the staff confirmed that there is no in-scope steel piping, piping components, and piping elements exposed to closed-cycle cooling water in the ESF systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.2.1, item 3.2.1-35 addresses steel containment isolation piping and components exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling for this component group. The applicant stated that the associated items are evaluated for aging management in their respective mechanical systems. The staff reviewed LRA Sections 2.3.3 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel containment isolation piping and components exposed to raw water. The staff also reviewed the AMR results for the mechanical systems, into which the components that are intended to be evaluated using this GALL Report item were placed, and confirmed that the components are evaluated for aging management in accordance with GALL AMP XI.M20. The staff noted that a search of the applicant's USAR did not find any evidence of steel containment isolation piping and components in the ESF systems exposed to raw water that are not included in the evaluations performed in the applicable mechanical systems. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel containment isolation piping and components exposed to raw water in the ESF systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.2.1, item 3.2.1-38 addresses stainless steel containment isolation piping and components exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling for this component group. The applicant stated that the associated items are evaluated for aging management in their respective mechanical systems. The staff reviewed LRA Sections 2.3.3 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel containment isolation piping and components exposed to raw water. The staff also reviewed the AMR results for the mechanical systems, into which the components that are intended to be evaluated using this GALL Report item were placed, and confirmed that the components are evaluated for aging management in accordance with GALL AMP XI.M20. The staff noted that a search of the applicant's USAR did not find any evidence of stainless steel containment isolation piping and components in the ESF systems exposed to raw water that are not included in the evaluations performed in the applicable mechanical systems. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope stainless steel containment isolation piping and components exposed to raw water in the ESF systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.2.1, item 3.2.1-54 addresses steel piping, piping components, and piping elements exposed externally to indoor controlled air and states that there are no aging effects or aging mechanisms, and that no AMPs will be credited for this material and environment combination. The GALL Report, Table V.F, item V.F-16 states that there is no aging effect or aging mechanism, and that no AMP is recommended for this component group exposed to this environment and, therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.2.1, item 3.2.1-57 addresses stainless steel and copper alloy (with less than 15 percent Zn) piping, piping components, and piping elements exposed to air with borated water leakage and states that there are no aging effects or aging mechanisms, and that no AMPs will be credited for this material and environment combination. The GALL Report, Table V.F, items V.F-5 and V.F-13 state that there are no aging effects or aging mechanisms, and that no AMPs are recommended for this component group exposed to this environment and, therefore, the staff finds the applicant's determination acceptable.

3.2.2.1.2 Loss of Material Due to Cladding Breach

LRA Table 3.2.1, item 3.2.1-2 discusses loss of material due to cladding breach for pumps with steel pump casings and stainless steel cladding, which are exposed to treated borated water. The applicant stated that this is not applicable to KPS. See SER Section 3.2.2.2.2 for the staff's evaluation of this issue.

3.2.2.1.3 Loss of Material Due to Pitting and Crevice Corrosion

LRA Table 3.2.1, item 3.2.1-4 and Section 3.2.2.2.3.2 address loss of material due to pitting and crevice corrosion of stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. The applicant stated that this item is not applicable because there are no in-scope components constructed of stainless steel exposed to soil in the ESF systems. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include stainless steel components exposed to soil. The staff also reviewed the USAR to verify the same. Based on its review of the LRA and USAR, the staff confirmed that the applicant's plant does not have any in-scope components constructed of stainless steel exposed to soil in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.4 Loss of Material Due to Pitting and Crevice Corrosion

LRA Table 3.2.1, item 3.2.1-7 addresses the exterior of a stainless steel tank bottom that may have its moisture barrier breached and exposed to rain water or other sources of raw water. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed and that a plant-specific AMP be evaluated because moisture and water can accumulate under the tank due to cracking of the perimeter seal from weathering. The applicant stated that this item is not applicable because its refueling water storage tank is located inside the auxiliary building and is not exposed to a raw water environment. The applicant also stated that based on plant-specific OE, the tank has not been exposed to any moisture that could collect underneath the tank. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any stainless steel tanks in the ESF systems other than the refueling water storage tank. The staff also reviewed the USAR to verify the same. The staff determined that the presence of the tank inside the auxiliary building effectively eliminates the potential for ingress of raw water below the tank. Based on its review of the LRA and USAR, the staff confirmed that the applicant's plant does not have a tank whose bottom may have its moisture barrier breached and exposed to rain water or other sources of raw water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.5 Loss of Material Due to Erosion

LRA Table 3.2.1, item 3.2.1-12 addresses erosion in the miniflow recirculation orifice for centrifugal charging pumps used as high-head safety injection pumps exposed to treated borated water. The GALL Report recommends a plant-specific AMP be evaluated for erosion of the miniflow recirculation orifice due to extended use of the centrifugal safety injection pump for normal charging. The GALL Report references Licensee Event Report (LER) 50-275/94-023 for evidence of erosion. The applicant stated that this item is not applicable because its installed safety injection pumps are not used as the normal charging pumps. The applicant also stated that the charging pumps are positive displacement pumps which do not have miniflow recirculation orifices. The staff reviewed LRA Sections 2.2.3 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for centrifugal charging pumps used as high-head safety injection pumps exposed to treated borated water.

The staff noted that the applicant stated that it is currently not using the centrifugal pumps in a manner which would result in prolonged use. The staff also noted that one of the responses to the events of LER 50-275/94-023 was to switch from using the centrifugal pump to the positive displacement pump for normal injection. Based on the ability of the applicant to switch from using the centrifugal pump to the positive displacement pump for normal injection, the staff cannot conclude from the applicant's statement that the positive displacement pump is being used for normal injection and that the centrifugal pump has not been used for that purpose in the past. Past use of the centrifugal pump for normal injection could indicate that greater than acceptable erosion has occurred or may occur with minimal additional use during the period of extended operation. By letter dated October 13, 2009, the staff issued RAI 3.2.2.2.6-1 requesting that the applicant provide information concerning the interchangeability of the safety injection pumps and the charging pumps, and the operating history of the safety injection pumps so as to allow the staff to determine whether these pumps have been or will be operated for a sufficient period of time to cause erosion of the miniflow recirculation orifice.

In its response dated November 13, 2009, the applicant stated that the charging pumps are positive displacement pumps which do not have miniflow recirculation orifices. The applicant also stated that while the safety injection pumps are centrifugal pumps, they are not interchangeable with the charging pumps and are not operated for sufficient periods to cause loss of material due to erosion.

The staff finds that this item is not applicable because the conditions of the item, centrifugal charging pumps with miniflow recirculation orifices, are not met. The staff's concern described in RAI 3.2.2.2.6-1 is closed. Based on its review of the LRA and RAI 3.2.2.2.6-1, the staff confirmed that there are no in-scope centrifugal charging pumps used as high-head safety injection pumps exposed to treated borated water and, therefore, finds the applicant's determination acceptable.

3.2.2.1.6 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion

LRA Table 3.2.1, item 3.2.1-29 addresses copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. The GALL Report recommends the use of GALL AMP XI.M21, "Closed-Cycle Cooling Water System," to manage loss of material due to pitting, crevice, and galvanic corrosion for this component group. The applicant stated that this item is not applicable because the applicant has no components fabricated from copper alloy that are exposed to closed-cycle cooling water in the ESF systems. The staff reviewed LRA Sections 2.3.3 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. The staff also noted that a search of the applicant's USAR did not find any evidence of copper alloy piping, piping components, piping elements, and heat exchanger components in the ESF systems exposed to closed-cycle cooling water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.7 Loss of Material Due to General, Pitting, and Crevice Corrosion

LRA Table 3.2.1, item 3.2.1-32 addresses steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal). The GALL Report recommends the use of GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," to manage loss of material due to general, pitting, and crevice corrosion for this component group. The applicant stated that this item is not applicable because there are no ESF steel piping or ducting components fabricated from steel and internally exposed to air-indoor uncontrolled. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal). The staff also noted that a search of the applicant's USAR did not find any evidence of steel piping and ducting components and internal surfaces in the ESF systems exposed to air-indoor uncontrolled (internal). Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal) in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.8 Loss of Material Due to General, Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion and Fouling

LRA Table 3.2.1, item 3.2.1-36 addresses steel heat exchanger components exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion and fouling for this component group. The applicant stated that this item is not applicable because there are no ESF system steel heat exchanger components exposed to raw water. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel heat exchanger components exposed to raw water. The staff also noted that a search of the applicant's USAR did not find any evidence of steel heat exchanger components in the ESF systems exposed to raw water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel heat exchanger components exposed to raw water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.9 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

LRA Table 3.2.1, item 3.2.1-37 addresses stainless steel piping, piping components and piping elements exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for this component group. By letter dated September 25, 2009, the applicant amended its LRA to state that LRA Table 3.2.1, item 3.2.1-37 is not applicable.

The applicant also amended its LRA by removing its reference to LRA Table 3.2.1, item 3.2.1-37 in the safety injection system for the stainless steel pipe exposed to raw water, which is subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The staff noted that this was the only AMR item that referenced LRA Table 3.2.1, item 3.2.1-37. The staff's review of stainless steel components exposed to raw water subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and its evaluation is documented in SER Section 3.2.2.3.1.

Based on its review of the LRA and the applicant's letter dated September 25, 2009, the staff confirmed that the in-scope stainless steel pipe exposed to raw water in the safety injection system is evaluated in SER Section 3.2.2.3.2 and, therefore, finds the applicant's determination acceptable.

3.2.2.1.10 Reduction of Heat Transfer Due to Fouling

LRA Table 3.2.1, item 3.2.1-40 addresses steel and stainless steel heat exchanger tubes serviced by open-cycle cooling water exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage reduction of heat transfer due to fouling for this component group. The applicant stated that this item is not applicable because there are no ESF heat exchanger tubes fabricated from steel or stainless steel and exposed to open-cycle cooling water. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include steel and stainless steel heat exchanger tubes serviced by open-cycle cooling water exposed to raw water. The staff also noted that a search of the applicant's USAR did not find any evidence of steel and stainless steel heat exchanger tubes serviced by open-cycle cooling water exposed to raw water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel and stainless steel heat exchanger tubes serviced by open-cycle cooling water exposed to raw water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.11 Loss of Material Due to Selective Leaching

LRA Table 3.2.1, item 3.2.1-41 addresses copper alloy (greater than 15 percent Zn) piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. The GALL Report recommends the use of GALL AMP XI.M33, "Selective Leaching of Materials," to manage loss of material due to selective leaching for this component group. The applicant stated that this item is not applicable because there are no ESF system components fabricated from copper alloy (greater than 15 percent Zn) and exposed to closed-cycle cooling water. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include copper alloy greater than 15 percent Zn piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water. Based on its review of the LRA, the staff confirmed that there are no in-scope copper alloy (greater than 15 percent Zn) piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.12 Loss of Material Due to Selective Leaching

LRA Table 3.2.1, item 3.2.1-43 addresses gray cast iron piping, piping components, and piping elements exposed to soil. The GALL Report recommends the use of GALL AMP XI.M33, "Selective Leaching of Materials," to manage loss of material due to selective leaching for this component group. The applicant stated that this item was not applicable because there are no ESF system piping, piping components, and piping elements fabricated from gray cast iron and exposed to soil. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include gray cast iron piping, piping components, and piping elements exposed to soil. The staff also noted that a search of the applicant's USAR did not find any evidence of gray cast iron piping, piping components, and piping elements in the ESF exposed to soil. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope gray cast iron piping, piping components, and piping elements exposed to soil in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.13 Loss of Material Due to Selective Leaching

LRA Table 3.2.1, item 3.2.1-44 addresses gray cast iron motor coolers exposed to treated water. The GALL Report recommends the use of GALL AMP XI.M33, "Selective Leaching of Materials," to manage loss of material due to selective leaching for this component group. The applicant stated that this item is not applicable because there are no ESF system components fabricated from gray cast iron and exposed to treated water. The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant's LRA does not have any AMR results for the ESF systems that include gray cast iron motor coolers exposed to treated water. The staff also noted that a search of the applicant's USAR did not find any evidence of gray cast iron motor coolers in the ESF systems exposed to treated water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope gray cast iron motor coolers exposed to treated water in the ESF systems and, therefore, finds the applicant's determination acceptable.

3.2.2.1.14 Loss of Fracture Toughness Due to Thermal Aging Embrittlement

LRA Table 3.2.1, item 3.2.1-47 addresses the loss of fracture toughness due to thermal aging embrittlement of CASS Class 1 piping, piping components, and piping elements exposed to reactor coolant greater than 250 °C (482 °F). The AMR items corresponding to item 3.2.1-47 are described in LRA Tables 3.2.2-2 and 3.2.2-3, and include CASS Class 1 valves in safety injection and RHR systems of the ESF systems. The applicant stated that these AMR items were consistent with the GALL Report item for component, material, environment, and aging effect, but a program different than GALL AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel," is credited to manage the aging effects. The applicant stated that the program consists of the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, with an exception. The applicant further stated that this program is consistent with GALL AMP XI.M12.

The staff reviewed LRA item 3.2.1-47 in comparison with GALL Report Volume 1, Table 2, ID 47. In its review of the LRA, the staff noted that the generic note for the AMR items was E, which means that the component, material, environment, and aging effect/mechanism are consistent with the GALL Report but a different AMP is credited to manage the aging effects. In its review, the staff found that the LRA AMR items were consistent with the GALL Report in component, material, environment, and aging effect. The applicant stated that the loss of fracture toughness of CASS valves in the safety injection and RHR systems is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program, which takes exception to GALL AMP XI.M1 in that a different edition of the ASME Code Section XI is used. The staff reviewed the applicant's ASME Section XI ISI, Subsections IWB, IWC, and IWD Program and its evaluation is documented in SER Section 3.0.3.2.1. The applicant further stated in LRA Tables 3.2.2-2 and 3.2.2-3 that it is permissible to use the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program because it is consistent with GALL AMP XI.M12. The staff found this acceptable because GALL AMP XI.M12 states that based on the assessment documented in the letter dated May 19, 2000, from Christopher Grimes, NRC, to Douglas Walters, NEI (LRA Reference 4.8-27), for CASS Class 1 pump casings and valve bodies and bonnets exposed to reactor coolant greater than 250 °C (482 °F), screening for susceptibility to thermal aging is not required, and the existing ASME Code Section XI ISI requirements are adequate.

Based on its review of the program to manage the loss of fracture toughness due to thermal aging embrittlement of CASS Class 1 valves in the safety injection and RHR systems of the ESF systems, the staff finds that all program elements are consistent with GALL AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel," and, therefore, acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.1.15 Cracking Due to Stress-Corrosion Cracking

LRA Table 3.2.1, item 3.2.1-48 addresses the cracking due to SCC of austenitic stainless steel components, from the ESF systems, that are exposed to treated borated water greater than 60 °C (140 °F). The AMR items corresponding to item 3.2.1-48 include piping and valves in the safety injection system (Table 3.2.2-2) and piping, piping components and elements, and heat exchangers in the RHR system (Table 3.2.2-3). The applicant stated that the cracking due to SCC of these stainless steel components is managed by the WCP Program, which is a plant-specific AMP, and the Primary Water Chemistry Program. The applicant further stated that the program is consistent with the GALL Report.

The staff reviewed LRA Table 3.2.1, item 3.2.1-48 in comparison with the GALL Report, Volume 1, Table 2, ID 48. In its review, the staff noted that the LRA AMR items were consistent with the GALL Report in component, material, environment, and aging effect. The staff noted that for these AMR items, the GALL Report recommends the Primary Water Chemistry Program to manage the effects of cracking due to SCC. Consequently, the applicant's program is consistent with the GALL Report and, therefore, acceptable. However, the generic notes in LRA Tables 3.2.2-2 and 3.2.2-3 are confusing. Note A is listed for the Primary Water Chemistry Program and note E is listed for the WCP Program. Consistency note A means that the program is consistent with the GALL Report because the Primary Water Chemistry Program is used to manage the aging effects, whereas note E means that a different program, the WCP Program, is being credited to manage the aging effects. For these items, the use of the WCP Program should be considered an additional program that provides inspection capabilities beyond what is specified in the GALL Report. The staff finds that the AMP proposed by the applicant is at least as comprehensive as that recommended in the GALL Report. On the basis of its review, the staff determines that the applicant's proposed program is acceptable for managing the cracking due to SCC in austenitic stainless steel ESF components.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.1.16 Galvanized Steel Ducting Exposed to Air-Indoor Controlled (External)

LRA Table 3.2.1, item 3.2.1-51 addresses galvanized steel ducting exposed to air-indoor controlled (external) and states that there are no aging effects or mechanisms and that no AMP is recommended. The GALL Report, Table V, item V.F-1 (EP-14) recommends that there is no aging effect or aging mechanism and that no AMP is recommended for this component group and, therefore, the staff finds the applicant's determination acceptable.

3.2.2.1.17 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion of Stainless Steel Heat Exchanger Components Exposed to Raw Water

LRA Table 3.2.1, item 3.2.1-39 addresses stainless steel heat exchanger components exposed to raw water which are being managed for loss of material/pitting, crevice, and microbiologically-influenced corrosion by the WCP Program. This item was used in LRA Table 3.3.2-3, "Auxiliary Systems – Spent Fuel Pool Cooling – Aging Management Evaluation," for AMR items for the SFP heat exchanger tubes and spent fuel heat exchanger tubesheet, and Table 3.3.2-9, "Auxiliary Systems – Chemical and Volume Control – Aging Management Evaluation," for AMR items for the boric acid evaporator distillate sample cooler tubing. The applicant cited generic note H indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material and component type is stainless steel piping, piping components, and piping elements exposed to raw water and noted that the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to monitor the aging effect of loss of material due to loss of material due to pitting, crevice, and microbiologically-influenced corrosion.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff noted that both the SFP cooling heat exchanger and boric acid evaporator distillate sample cooler tubing are nonsafety-related components and, therefore, do not fall under the scope of the GALL Report recommended program. The staff finds the applicant's proposal acceptable because the applicant has: (1) identified an applicable aging effect, (2) selected an AMP with an appropriate scope for the component under consideration, and (3) chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.1.18 Loss of Material Due to Pitting and Crevice Corrosion

LRA Table 3.2.1, item 3.2.1-49 addresses the loss of material due to pitting and crevice corrosion of stainless steel piping, piping components, piping elements, and tanks exposed to primary treated water. The LRA credits the Primary Water Chemistry Program and WCP Program to manage this aging effect for stainless steel piping, piping components, piping elements, and tanks. The GALL Report recommends GALL AMP XI.M2, "Water Chemistry," to ensure that these aging effects are adequately managed. In LRA Table 3.2.1, the applicant assigned each component two items, one in which the Primary Water Chemistry Program is credited and the other in which the WCP Program is credited. The applicant stated that all the items for which the Water Chemistry Program is credited are fully consistent with the GALL Report, citing generic note A. The applicant cited generic note E for all the items for which the WCP Program is credited, indicating that the LRA AMR is consistent with the GALL Report item for material, environment, and aging effect except that a different AMP is credited.

The staff reviewed the applicant's Primary Water Chemistry and WCP programs, and its evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. In its review of LRA item 3.2.1-49, the staff noted that the GALL Report does not recommend that the effectiveness of the Water Chemistry Program be confirmed by an inspection program to manage the effects of loss of material on stainless steel piping, piping components, piping elements, and tanks. The staff also noted that the applicant proposed to manage the aging of the components under consideration through the use of its Primary Water Chemistry Program, which is consistent with that recommended by the GALL Report. In addition, the applicant proposed to use the WCP Program, which is an inspection program, to supplement the Primary Water Chemistry Program, in addition to the recommendations in the GALL Report. The staff finds that the AMPs proposed by the applicant are in addition to those recommended by the GALL Report and, therefore, acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation Is Recommended

LRA Section 3.2.2.2 provides further evaluation of aging management as recommended by the GALL Report for the ESF components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to cladding breach
- loss of material due to pitting and crevice corrosion

- reduction of heat transfer due to fouling
- hardening and loss of strength due to elastomer degradation
- loss of material due to erosion
- loss of material due to general corrosion and fouling
- loss of material due to general, pitting, and crevice corrosion

3.2.2.2.1 Cumulative Fatigue Damage

LRA Section 3.2.2.2.1 states that fatigue is a TLAA, as defined in 10 CFR 54.3, "Definitions." Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). SER Section 4.3 documents the staff's review of the applicant's evaluation of this TLAA.

3.2.2.2.2 Loss of Material Due to Cladding Breach

LRA Section 3.2.2.2.2 refers to Table 3.2-1, item 3.2.1-2 and addresses steel pump casings with stainless steel cladding exposed to treated borated water which are being managed for loss of material due to cladding breach. The applicant stated that the cladding failures described in the GALL Report were based on NRC IN 94-63, concerning high-head safety injection pumps at North Anna Power Station. According to the applicant, the failures at North Anna were related to manufacturing at the Pacific Pump Division of Dresser Industries and not related to aging; whereas the applicant's pumps were manufactured by Sulzer Bingham. The applicant stated that since there was no OE related to loss of material due to cladding breach in Sulzer Bingham pumps, this item was not applicable.

The staff reviewed LRA Section 3.2.2.2.2 against the criteria in SRP-LR Section 3.2.2.2.2, which states that loss of material due to cladding breach could occur in PWR steel pump casings with stainless steel cladding exposed to treated borated water and that the GALL Report recommends further evaluation of a plant-specific AMP to ensure this aging effect is adequately managed. Acceptance criteria are described in the SRP-LR, Appendix A.1, "Aging Management Review – Generic."

The staff reviewed USAR Table 6.2-6, "Safety Injection Pump Design Parameters," and noted that the safety injection pumps are carbon steel forgings with stainless steel cladding. Contrary to the applicant's position that this item was not applicable, the staff did not consider the lack of OE related to loss of material due to cladding breach in Sulzer Bingham pumps as a sufficient basis to ensure that this aging effect is managed. By letter dated December 3, 2009, the staff issued RAI 3.2.2.2.2-1 requesting that the applicant provide a plant-specific AMP to ensure that the loss of material due to cladding breach is adequately managed.

In its response dated January 21, 2010, the applicant stated that a VT-1 visual examination of one safety injection pump will be performed prior to the period of extended operation to ensure there are no signs of cracking in stainless steel cladding or corrosion. The applicant also stated that NRC IN 94-63, upon which this item is based, describes visible rust-like stains as being indicative of a cladding breach and corrosion of the underlying carbon steel casing material. The applicant further stated that Commitment No. 37, covering the above visual examination, will be added to LRA Appendix A, USAR Table A6.0-1.

Based on its review, the staff finds the applicant's response to RAI 3.2.2.2.2-1 acceptable because the noted visual examination for one of the two safety injection pumps will identify any corrosion of the underlying carbon steel, in the unlikely event of a cladding breach. Therefore, the staff finds that managing the loss of material due to cladding breach for steel pump casings with stainless steel cladding exposed to treated borated water through a visual examination prior to the period of extended operation is an acceptable plant-specific program which will provide reasonable assurance that this aging effect is adequately managed. The staff's concern described in RAI 3.2.2.2.2-1 is resolved.

Based on the applicant's commitment, the staff concludes that the applicant's program meets SRP-LR Section 3.2.2.2.2 criteria. For those items that apply to LRA Section 3.2.2.2.2, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion

Item 1. LRA Section 3.2.2.2.3.1 refers to Table 3.2.1, item 3.2.1-3 and addresses loss of material due to pitting and crevice corrosion from stainless steel containment isolation piping and component internal surfaces exposed to treated water. The applicant stated that these components are evaluated for aging management in their respective mechanical systems.

The staff reviewed LRA Section 3.2.2.2.3.1 against the criteria in SRP-LR Section 3.2.2.2.3.1, which states that loss of material due to pitting and crevice corrosion could occur for the internal surfaces of stainless steel containment isolation piping, piping components, and piping elements exposed to treated water. The GALL Report recommends the use of GALL AMP XI.M2, "Water Chemistry," augmented by further evaluation to verify the effectiveness of the program to manage the effects of aging for this component group. The GALL Report states that the existing AMP relies on monitoring and control of water chemistry to mitigate degradation. The GALL Report also states that control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions and that the effectiveness of the chemistry control program should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program and notes that a one-time inspection of selected components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The staff reviewed AMR items associated with LRA Table 3.2.1, item 3.2.1-3 and the mechanical systems into which the components that are intended to be evaluated using this GALL Report item were placed. The staff noted that for some mechanical systems where stainless steel components are exposed to treated water, the LRA only credits the use of the Primary Water Chemistry Program and is not augmented by an inspection program to verify the effectiveness of the Primary Water Chemistry Program. The staff finds that if the components which were intended to be evaluated as part of this item are evaluated as part of the associated mechanical system, they may be subjected to aging management by only the Primary Water Chemistry Program and not by a combination of the Primary Water Chemistry Program and a program to verify the effectiveness of the chemistry control program, as recommended by the GALL Report. This approach may not adequately manage aging because the effectiveness of the Primary Water Chemistry Program may not be confirmed in all instances. By letter dated

August 28, 2009, the staff issued RAI 3.2.2.2.3.1-1 requesting that the applicant evaluate components meeting the definition of this table, under the guidance of this table, as opposed to including these components in their parent mechanical system for evaluation.

In its response dated September 28, 2009, the applicant stated that for all of the piping and valves under consideration, when aging management is performed under the system to which the piping and valves belong, aging management will be performed in accordance with both the Primary Water Chemistry Program and WCP Program. Subsequent review of the LRA by the staff confirmed that all items where stainless steel containment isolation piping, piping components, and piping elements internal surfaces are exposed to treated water and subject to loss of material due to general, pitting, and crevice corrosion are managed for aging using both the Primary Water Chemistry and WCP programs. The applicant's WCP Program encompasses GALL AMP XI.M32, "One-Time Inspection," and performs visual inspections of selected components during maintenance. The staff reviewed the applicant's Primary Water Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff finds the applicant's response acceptable because the applicant's Water Chemistry Program and WCP Program are consistent with the "Water Chemistry" and "One-Time Inspection" programs as defined in the GALL Report, which are recommended by the GALL Report to manage the effects of loss of material for stainless steel containment isolation piping and component internal surfaces exposed to treated water.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.3.1 criteria. For those items that apply to LRA Section 3.2.2.2.3.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. This item is not applicable to KPS. See SER Section 3.2.2.1.3.

Item 3. This item is applicable to BWRs only. See SER Section 3.2.2.1.1.

Item 4. LRA Table 3.2-1, item 3.2.1-6 and LRA Section 3.2.2.2.3.4 address loss of material due to pitting and crevice corrosion in piping, piping components, and piping elements exposed to lubricating oil. The applicant stated that loss of material for stainless steel and copper alloy piping components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to crevice and pitting corrosion through examination of stainless steel and copper alloy components.

The staff reviewed LRA Section 3.2.2.2.3.4 against the criteria in SRP-LR Section 3.2.2.2.3.4, which states that loss of material due to pitting and crevice corrosion may occur in stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage loss of material due to pitting and crevice corrosion in copper alloy and stainless steel piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32. The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.2.2.2.3.4, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.3.4 criteria. For those items that apply to LRA Section 3.3.2.2.3.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 5. This item is not applicable to KPS. See SER Section 3.2.2.1.4.

Item 6. LRA Section 3.2.2.2.3.6 refers to Table 3.2.1, item 3.2.1-8 and addresses stainless steel piping exposed to internal condensation or moist air, which are being managed for loss of material due to pitting and crevice corrosion by the WCP Program.

The staff reviewed LRA Section 3.2.2.2.3.6 against the criteria in SRP-LR Section 3.2.2.2.3.6, which states that loss of material from pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to internal condensation. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in the SRP-LR BTP RSLB-1. The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19.

In its review of components associated with LRA item 3.2.1-8, the staff finds the applicant's proposal to manage aging using the WCP Program acceptable because this AMP contains appropriate inspection procedures to detect loss of material from the interior surfaces of piping and tanks. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.3.6 criteria. For those items that apply to LRA Section 3.2.2.2.3.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.4 Reduction of Heat Transfer Due to Fouling

Item 1. LRA Section 3.2.2.2.4.1 refers to Table 3.2.1, item 3.2.1-9 and addresses the reduction of heat transfer due to fouling for copper alloy heat exchanger tubes exposed to lubricating oil in the EDG system. The applicant stated that this aging effect is managed by the Lubricating Oil Analysis Program. The applicant also stated that the WCP Program will confirm the effectiveness of the Lubricating Oil Analysis Program by visually inspecting internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations.

The staff reviewed LRA Section 3.2.2.2.4.1 against the criteria in SRP-LR Section 3.2.2.2.4.1, which states that reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The GALL Report recommends the use of the Lubricating Oil Analysis Program, augmented by further evaluation to verify the effectiveness of the program to manage the effects of reduction of heat transfer due to fouling for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The SRP-LR states that the existing AMP relies on monitoring and controlling lube oil chemistry to mitigate the reduction of heat transfer due to fouling and that control of lube oil contaminants may not always be fully effective in precluding fouling. Therefore, the SRP-LR also states that the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur and notes that a one-time inspection of selected components at susceptible locations is an acceptable method for determining that this aging effect is not occurring.

The staff evaluated the applicant's Lubricating Oil Analysis Program and WCP Program and its review is documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff finds the applicant's use of the Lubricating Oil Analysis Program, in conjunction with effectiveness verification through the WCP Program, acceptable to manage the reduction of heat transfer due to fouling because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.2.2.2.4.1 and the GALL Report, (2) the Lubricating Oil Analysis Program periodically samples the oil to confirm oil quality, and (3) the WCP Program verifies effectiveness by inspecting heat transfer surfaces for fouling.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.4.1 criteria. For those items that apply to LRA Section 3.2.2.2.4.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.2.2.2.4.2 refers to Table 3.2.1, item 3.2.1-10 and addresses the reduction of heat transfer due to fouling for stainless steel heat exchanger tubes exposed to treated water in the containment vessel internal spray pump, RHR, and safety injection gland seal heat exchangers. The applicant stated that this aging effect is managed by the Primary Water Chemistry Program. The applicant further stated that the WCP Program will confirm the effectiveness of the Primary Water Chemistry Program by visually inspecting internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations.

The staff reviewed LRA Section 3.2.2.2.4.2 against the criteria in SRP-LR Section 3.2.2.2.4.2, which states that the reduction of heat transfer due to fouling may occur for stainless steel heat exchanger tubes exposed to treated water, and that management of this aging effect relies on water chemistry control. The GALL Report recommends the use of the Primary Water Chemistry Program, augmented by further evaluation to verify the effectiveness of the program to manage the effects of reduction of heat transfer due to fouling for stainless steel heat exchanger tubes exposed to treated water. As noted in the SRP-LR, since control of water chemistry may not always have been adequate to preclude fouling, the GALL Report recommends that the effectiveness of the water chemistry control program be verified to ensure that reduction of heat transfer due to fouling is not occurring. The SRP-LR notes that a one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the components' intended functions will be maintained during the period of extended operation. The staff noted the discussion in GALL AMP XI.M2, "Water Chemistry," relative to water chemistry programs being generally effective in removing impurities, except in low flow or stagnant flow areas.

The staff evaluated the applicant's Primary Water Chemistry Program and WCP Program and its review is documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff finds the applicant's use of the Primary Water Chemistry Program, in conjunction with effectiveness verification through the WCP Program, acceptable to manage the reduction of heat transfer due to fouling because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.2.2.2.4.2 and the GALL Report, (2) the Primary Water Chemistry Program periodically monitors and controls contaminants below levels known to cause a reduction in heat transfer, and (3) the WCP Program verifies effectiveness by inspecting heat transfer surfaces for fouling.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2 2.2.4.2 criteria. For those items that apply to LRA Section 3.2.2.2.4.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.5 Hardening and Loss of Strength Due to Elastomer Degradation

LRA Table 3.2.1, item 3.2.1-11 is for BWRs only, it is not applicable to KPS. See SER Section 3.2.2.1.1.

3.2.2.2.6 Loss of Material Due to Erosion

LRA Table 3.2.1, item 3.2.1-12 is not applicable to KPS. See SER Sections 3.2.2.1.1 and 3.2.2.2.6.

3.2.2.2.7 Loss of Material Due to General Corrosion and Fouling

LRA Table 3.2.1, item 3.2.1-13 is for BWRs only, it is not applicable to KPS. See SER Section 3.2.2.1.1.

3.2.2.2.8 Loss of Material Due to General, Pitting, and Crevice Corrosion

Item 1. LRA Section 3.2.2.2.8.1 and Table 3.2-1, item 3.2.1-14 are applicable to BWRs only. See SER Section 3.2.2.1.1.

Item 2. LRA Section 3.2.2.2.8.2 refers to Table 3.2.1, item 3.2.1-15 and addresses loss of material due to general, pitting, and crevice corrosion from steel containment isolation piping, piping components, and piping elements internal surfaces exposed to treated water. The applicant stated that these components are evaluated for aging management in their respective mechanical systems.

The staff reviewed LRA Section 3.2.2.2.8.2 against the criteria in SRP-LR Section 3.2.2.2.8.2, which states that loss of material due to general, pitting, and crevice corrosion could occur for the internal surfaces of steel containment isolation piping, piping components, and piping elements exposed to treated water. The GALL Report recommends the use of GALL AMP XI.M2, "Water Chemistry," augmented by further evaluation to verify the effectiveness of the program to manage the effects of aging for this component group. The GALL Report states that the existing AMP relies on monitoring and control of water chemistry to mitigate degradation and that control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. The GALL Report also states that the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program and notes that a one-time inspection of selected components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the AMR items associated with LRA Table 3.2.1, item 3.2.1-15 and the mechanical systems into which the components that are intended to be evaluated using this GALL Report item were placed. The staff noted that for some mechanical systems where stainless steel components are exposed to treated water, the LRA only credits the use of the Primary Water Chemistry Program and is not augmented by an inspection program to verify the effectiveness of the Primary Water Chemistry Program. The staff finds that if the components which were intended to be evaluated as part of this item are evaluated as part of the associated mechanical system, they may be subjected to aging management by only the Primary Water Chemistry Program and not by a combination of the Primary Water Chemistry Program and a program to verify the effectiveness of the water chemistry control program, as recommend by the GALL Report. This approach may not adequately manage aging because the effectiveness of the Primary Water Chemistry Program may not be verified in all instances deemed necessary by the GALL Report. By letter dated August 28, 2009, the staff issued RAI 3.2.2.2.8.2-1 requesting that the applicant evaluate components meeting the definition of this table, under the guidance of this table, as opposed to including these components in their parent mechanical system for evaluation.

In its response dated September 28, 2009, the applicant stated that for all of the piping and valves under consideration, when aging management is performed under the system to which the piping and valves belong, aging management will be performed in accordance with the Primary Water Chemistry and WCP programs. Subsequent review of the LRA by the staff confirmed that all items where steel containment isolation piping, piping components, and piping elements internal surfaces are exposed to treated water and subject to loss of material due to general, pitting, and crevice corrosion, are managed for aging using both the Primary Water Chemistry and WCP programs. The applicant's WCP Program encompasses GALL AMP XI.M32, "One-Time Inspection Program," and performs visual inspections of selected components during maintenance. The staff reviewed the applicant's Primary Water Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff finds the applicant's response acceptable because the applicant's Primary Water Chemistry Program and WCP Program are consistent with the "Water Chemistry" and "One-Time Inspection" programs as defined in the GALL Report, which are recommended by the GALL Report to manage the effects of loss of material for stainless steel containment isolation piping and component internal surfaces exposed to treated water.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.8.2 criteria. For those items that apply to LRA Section 3.2.2.2.8.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 3. LRA Section 3.2.2.2.8.3 and Table 3.2-1, item 3.2.1-16 address loss of material due to general, pitting, and crevice corrosion in piping, piping components, and piping elements exposed to lubricating oil. The applicant stated that loss of material for steel and cast iron piping components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, and crevice corrosion through the examination of steel and cast iron components.

The staff reviewed LRA Section 3.2.2.2.8.3 against the criteria in SRP-LR Section 3.2.2.2.8.3, which states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and the reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable of identifying these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.2.2.2.8.3, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.8.3 criteria. For those items that apply to LRA Section 3.2.2.2.8.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.9 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.2.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.2.2-1 through 3.2.2-3, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

3.2.2.3.1 Stainless Steel Components Subject to Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion Exposed to Raw Water (Internal)

LRA Table 3.2.2-2 addresses piping fabricated from stainless steel exposed to raw water (internal) subject to the loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and will require that the extent of the inspection and its results be documented even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.2.2.3.2 Loss of Material Due to General, Pitting, and Crevice Corrosion and Loss of Material Due to General, Pitting, Crevice, and Boric Acid Corrosion

LRA Table 3.2.1, item 3.2.1-33 addresses loss of material due to general, pitting, and crevice corrosion for steel encapsulation components exposed to air-indoor uncontrolled (internal). LRA Table 3.2.1, item 3.2.1-46 also addresses loss of material due to general, pitting, crevice, and boric acid corrosion for steel encapsulation components exposed to air with borated water leakage (internal).

The LRA credits the WCP Program to manage loss of material for steel valve enclosures in an air-indoor uncontrolled (internal) environment only in the safety injection system for item 3.2.1-33. The LRA credits the WCP Program to manage loss of material for steel valve enclosures in an air-moist (internal) environment only in the safety injection system for item 3.2.1-46.

For both items 3.2.1-33 and 3.2.1-46, the GALL Report recommends GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," to manage this aging effect.

By letter dated April 13, 2009, the applicant supplemented its LRA with additional information related to the WCP Program. In its letter, the applicant provided a comparison between the program elements of the WCP Program and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The staff reviewed this comparison and noted that the applicant's program will be performing periodic visual inspections of in-scope components during maintenance and surveillance activities, consistent with the recommendations of GALL AMP XI.M38.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of steel to detect loss of material. The staff further determined that this program will perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and will require that the extent of the inspection and inspection results be documented even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3.3 Loss of Material Due to Selective Leaching of Steel and Copper Components

In LRA Tables 3.2.2-2, 3.3.2-8, and 3.3.2-19, the applicant stated that steel, including gray cast iron, and copper piping, piping components and piping elements exposed to lube oil are being managed for loss of material due to selective leaching by the Selective Leaching of Materials Program. The AMR line items cite generic note H, indicating that for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel, including gray cast iron, and copper piping, piping components, and piping elements exposed to lube oil and confirmed that this aging effect does not have an entry in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Selective Leaching of Materials Program and its evaluation is documented in SER Section 3.0.3.1.12. The staff finds the applicant's currently proposed use of this AMP to manage the aging effects for these AMR line items acceptable because: (1) the applicant's program includes examinations that will determine whether loss of material due to selective leaching is occurring from a sample population, (2) the examinations being performed will consist of a visual examination supplemented by mechanical testing, such as scraping or chipping, to detect if loss of material due to selective leaching has occurred, and (3) results of the examinations will be evaluated to determine acceptability of the component, and in cases of failure to meet criteria, a suitable expansion in scope of inspection.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3.4 Loss of Material Due to Microbiologically-Influenced Corrosion for Stainless Steel and Steel

In LRA Table 3.2.2-1, the applicant stated that the stainless steel containment spray pump gland seal coolers (tubing) exposed to treated water-closed-cycle cooling (external) and steel containment spray pump gland seal coolers (shell) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.2.2-2, the applicant stated that the stainless steel safety injection pump gland seal coolers (tubing) exposed to treated water-closed-cycle cooling (external) and steel safety injection pump gland seal coolers (shell) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.2.2-3, the applicant stated that the stainless steel residual heat exchangers (tubes and tubesheet) and shaft seal heat exchangers (tubing) exposed to treated water-closed-cycle cooling (external) and steel residual heat exchanger and shaft seal heat exchanger shells exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. The applicant credited the Closed-Cycle Cooling Water System Program and the WCP Program to manage this aging effect for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff further determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program would be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined the applicant's WCP Program will manage the aging effects of loss of material through program inspections that provide verification of the effectiveness of Closed-Cycle Cooling Water System Program. The staff also determined that these inspections will be performed by using NDE techniques that are effective and capable of identifying these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. Based on its review, the staff finds the applicant's use of the programs identified above acceptable because the chemistry control will provide an environment that is not conducive for loss of material to occur and the applicant will verify the effectiveness of the chemistry control with performance monitoring and examinations performed by its WCP Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.2.2.3.5 Loss of Material Due to General, Pitting, and Crevice Corrosion for Steel

In LRA Table 3.2.2-1, the applicant stated that the steel caustic additive filter housing, caustic additive recirculation and fill pump, caustic additive standpipe, caustic additive fill tank, and piping and valves exposed to treated water-primary are being managed for loss of material due general, pitting, and crevice corrosion by the Primary Water Chemistry Program and WCP Program. The AMR line items cite generic note H, indicating that for the line items, the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Primary Water Chemistry Program and WCP Program; these evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff determined that the Primary Water Chemistry Program includes periodic monitoring and control of contaminants such as chloride, fluoride, dissolved oxygen, and sulfate concentrations below specified levels that may result in loss of material and the program also maintains water quality (pH and conductivity). The staff further determined that the applicant's program specifies sampling and analysis frequencies and corrective actions if specified limits are exceeded. The staff determined the applicant's WCP Program will manage the aging effects of loss of material through program inspections that provide verification of the effectiveness of Primary Water Chemistry Program. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable of identifying these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. Based on its review, the staff finds the applicant's use of the programs identified above acceptable because the chemistry control will provide an environment that is not conducive for loss of material to occur, and the applicant will verify the effectiveness of the chemistry control with examinations performed by its WCP Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.2.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the ESF system components within the scope of license renewal and subject to an AMR 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).

3.3 Aging Management of Auxiliary Systems

This section of the SER documents the staff's review of the applicant's AMR results for the auxiliary system components and component groups, comprised into the following systems:

- new fuel storage system
- spent fuel storage system
- spent fuel pool cooling system
- fuel handling system
- cranes (excluding fuel handling) system
- service water system
- component cooling system
- station and instrument air system
- chemical and volume control system
- control room air conditioning system
- auxiliary building air conditioning system
- auxiliary building special ventilation and steam exclusion system
- auxiliary building ventilation system
- reactor building ventilation system
- turbine building and screenhouse ventilation system
- shield building ventilation system
- technical support center ventilation system
- fire protection system
- diesel generator system
- circulating water system
- gaseous waste processing and discharge system
- liquid waste processing and discharge system
- radiation monitoring system
- makeup and demineralized water system
- service water pretreatment system
- miscellaneous drains and sumps system
- miscellaneous gas system
- potable water system
- primary sampling system

3.3.1 Summary of Technical Information in the Application

LRA Section 3.3 provides AMR results for the auxiliary system components and component groups. LRA Table 3.3.1, "Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of NUREG 1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the auxiliary system components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry OE in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry OE included a review of the GALL Report and OE issues identified since the issuance of the GALL Report.

3.3.2 Staff Evaluation

The staff reviewed LRA Section 3.3 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for auxiliary system components, within the scope of license renewal and subject to an AMR, 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).

The staff conducted an onsite audit of AMPs to confirm the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.3.2.1 and 3.3.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.3.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's OE to verify the applicant's claims.

Table 3.3-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.3 and addressed in the GALL Report.

Table 3.3-1 Staff Evaluation for Auxiliary System Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel cranes – structural girders exposed to air-indoor uncontrolled (external) (3.3.1-1)	Cumulative fatigue damage	TLAA to be evaluated for structural girders of cranes. See SRP-LR, Section 4.7 for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1)	Yes	TLAA 4.7.1	Fatigue is a TLAA (See SER Sections 3.3.2.2.1 and 4.7.1)
Steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to air-indoor uncontrolled, treated borated water or treated water (3.3.1-2)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA 4.3	Fatigue is a TLAA (See SER Sections 3.3.2.2.1 and 4.3)
Stainless steel heat exchanger tubes exposed to treated water (3.3.1-3)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution > 60 °C (140 °F) (3.3.1-4)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel and stainless clad steel heat exchanger components exposed to treated water > 60 °C (140 °F) (3.3.1-5)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-6)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes	WCP Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel non-regenerative heat exchanger components exposed to treated borated water > 60 °C (140 °F) (3.3.1-7)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water and eddy current testing of tubes.	Yes	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.4.1)
Stainless steel regenerative heat exchanger components exposed to treated borated water > 60 °C (140 °F) (3.3.1-8)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to SCC and cyclic loading. A plant-specific AMP is to be evaluated.	Yes	Primary Water Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.4.2)
Stainless steel high-pressure pump casing in PWR chemical and volume control system (CVCS) (3.3.1-9)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to SCC and cyclic loading. A plant-specific AMP is to be evaluated.	Yes	WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.4.3)
High-strength steel closure bolting exposed to air with steam or water leakage (3.3.1-10)	Cracking due to SCC and cyclic loading	Bolting Integrity. The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.2.4.4)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Elastomer seals and components exposed to air-indoor uncontrolled (internal/external) (3.3.1-11)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring Program	Consistent with the GALL Report (See SER Section 3.3.2.2.5.1)
Elastomer lining exposed to treated water or treated borated water (3.3.1-12)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP that determines and assesses the qualified life of the linings in the environment is to be evaluated.	Yes	Not applicable to KPS	Not applicable (See SER Section 3.3.2.1.1)
Boral, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water (3.3.1-13)	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	A plant-specific AMP is to be evaluated.	Yes	Plant-specific surveillance commitments for boron carbide and Boral	Consistent with the GALL Report (See SER Section 3.3.2.2.6)
Steel piping, piping components, and piping elements exposed to lubricating oil (3.3.1-14)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.7.1)
Steel RCP oil collection system piping, tubing, and valve bodies exposed to lubricating oil (3.3.1-15)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.7.1)
Steel RCP oil collection system tank exposed to lubricating oil (3.3.1-16)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank.	Yes	Fire Protection Program	Consistent with the GALL Report (See SER Section 3.3.2.2.7.1)
Steel piping, piping components, and piping elements exposed to treated water (3.3.1-17)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-18)	Loss of material/general (steel only), pitting, and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.7.3)
Steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to soil (3.3.1-19)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Yes	Buried Piping and Tanks Inspection Program	Consistent with the GALL Report (See SER Section 3.2.2.2.8)
Steel piping, piping components, piping elements, and tanks exposed to fuel oil (3.3.1-20)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion and fouling	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry Program, Fuel Oil Tank Inspections Program, and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.9.1)
Steel heat exchanger components exposed to lubricating oil (3.3.1-21)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion and fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.9.2)
Steel with elastomer lining or stainless steel cladding piping, piping components, and piping elements exposed to treated water and treated borated water (3.3.1-22)	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.2.10.1)
Stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water (3.3.1-23)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water (3.3.1-24)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external) (3.3.1-25)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.10.3)
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.3.1-26)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.10.4)
Stainless steel HVAC ducting and aluminum HVAC piping, piping components, and piping elements exposed to condensation (3.3.1-27)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.10.5)
Copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-28)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Fire Protection Program, WCP Program, and Compressed Air Monitoring Program	Consistent with the GALL Report (See SER Section 3.3.2.2.10.6)
Stainless steel piping, piping components, and piping elements exposed to soil (3.3.1-29)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Buried Piping and Tanks Inspection Program	Consistent with the GALL Report (See SER Section 3.3.2.2.10.7)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution (3.3.1-30)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy piping, piping components, and piping elements exposed to treated water (3.3.1-31)	Loss of material due to pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil (3.3.1-32)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.12.1)
Stainless steel piping, piping components, and piping elements exposed to lubricating oil (3.3.1-33)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.2.12.2)
Elastomer seals and components exposed to air-indoor uncontrolled (internal or external) (3.3.1-34)	Loss of material due to wear	A plant-specific AMP is to be evaluated.	Yes	WCP Program and External Surfaces Monitoring Program	Consistent with the GALL Report (See SER Section 3.3.2.2.13)
Steel with stainless steel cladding pump casing exposed to treated borated water (3.3.1-35)	Loss of material due to cladding breach	A plant-specific AMP is to be evaluated. Reference NRC IN 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes	Not applicable to KPS	KPS does not have centrifugal charging pumps (See SER Section 3.3.2.2.14)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated water (3.3.1-36)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.3.1-37)	Cracking due to SCC and IGSCC	BWR Reactor Water Cleanup System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.3.1-38)	Cracking due to SCC	BWR Stress-Corrosion Cracking and Water Chemistry	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel BWR spent fuel storage racks exposed to treated water > 60 °C (140 °F) (3.3.1-39)	Cracking due to SCC	Water Chemistry	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Steel tanks in diesel fuel oil system exposed to air-outdoor (external) (3.3.1-40)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	External Surfaces Monitoring Program	Consistent with the GALL Report (See SER Section 3.3.2.1.2)
High-strength steel closure bolting exposed to air with steam or water leakage (3.3.1-41)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel closure bolting exposed to air with steam or water leakage (3.3.1-42)	Loss of material due to general corrosion	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel bolting and closure bolting exposed to air-indoor uncontrolled (external) or air-outdoor (external) (3.3.1-43)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel compressed air system closure bolting exposed to condensation (3.3.1-44)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel closure bolting exposed to air-indoor uncontrolled (external) (3.3.1-45)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and stainless clad steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water > 60 °C (140 °F) (3.3.1-46)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-47)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-48)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report
Stainless steel, steel with stainless steel cladding heat exchanger components exposed to closed-cycle cooling water (3.3.1-49)	Loss of material due to microbiologically -influenced corrosion	Closed-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.3.1-50)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-51)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.3.1-52)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water Program and WCP Program	Consistent with the GALL Report
Steel compressed air system piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-53)	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	No	Compressed Air Monitoring Program	Consistent with the GALL Report
Stainless steel compressed air system piping, piping components, and piping elements exposed to internal condensation (3.3.1-54)	Loss of material due to pitting and crevice corrosion	Compressed Air Monitoring	No	Compressed Air Monitoring Program	Consistent with the GALL Report
Steel ducting closure bolting exposed to air-indoor uncontrolled (external) (3.3.1-55)	Loss of material due to general corrosion	External Surfaces Monitoring	No	Bolting Integrity Program	Consistent with the GALL Report
Steel HVAC ducting and components external surfaces exposed to air-indoor uncontrolled (external) (3.3.1-56)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping and components external surfaces exposed to air-indoor uncontrolled (external) (3.3.1-57)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report
Steel external surfaces exposed to air-indoor uncontrolled (external), air-outdoor (external), and condensation (external) (3.3.1-58)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report (Two exceptions are covered in SER Section 3.3.2.23)
Steel heat exchanger components exposed to air-indoor uncontrolled (external) or air-outdoor (external) (3.3.1-59)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to air-outdoor (external) (3.3.1-60)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report
Elastomer fire barrier penetration seals exposed to air-outdoor or air-indoor uncontrolled (3.3.1-61)	Increased hardness, shrinkage, and loss of strength due to weathering	Fire Protection	No	Fire Protection Program	Consistent with the GALL Report
Aluminum piping, piping components, and piping elements exposed to raw water (3.3.1-62)	Loss of material due to pitting and crevice corrosion	Fire Protection	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Steel fire-rated doors exposed to air-outdoor or air-indoor uncontrolled (3.3.1-63)	Loss of material due to wear	Fire Protection	No	Fire Protection Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to fuel oil (3.3.1-64)	Loss of material due to general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-indoor uncontrolled (3.3.1-65)	Concrete cracking and spalling due to aggressive chemical attack and reaction with aggregates	Fire Protection and Structures Monitoring	No	Fire Protection Program and Structures Monitoring Program	Consistent with the GALL Report
Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-outdoor (3.3.1-66)	Concrete cracking and spalling due to freeze thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring	No	Fire Protection Program and Structures Monitoring Program	Consistent with the GALL Report
Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-outdoor or air-indoor uncontrolled (3.3.1-67)	Loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring	No	Fire Protection Program and Structures Monitoring Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to raw water (3.3.1-68)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion and fouling	Fire Water System	No	Fire Protection Program and External Surfaces Monitoring Program	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-69)	Loss of material due to pitting and crevice corrosion and fouling	Fire Water System	No	Fire Protection Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-70)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion and fouling	Fire Water System	No	Fire Protection Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to moist air or condensation (internal) (3.3.1-71)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	WCP Program, Compressed Air Monitoring Program, and Fire Protection Program	Consistent with the GALL Report (See SER Sections 3.3.2.1.3 and 3.3.2.1.4)
Steel HVAC ducting and components internal surfaces exposed to condensation (internal) (3.3.1-72)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically -influenced corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.1.4)
Steel crane structural girders in load handling system exposed to air-indoor uncontrolled (external) (3.3.1-73)	Loss of material due to general corrosion	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Inspection of Overhead Heavy Load and Refueling Handling Systems Program	Consistent with the GALL Report
Steel cranes – rails exposed to air-indoor uncontrolled (external) (3.3.1-74)	Loss of material due to wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Inspection of Overhead Heavy Load and Refueling Handling Systems Program	Consistent with the GALL Report
Elastomer seals and components exposed to raw water (3.3.1-75)	Hardening and loss of strength due to elastomer degradation; loss of material due to erosion	Open-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.3.2.3.29)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements (without lining/coating or with degraded lining/coating) exposed to raw water (3.3.1-76)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion, fouling, and lining/coating degradation	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program and Compressed Air Systems Monitoring Program	Consistent with the GALL Report
Steel heat exchanger components exposed to raw water (3.3.1-77)	Loss of material due to general, pitting, crevice, galvanic, and microbiologically -influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report
Stainless steel, Ni-alloy, and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-78)	Loss of material due to pitting and crevice corrosion	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-79)	Loss of material due to pitting and crevice corrosion and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-80)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Open-Cycle Cooling Water System	No	Structures Monitoring Program	Consistent with the GALL Report
Copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-81)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy heat exchanger components exposed to raw water (3.3.1-82)	Loss of material due to pitting, crevice, galvanic, and microbiologically -influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report
Stainless steel and copper alloy heat exchanger tubes exposed to raw water (3.3.1-83)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Program	Consistent with the GALL Report
Copper alloy > 15% Zn piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed-cycle cooling water (3.3.1-84)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials Program	Consistent with the GALL Report
Gray cast iron piping, piping components, and piping elements exposed to soil, raw water, treated water, or closed-cycle cooling water (3.3.1-85)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials Program	Consistent with the GALL Report
Structural steel (new fuel storage rack assembly) exposed to air-indoor uncontrolled (external) (3.3.1-86)	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring Program	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water (3.3.1-87)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Aluminum and copper alloy > 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.3.1-88)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Steel bolting and external surfaces exposed to air with borated water leakage (3.3.1-89)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Stainless steel and steel with stainless steel cladding piping, piping components, piping elements, tanks, and fuel storage racks exposed to treated borated water > 60 °C (140 °F) (3.3.1-90)	Cracking due to SCC	Water Chemistry	No	WCP Program, Primary Water Chemistry Program, and ASME Section XI ISI (IWB, IWC, and IWD) Program	Consistent with the GALL Report (See SER Section 3.3.2.1.5)
Stainless steel and steel with stainless steel cladding piping, piping components, and piping elements exposed to treated borated water (3.3.1-91)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	WCP Program and Primary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.3.2.1.7)
Galvanized steel piping, piping components, and piping elements exposed to air-indoor uncontrolled (3.3.1-92)	None	None	No	None	Consistent with the GALL Report (See SER Section 3.3.2.1.6)
Glass piping elements exposed to air, air-indoor uncontrolled (external), fuel oil, lubricating oil, raw water, treated water, and treated borated water (3.3.1-93)	None	None	No	None	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.3.1-94)	None	None	No	None	Consistent with the GALL Report
Steel and aluminum piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.3.1-95)	None	None	No	None	Consistent with the GALL Report
Steel and stainless steel piping, piping components, and piping elements in concrete (3.3.1-96)	None	None	No	None	Consistent with the GALL Report
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.3.1-97)	None	None	No	None	Consistent with the GALL Report
Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to dried air (3.3.1-98)	None	None	No	None	Consistent with the GALL Report
Stainless steel and copper alloy < 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.3.1-99)	None	None	No	None	Consistent with the GALL Report

The staff's review of the auxiliary system component groups followed several approaches. One approach, documented in SER Section 3.3.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.3.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.3.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with, or not addressed, in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the auxiliary system components is documented in SER Section 3.0.3.

3.3.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.3.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the auxiliary system components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Bolting Integrity Program
- Boric Acid Corrosion Program
- Buried Piping and Tanks Inspection Program
- Closed-Cycle Cooling Water System Program
- Compressed Air Monitoring Program
- External Surfaces Monitoring Program
- Fire Protection Program
- Fuel Oil Chemistry Program
- Fuel Oil Tanks Inspection Program
- Inspection of Overhead Heavy Load and Refueling Handling Systems Program
- Lubricating Oil Analysis Program
- Open-Cycle Cooling Water System Program
- Primary Water Chemistry Program
- Secondary Water Chemistry Program
- Selective Leaching of Materials Program
- Work Control Process Program

LRA Tables 3.3.2-1 through 3.3.2-29 summarize AMRs for the auxiliary system components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item describing how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report and that it had reviewed and accepted the identified exceptions to the GALL

Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review, and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report. The staff confirmed whether the AMR line item of the different component was applicable to the component under review and whether the exceptions to the GALL Report AMPs had been reviewed and accepted by the staff. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff reviewed these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report, and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the auxiliary systems' components that are subject to an AMR.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.3.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

3.3.2.1.1 AMR Results Identified as Not Applicable

LRA Table 3.3.1, items 3.3.1-3, 3.3.1-4, 3.3.1-5, 3.3.1-17, 3.3.1-23, 3.3.1-24, 3.3.1-30, 3.3.1-31, 3.3.1-36 through -39, and 3.3.1-49 discuss the applicant's determination on GALL AMR items that are applicable only to BWR-designed reactors. In the applicant's AMR discussions for these items, no additional information is provided. The staff confirmed that these AMR items in Table 1 of the GALL Report, Volume 1 are only applicable to BWR-designed reactors, and that KPS is a PWR with a dry ambient containment. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding that AMR items 3.3.1-3, 3.3.1-4, 3.3.1-5, 3.3.1-17, 3.3.1-23, 3.3.1-24, 3.3.1-30, 3.3.1-31, 3.3.1-36 through -39, and 3.3.1-49 in Table 1 of the GALL Report, Volume 1 are not applicable to KPS.

LRA Table 3.3.1, item 3.3.1-12 addresses elastomer lined components in the SFP cooling system exposed to treated water or treated borated water. The GALL Report recommends that a plant-specific AMP be evaluated to determine and assess the qualified life of the linings in the environment to ensure that these aging effects are adequately managed due to hardening and loss of strength for this component group. The applicant stated that this item is not applicable because there are no in-scope lined components exposed to treated water or treated borated water in its SFP cooling and cleanup system. The staff reviewed LRA Sections 2.3.1 and 3.3 and confirmed that the applicant's LRA does not have any AMR results for the spent fuel system that include elastomer lined components exposed to treated water or treated borated water. The staff also noted that a search of the applicant's USAR failed to find any evidence of elastomer lined components in the SFP cooling or cleanup systems. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope elastomer lined components exposed to treated water or treated borated water in the spent fuel cooling and cleanup system and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, item 3.3.1-62 addresses aluminum piping, piping components, and piping elements exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M26, "Fire Protection," to manage loss of material due to pitting and crevice corrosion for this component group. The applicant stated that this item is not applicable because the applicant's fire protection system does not contain aluminum piping, piping components, and piping elements exposed to raw water. The staff reviewed LRA Sections 2.3 and 3.3 and confirmed that the applicant's LRA does not have any AMR results for the fire protection system that include aluminum piping, piping components, and piping elements exposed to raw water. The staff also noted that a search of the applicant's USAR did not find any evidence of aluminum piping, piping components, and piping elements in the fire protection systems exposed to raw water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope aluminum piping, piping components, and piping elements exposed to raw water in the fire protection systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, item 3.4.1-64 addresses steel piping, piping components, and piping elements exposed to fuel oil. The GALL Report recommends the use of GALL AMP XI.M26, "Fire Protection," and GALL AMP XI.M30, "Fuel Oil Chemistry," to manage loss of material due to pitting and crevice corrosion for this component group. The applicant stated that this item is not applicable because the applicant's fire protection system does not contain steel piping, piping components, and piping elements exposed to fuel oil. The staff reviewed LRA Sections 2.3 and 3.3 and confirmed that the applicant's LRA does not have any AMR results for the fire protection system that include steel piping, piping components, and piping elements exposed to fuel oil. The staff also noted that a search of the applicant's USAR did not find any evidence of steel piping, piping components, and piping elements in the fire protection systems exposed to fuel oil. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel piping, piping components, and piping elements exposed to fuel oil in the fire protection systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, item 3.3.1-86 refers to a loss of material due to general, pitting, and crevice corrosion for structural steel in new fuel storage rack assemblies exposed to air-indoor uncontrolled (external). The applicant stated that this item is not applicable because the new fuel storage rack assemblies are composed of stainless steel. The staff reviewed LRA

Sections 2.3.1 and 3.3, and the applicant's USAR, and confirmed the applicant's statement. Based on its review of the LRA and USAR, the staff finds the applicant's determination acceptable.

LRA Table 3.3.1, item 3.3.1-87 refers to a reduction of neutron-absorbing capacity due to boraflex degradation in spent fuel storage rack neutron-absorbing sheets composed of boraflex and exposed to treated borated water. The applicant stated that this item is not applicable because there is no boraflex in the spent fuel storage racks. The applicant uses boron carbide and Boral for neutron absorption. The staff reviewed LRA Sections 2.3.1 and 3.3, and the applicant's USAR, and confirmed the applicant's statement. Based on its review of the LRA and USAR, the staff finds the applicant's determination acceptable.

3.3.2.1.2 Loss of Material Due to General, Pitting, and Crevice Corrosion in Diesel Generator Expansion Tanks

LRA Table 3.3.1, item 3.3.1-40 and associated AMRs in LRA Table 3.3.2-19 address loss of material due to general, pitting, and crevice corrosion in the diesel generator expansion tanks surfaces exposed to outdoor air.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for the diesel generator expansion tanks. The GALL Report recommends GALL AMP XI.M29, "Aboveground Steel Tanks," to manage this aging effect. The AMR item in Table 3.3.2-19, that references GALL Report Table 3, item 40, cites generic note A, indicating that the AMR item is consistent with the GALL Report component, material, environment, aging effect, and AMP. The staff noted that the correct generic note reference should have been E.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff reviewed the applicant's AMR item associated with item 3.3.1-40 and noted that the applicant credited GALL Report AMR item VII.H1-11 in LRA Table 3.3.2-19. The GALL Report recommends using GALL AMP XI.M29, "Aboveground Steel Tanks," to manage this aging effect.

The staff noted that there are differences between GALL AMP XI.M36, "External Surfaces Monitoring," and GALL AMP XI.M29, "Aboveground Steel Tanks." GALL AMP XI.M36 is a condition based monitoring program, while GALL AMP XI.M29 is a preventive maintenance program. Both GALL AMPs XI.M36 and XI.M29 include visual inspections and periodic walkdowns, with sampling allowed. GALL AMP XI.M29 recommends caulking or sealant be applied to the perimeter of the interface between the tank and its slab or foundation. In contrast, GALL AMP XI.M36 includes no preventive measures against corrosion. In the "parameters monitored or inspected" program element, GALL AMP XI.M29 recommends the inspection of caulking and sealant while GALL AMP XI.M36 discusses inspection of bare surfaces, paint, and insulation. In addition to differences in the visual inspections, GALL AMP XI.M29 also recommends UT to determine the thickness of the tank bottom, when the tank bottom is in contact with the ground to ensure significant degradation is not occurring. By letter dated December 3, 2009, the staff issued RAI 3.3.2.1-1 requesting that the applicant identify the location of the expansion tanks, including type of foundation, accessibility of the tanks for full visual inspections, and frequency of those inspections.

In its response dated January 21, 2010, the applicant stated that the expansion tanks include the jacket water expansion tanks for the EDG and for the TSC diesel generator. The applicant also stated that, for the EDG, the tank is located about 8 feet above the skid of the diesel generator in the basement of the administration building. For the TSC diesel generator, the jacket water expansion tank is located on a steel frame about 7 feet above the roof of the TSC building. The applicant further stated that both diesel generators are operated on a monthly basis to satisfy technical and surveillance requirements, during which time an external visual examination is conducted.

The staff finds the applicant's response acceptable because the expansion tanks are elevated and, therefore, do not have foundations where moisture collection would be a concern. The staff finds that the inspection performed, in accordance with the External Surfaces Monitoring Program, is consistent with the GALL Report recommendations for aboveground steel tanks that are not in contact with the soil or concrete. The staff's concern described in RAI 3.3.2.1-1 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.3 Loss of Material Due to General, Pitting, and Crevice Corrosion

LRA Table 3.3.1, item 3.3.1-71 addresses loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to moist air or condensation (internal).

The LRA credits the Fire Protection Program to manage this aging effect for steel CO_2 storage tank, Halon cylinders, odorizers, and retarding chambers in LRA Table 3.3.2-18. The LRA credits the Compressed Air Monitoring program to manage this aging effect for steel air dryers, compressor casings, filter housings, piping, traps, and valves in Table 3.3.2-19. The GALL Report recommends GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," to manage this aging effect. The AMR items that reference this item cite generic note E, indicating that the AMR items are consistent with the GALL Report material, environment, and aging effect, but a different AMP is credited. The staff noted that for one AMR item, the applicant referenced generic note A. The staff noted that this was a typographical error and, by letter dated January 21, 2010, the applicant amended its LRA to state that these items cite generic note E.

GALL AMP XI.M38 recommends periodic visual inspections of the internal surface of components when accessible during performance of maintenance or surveillance activities. The staff noted that the steel CO_2 storage tank, Halon cylinders, odorizers, and retarding chambers are in the Halon and CO_2 fire protection system. The staff reviewed the Fire Protection Program, which provides for periodic visual inspection and performance testing of the Halon and CO_2 system components for managing loss of material due to corrosion. The staff's review of the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. On the basis that periodic visual inspections are performed, the staff finds that the Fire Protection Program will adequately manage loss of material due to general, pitting, and crevice corrosion of fire protection system steel Halon and CO_2 components exposed to an air-moist internal environment during the period of extended operation.

GALL AMP XI.M38 recommends periodic visual inspections of the internal surface of components when accessible during performance of maintenance or surveillance activities. The staff noted that the steel air dryers, compressor casings, filter housings, piping, traps, and valves are in the air starting subsystem for the EDGs, so the applicant has proposed the Compressed Air Monitoring Program. The staff reviewed the Compressed Air Monitoring Program, which includes periodic visual inspections of internal surfaces of air dryers, compressor casings, filter housings, piping, traps, and valves for loss of material due to corrosion, for monitoring of system air quality in accordance with industry standards and guidelines. The staff's review of the Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.6. On the basis that periodic visual inspections of internal surfaces of air dryers, compressor casings, filter housings, piping, traps, and valves are performed, the staff finds that the Compressed Air Monitoring Program will adequately manage loss of material due to general, pitting, and crevice corrosion of instrument and control air system steel air dryers, compressor casings, filter housings, piping, traps, and valves exposed to an air-moist internal environment through the period of extended operation.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.4 Loss of Material Due to General, Pitting, and Crevice Corrosion and (For Drip Pans and Drain Lines) Due to Microbiologically-Influenced Corrosion

LRA Table 3.3.1, item 3.3.1-71 addresses loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to moist air or condensation (internal). LRA Table 3.3.1, item 3.3.1-72 also addresses loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically-influenced corrosion for steel HVAC ducting and components internal surfaces exposed to condensation (internal).

The LRA credits the WCP Program to manage the respective aging effect for steel components in an air-moist (internal or external) environment only in the following systems for item 3.3.1-71:

- diesel generator system
- fire protection system
- gaseous waste processing and discharge system
- liquid waste processing and discharge system
- miscellaneous drains and sumps system
- miscellaneous gas system
- reactor building ventilation system
- shield building ventilation system

The LRA also credits the WCP Program to manage the respective aging effect for steel components in an air-moist (internal or external) environment only in the following systems for item 3.3.1-72:

- auxiliary building air conditioning system
- auxiliary building special ventilation and steam exclusion system
- auxiliary building ventilation system
- control room air conditioning system
- reactor building ventilation system

- technical support center ventilation system
- turbine building and screenhouse ventilation system

For both items 3.3.1-71 and 3.3.1-72, the GALL Report recommends GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," to manage this aging effect.

By letter dated April 13, 2009, the applicant supplemented its LRA with additional information related to the WCP Program. The applicant provided a comparison between the program elements of the WCP Program and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The staff reviewed this comparison and noted that the applicant's program will be performing periodic visual inspections of in-scope components during maintenance and surveillance activities, consistent with the recommendations of GALL AMP XI.M38.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of steel in order to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and inspection results be documented, even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.5 Cracking Due to Stress-Corrosion Cracking

LRA Table 3.3.1, item 3.3.1-90 describes the cracking due to SCC of austenitic stainless steel components, from the auxiliary systems, that were exposed to treated borated water greater than 60 °C (140 °C). The AMR items corresponding to item 3.3.1-90 include piping/tubing, piping elements, tanks, evaporator, distillate cooler, evaporator condenser, excess letdown heat exchanger, feed preheater, seal water heat exchanger, and valves in the CVCS (Table 3.3.2-9) and tubing, valves, filter housings, flow indicators, and sample heat exchangers in the primary sampling system (Table 3.3.2-29). The applicant stated that the cracking due to SCC of these stainless steel components is managed by the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program; the WCP Program, which is a plant-specific program; and the Primary Water Chemistry Program. The applicant further stated that the program is consistent with the GALL Report.

The staff reviewed LRA item 3.2.1-90 in comparison with the GALL Report Volume 1, Table 3, ID 90. In its review, the staff found that the LRA AMR items were consistent with the GALL Report in component, material, environment, and aging effect. The staff noted that for these AMR items, the GALL Report recommends GALL AMP XI.M2, "Water Chemistry," to manage the effects of cracking due to SCC. Consequently, the applicant's program is consistent with the GALL Report and, therefore, acceptable. However, the generic notes in Tables 3.3.2-9 and 3.3.2-29 are confusing. Note A is listed for the Primary Water Chemistry Program and note E is listed for the WCP Program. Consistency note A means that the program is consistent with the GALL Report because the Primary Water Chemistry Program is used to manage the aging effects, whereas note E means that a different program, the WCP Program, is being credited to manage the aging effects. For these items, the use of the WCP Program should be considered an additional program that provides inspection capabilities beyond what is specified in the GALL Report. The staff finds that the AMP proposed by the applicant is at least as comprehensive as that recommended in the GALL Report.

The staff concludes that the applicant has demonstrated that the effects of aging for these components 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).

3.3.2.1.6 Galvanized Steel Piping, Piping Components, and Piping Elements Exposed to Air-Indoor Uncontrolled

LRA Table 3.3.1, item 3.3.1-92 addresses galvanized steel piping, piping components, and piping elements exposed to air-indoor uncontrolled and states that there are no aging effects or mechanisms, and no AMP is recommended. The GALL Report, Table VII, item VII.J-6 (AP-13) recommends that there is no aging effect or aging mechanism and that no AMP is recommended for this component group and, therefore, the staff finds the applicant's determination acceptable.

3.3.2.1.7 Loss of Material Due to Pitting and Crevice Corrosion of Stainless Steel Piping, Piping Components, Piping Elements, and Steel with Stainless Steel Cladding Exposed to Treated Borated Water

LRA Table 3.3.1, item 3.3.1-91 addresses stainless steel piping, piping components, piping elements, and steel with stainless steel cladding exposed to treated borated water which are being managed for loss of material due to pitting and crevice corrosion. The LRA credits the

Primary Water Chemistry Program and WCP Program to manage this aging effect for this component group. The GALL Report recommends GALL AMP XI.M2, "Water Chemistry," to ensure that these aging effects are adequately managed. In Table 3.3.1, the applicant assigned each component two items, one in which the Primary Water Chemistry Program is credited and another in which the WCP Program is credited. The applicant stated that all the items for which the Primary Water Chemistry Program is credited are fully consistent with the GALL Report, citing generic note A. The applicant also stated that all the items for which the WCP Program is credited are consistent with the GALL Report in all respects except a different AMP is credited, citing generic note E.

The staff reviewed the applicant's Primary Water Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. In its review of components associated with item 3.3.1-91 assigned generic note E, the staff noted that the GALL Report does not recommend that the effectiveness of the Primary Water Chemistry Program be confirmed by an inspection program. The staff also noted that the applicant proposed to manage the aging of the components under consideration using the Primary Water Chemistry Program, as is recommended by the GALL Report. In addition, the applicant proposed to use the WCP Program, which is an inspection program, to supplement the Primary Water Chemistry Program, in excess of the recommendations in the GALL Report. The staff finds that the AMPs proposed by the applicant are in excess of those recommended by the GALL Report and are, therefore, acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.8 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion, Fouling, and Lining-Coating Degradation of Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

LRA Table 3.3.1, item 3.3.1-76 addresses steel piping, piping components, and piping elements exposed to raw water which are being managed for loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, fouling, and lining-coating degradation by the Open-Cycle Cooling Water System, WCP, and Compressed Air Monitoring programs. The applicant cited two generic notes: (1) generic note B indicating that the items are consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP; and (2) generic note E indicating that the item is consistent with the GALL Report item for material, environment, and aging effect, but a different AMP is credited.

The staff reviewed all AMR result items in the GALL Report where the material and component type is steel piping, piping components, and piping elements exposed to raw water and noted that the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage the aging effects of loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, fouling, and lining/coating degradation.

The staff reviewed the applicant's Open-Cycle Cooling Water System, WCP, and Compressed Air Monitoring programs and its evaluations are documented in SER Sections 3.0.3.2.14, 3.0.3.2.19, and 3.0.3.2.6, respectively. The LRA credits the Open-Cycle Cooling Water System Program for safety-related generic note B items. In its review of components associated with

LRA item 3.3.1-76, for which the applicant assigned generic note B, the staff noted that the AMP recommended by the GALL Report is intended for use with coated or lined components, while at least some of the components under consideration are unlined. The staff also noted that the inspection procedures and intervals recommended in the GALL Report may be inadequate because unlined steel components exposed to raw water are expected to corrode at a much higher rate than lined components. The staff previously identified this issue in its audit of the applicant's Open-Cycle Cooling Water Program and issued RAI B2.1.23-1 by letter dated July 13, 2009. In its response dated August 17, 2009, the applicant addressed components of its program which are designed to account for the higher corrosion rate expected for unlined piping. The staff found the applicant's response acceptable and its evaluation is found in SER Section 3.0.3.2.14.

The LRA credits the Compressed Air Monitoring Program for one item in LRA Table 3.3.2-19, consisting of traps in the diesel generator system, citing generic note E. Given that the components are listed as traps and are associated with the diesel generator air system, their inclusion in the compressed air system is reasonable. The staff finds the applicant's use of the Compressed Air Monitoring Program to manage the aging of these components acceptable because this program is a multifaceted program which will both mitigate and detect corrosion on the internal surfaces of traps.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.9 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion of Stainless Steel and Copper Piping, Piping Components, and Piping Elements Exposed to Raw Water

LRA Table 3.3.1, item 3.3.1-80 addresses stainless steel and copper piping, piping components, and piping elements exposed to raw water which are being managed for loss of material due to pitting, crevice, and microbiologically-influenced corrosion by the WCP and Structures Monitoring programs. The applicant cited generic note E indicating that the item is consistent with the GALL Report item for material, environment, and aging effect, but a different AMP is credited.

The staff reviewed all AMR result items in the GALL Report where the material and component type is stainless steel and copper piping, piping components, and piping elements exposed to raw water and noted that the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to monitor the aging effects of loss of material due to pitting, crevice, and microbiologically-influenced corrosion.

The staff reviewed the applicant's WCP and Structures Monitoring programs and its evaluations are documented in SER Sections 3.0.3.2.19 and 3.0.3.2.18, respectively. In its review of LRA item 3.3.1-80, the staff noted that there are two items associated with this LRA item that cite generic note E, which are sumps in the RCV system (LRA Table 3.5.2-1) and trash grills anchorage in the intake structure system (LRA Table 3.5.2-11). The staff finds the use of the Structures Monitoring Program acceptable for the sumps in the RCV system because the sumps addressed in LRA Table 3.5.2-1 are structural and these sumps would not benefit from the aging management activities contained in the Open-Cycle Cooling Water Program other than by visual inspection, which is included in the Structures Monitoring Program. It is not, however, clear to the staff that the trash grills anchorage addressed in LRA Table 3.5.2-11 would not benefit from the aging management activities associated with the Open-Cycle Cooling Water Program. For example, it is not clear to the staff that an accumulation of mussels or clams on these anchorages would not obstruct water flow to the trash grills. It is, therefore, not clear to the staff that these anchors should not be subject to biocide applications and detailed inspections for the presence of biofouling organisms, as contained in the Open-Cycle Cooling Water Program. By letter dated January 4, 2010, the staff issued RAI 3.3.2.1-3 requesting that the applicant provide sufficient information concerning the configuration of the trash grills anchorage to permit the staff to conclude that issues associated with biofouling or other degradation issues, addressed by the Open-Cycle Cooling Water Program but not addressed by the Structures Monitoring Program, are not significant or propose to manage this aging using the Open-Cycle Cooling Water or equivalent AMP.

In its response dated February 2, 2010, the applicant stated that:

> The trash grilles and their anchorage are associated with the Intake Structure. As described in the LRA Section 2.4.2.10, the intake structure is located approximately 1,600 feet from the shore of Lake Michigan at a water depth of 15 feet. The Intake Structure consists of a submerged cluster of three 22-foot diameter steel inlet cones and trash grilles. The inlet cones are installed with the upper end located one foot above the lake bottom. The trash grilles are located at the top of each cone in a horizontal configuration. The trash grilles are anchored to, and supported by, a reinforced concrete ring foundation that is constructed on the outside perimeter of each inlet cone. The reinforced concrete ring foundation is supported by select riprap laid below the lakebed. The trash grille anchorage consists of stainless steel anchor bolts, with one end embedded in the ring foundation and the other end fastened to the top of the trash grille.
>
> The Structures Monitoring Program, described in LRA Appendix B, Section B2.1.31, manages the aging effects of the inlet cones, the trash grilles, and the trash grille anchorage as indicated in LRA Table 3.5.2-11. The Structures Monitoring Program provides for periodic underwater visual inspection and cleaning of these structural elements. The program inspects for loss of material and the accumulation of biofouling, including zebra mussels and other organic macro-fouling. Additionally, since the trash grille anchorage is located on the outside perimeter of the inlet cones, an accumulation of bio-fouling on the anchorages will not obstruct water flow into the trash grilles and inlet cones. Biocide applications would be impractical at this location and would provide no additional benefit beyond the visual inspections performed by the Structures Monitoring Program.

The staff finds the applicant's proposed AMP acceptable because the Structures Monitoring Program inspects for the accumulation of biofouling material, in addition to loss of material, and biocide applications would not be effective at the location of the intake structure due to dilution into Lake Michigan.

For line items for which the applicant cited generic note H, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment.

The staff finds the applicant's proposal acceptable because the applicant has: (1) identified an applicable aging effect, (2) selected an AMP with an appropriate scope for the component under consideration, and (3) chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.3.2.2 provides further evaluation of aging management, as recommended by the GALL Report, for the auxiliary system components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- reduction of heat transfer due to fouling
- cracking due to SCC
- cracking due to SCC and cyclic loading
- hardening and loss of strength due to elastomer degradation
- reduction of neutron-absorbing capacity and loss of material due to general corrosion
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion
- loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling
- loss of material due to pitting and crevice corrosion
- loss of material due to pitting, crevice, and galvanic corrosion
- loss of material due to pitting, crevice, and microbiologically-influenced corrosion
- loss of material due to wear
- loss of material due to cladding breach

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine whether they adequately address those issues. In addition, the staff reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.3.2.2. The staff's review of the applicant's further evaluation follows.

3.3.2.2.1 Cumulative Fatigue Damage

Fatigue is an age-related degradation mechanism caused by cyclic stressing of a component by either mechanical or thermal stresses. LRA Section 3.3.2.2.1 states that TLAAs are evaluated in accordance with 10 CFR 54.21(c)(1) and that the evaluations of this TLAA are addressed in Sections 4.3 and 4.7.1. This is consistent with SRP-LR Section 3.3.2.2.1 and is, therefore, acceptable.

3.3.2.2.2 Reduction of Heat Transfer Due to Fouling

LRA Section 3.3.2.2.2 and Table 3.3.1, item 3.3.1-3 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

3.3.2.2.3 Cracking Due to Stress-Corrosion Cracking

Item 1. LRA Section 3.3.2.2.3.1 and Table 3.3.1, item 3.3.1-4 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

Item 2. LRA Section 3.3.2.2.3.2 and Table 3.3.1, item 3.3.1-5 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

Item 3. LRA Section 3.3.2.2.3.3 refers to Table 3.3-1, item 3.3.1-6 and addresses cracking due to SCC in stainless steel diesel engine exhaust piping, piping components, and piping elements. The LRA states that cracking due to SCC is managed by the WCP Program. The applicant stated that this program includes visual inspections of the internal surfaces of the diesel engine exhaust piping on a recurring basis.

The staff reviewed LRA Section 3.3.2.2.3.3 against the criteria in SRP-LR Section 3.3.2.2.3.3, which states that cracking due to SCC may occur in stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in the SRP-LR, BTP RLSB-1.

The staff reviewed the applicant's WCP Program and its review is documented in SER Section 3.0.3.1.19. The applicant stated that visual inspections will be performed on the internal surfaces of the diesel exhaust piping components during opportunities provided by the WCP Program. However, the staff noted that the applicant did not describe how cracking due to SCC would be identified by the WCP Program. Specifically, the applicant did not define what type of visual inspection will be performed to manage this aging effect. By letter dated December 3, 2009, the staff issued RAI 3.3.2.2.3.3-1 requesting additional information on the frequency and type of inspections performed by the WCP Program.

In its response dated January 21, 2010, the applicant stated that surveillance and maintenance activities for diesel exhaust gas components will be identified and internal surface inspections will be performed for each material and environment combination managed by the WCP Program. The applicant also stated that the stainless steel diesel generator exhaust flexible connections will be components that are selected for periodic enhanced VT-1 inspections to monitor for evidence of cracking in the interior surfaces of the components under the periodic condition monitoring basis of the WCP Program. The staff finds this response acceptable because the stainless steel diesel engine exhaust piping exposed to diesel exhaust will be internally inspected by visual examination as part of the WCP Program. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and documented in SER Section 3.3.2.2.13. The staff's concern described in RAI 3.3.2.2.3.3-1 is resolved.

The staff finds use of the WCP Program to manage the aging effect of cracking acceptable because: (1) it is consistent with the recommendation in SRP-LR Section 3.3.2.2.3.3 that a plant-specific AMP be used to manage cracking in stainless steel diesel engine exhaust piping components, and (2) the applicant will periodically examine the internal surfaces of the stainless steel diesel exhaust gas components and flexible connections using an enhanced VT-1 under the WCP Program, which is an appropriate method to detect cracking.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.3.3 criteria. For those items that apply to LRA Section 3.3.2.2.3.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.4 Cracking Due to Stress-Corrosion Cracking and Cyclic Loading

Item 1. LRA Section 3.3.2.2.4.1 refers to Table 3.3.1, item 3.3.1-07 and addresses cracking due to SCC in stainless steel components in the non-regenerative heat exchanger exposed to treated borated water greater than 60 °C (140 °F). The applicant stated that this aging effect is managed by the Primary Water Chemistry Program. In addition, the applicant stated that the effectiveness of that program is confirmed by the WCP Program, by: (1) monitoring the temperature, radioactivity, and surge tank level of the component cooling system, which cools the letdown heat exchanger and (2) taking corrective actions if designated thresholds are exceeded.

The staff reviewed LRA Section 3.3.2.2.4.1 against the criteria in SRP-LR Section 3.3.2.2.4.1, which states that cracking could occur in stainless steel components in the non-regenerative heat exchanger exposed to treated borated water greater than 60 °C (140 °F). The GALL Report recommends the use of the water chemistry program augmented by a plant-specific verification program to manage the effects of cracking due to SCC in stainless steel components in non-regenerative heat exchangers exposed to treated borated water greater than 60 °C (140 °F). The SRP-LR states that although the existing AMP relies on monitoring and control of primary water chemistry to manage cracking due to SCC, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The SRP-LR also states that an acceptable verification program includes monitoring of the shell side water temperature and radioactivity, and eddy current testing of heat exchanger tubes.

The staff evaluated the applicant's Primary Water Chemistry Program and WCP Program and its review is documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff noted that the effectiveness of the Primary Water Chemistry Program is verified through the WCP

Program, which will manage the aging effects of cracking through inspections using NDE techniques that have been determined to be effective for the identification of these potential aging effects. The staff also noted that in the event the temperature, radioactivity, or surge tank level of the component cooling system exceeds a designated threshold, the applicant will initiate corrective action to evaluate the cause and extent of the condition. The staff finds the applicant's use of the Primary Water Chemistry Program, in conjunction with effectiveness verification through the WCP Program, acceptable to manage cracking due to SCC because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.3.2.2.4.1 and the GALL Report, (2) the Primary Water Chemistry Control Program periodically monitors and controls contaminants below levels known to result in cracking, and (3) the WCP Program verifies effectiveness by monitoring designated operational parameters and performing NDE inspections.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.4.1 criteria. For those items that apply to LRA Section 3.3.2.2.4.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.3.2.2.4.2 refers to Table 3.3-1, item 3.3.1-8 and addresses cracking due to SCC in stainless steel components of the regenerative heat exchanger that are exposed to treated borated water greater than 60 °C (140 °F). This section states that the aging effect is managed by the Primary Water Chemistry Program and that the effectiveness of this program is verified by the WCP Program, which will verify the absence of cracking through visual inspections of components fabricated of the same materials in similar environments.

The staff reviewed LRA Section 3.3.2.2.4.2 against the criteria in SRP-LR Section 3.3.2.2.4.2, which states that cracking could occur in stainless steel components in the regenerative heat exchanger exposed to treated borated water greater than 60 °C (140 °F). The GALL Report recommends the use of the water chemistry program augmented by a plant-specific verification program to manage the effects of cracking in stainless steel components in regenerative heat exchangers exposed to treated borated water greater than 60 °C (140 °F). The SRP-LR states that although the existing AMP relies on monitoring and control of primary water chemistry to manage cracking due to SCC, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The SRP-LR also states that acceptance criteria for a plant-specific AMP are described in SRP-LR, BTP RLSB-1.

The staff evaluated the applicant's Primary Water Chemistry Program and WCP Program and its review is documented in SER Sections 3.0.3.1.9 and 3.0.3.2.19, respectively. The staff noted that the effectiveness of the Primary Water Chemistry Program is verified through the WCP Program, which credits either VT-1 or enhanced VT-1 visual inspection methods for the detection of cracking. The staff finds the applicant's use of the Primary Water Chemistry program, in conjunction with effectiveness verification through the WCP Program, acceptable to manage cracking due to SCC because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.3.2.2.4.2 and the GALL Report, (2) the Primary Water Chemistry Program periodically monitors and controls contaminants below levels known to result in cracking, and (3) the WCP Program verifies effectiveness by performing NDE inspections.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3 2.2.4.2 criteria. For those items that apply to LRA Section 3.3.2.2.4.2, the

staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 3. LRA Section 3.3.2.2.4.3 addresses cracking due to cyclic loading that could occur in the stainless steel positive displacement pump casing of the high-pressure pumps in the CVCS. The applicant stated that cracking due to SCC is not an AERM because the casings are not exposed to temperatures greater than 60 °C (140 °F), the threshold for SCC to occur. Cracking of the charging pumps due to cyclic loading is managed by the WCP Program.

The staff reviewed LRA Section 3.3.2.2.4.3 against the criteria in SRP-LR Section 3.3.2.2.4.3, which states that cracking due to SCC and cyclic loading could occur for the stainless steel pump casing for the PWR high-pressure pumps in the CVCS. The existing AMP relies on the monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are adequately managed.

LRA Table 3.3.1, item 3.3.1-9 describes the cracking due to SCC and cyclic loading of the austenitic stainless steel positive displacement pump casing of the high-pressure pumps in the CVCS. The applicant stated that this aging effect is managed by the WCP Program. The applicant further stated that the program is consistent with the GALL Report.

The staff reviewed LRA item 3.3.1-9 in comparison with the GALL Report Volume 1, Table 3, ID 9. The staff found that for this AMR item, the SRP-LR states that the existing AMP relies on the monitoring and control of primary water chemistry to manage the effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the GALL Report recommends the primary water chemistry program to be augmented by a plant-specific verification program. In its review, the staff noted that the applicant stated that cracking due to SCC of these components is not an AERM because the casings are not exposed to temperatures greater than 60 °C (140 °F), the threshold for SCC to occur. The applicant further stated that the cracking of charging pumps due to cyclic loading is managed by the WCP Program. In its review, the staff noted that the WCP Program provides an opportunity to visually inspect the internal surfaces of components, such as pump casings, during preventive and corrective maintenance activities. In addition, the staff finds that the applicant's WCP Program is an acceptable alternative to GALL AMP XI.M32, "One-Time Inspection," for the purpose of verifying the effectiveness of water chemistry control. The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff finds this to be consistent with the GALL Report and, therefore, acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.4.3 criteria. For those items that apply to LRA Section 3.3.2.2.4.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 4. LRA Section 3.3.2.2.4.4 refers to LRA Table 3.3.1, item 3.3.1-10 and addresses high-strength steel closure bolting exposed to air with steam or water leakage. The GALL Report recommends GALL AMP XI.M18, "Bolting Integrity," to manage cracking due to SCC and cyclic loading for this component group. The applicant stated that this item is not applicable because the bolting for the high-pressure charging pump pressure head is not fabricated from high-strength steel. Based on this statement, the staff was unclear as to whether the applicant had other high-strength structural steel closure bolting in the auxiliary systems that required aging management. By letter dated July 13, 2009, the staff issued RAI B2.1.5-4 requesting that the applicant provide additional information to justify why SRP-LR Section 3.3.2.2.4.4 is not applicable.

In its response dated August 17, 2009, the applicant stated that there is no high-strength steel closure bolting exposed to air with steam or water leakage in the auxiliary systems.

The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that the applicant's LRA does not have any AMR results for the auxiliary systems that include high-strength steel closure bolting exposed to air with steam or water leakage. The staff also noted that a search of the applicant's USAR and the Audit Report did not find any evidence of high-strength steel closure bolting in the auxiliary systems exposed to air with steam or water leakage. Based on its review of the LRA, Audit Report, and USAR, the staff confirmed that there are no in-scope high-strength steel closure bolting exposed to air with steam or water leakage in the auxiliary systems and, therefore, finds the applicant's determination acceptable. The staff's concern described in RAI B2.1.5-4 is resolved.

3.3.2.2.5 Hardening and Loss of Strength Due to Elastomer Degradation

Item 1. LRA Section 3.3.2.2.5 refers to LRA Table 3.3.1, item 3.3.1-11 and addresses degradation of elastomer seals and components of heating and ventilation systems exposed to an air-indoor uncontrolled environment which are being managed for hardening and loss of strength by the External Surfaces Monitoring Program.

The staff reviewed LRA Section 3.3.2.2.5.1 against the criteria in SRP-LR Section 3.3.2.2.5.1, which states that hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air-indoor uncontrolled (internal/external). The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. The GALL Report recommends acceptance criteria which are described in SRP-LR, BTP RLSB-1.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. In its review of components subordinate to item 3.3.1-11 for which the applicant assigned generic note E, the staff noted that the External Surfaces Monitoring Program proposes to manage the aging of elastomeric materials through the use of visual inspections. The staff also noted that the aging effects being considered are hardening and loss of strength. Given that changes in material properties of elastomeric materials are not always accompanied by a change in appearance, the staff is unaware of how a visual inspection will detect the aging effects under consideration. The staff further noted that item 3.3.1-11 includes both internal and external surfaces of elastomers. Finally, the staff noted that a search of components subordinate to item 3.3.1-11 reveals only items associated with external surfaces. Given the nature of the components listed, it appears that most, if not all, of these items should have an additional item associated with their internal surface. By letter dated October 13, 2009, the staff issued RAI 3.2.2.5.1-1 requesting that the applicant: (1) clarify how a visual inspection will detect changes in hardness and strength of elastomeric materials, or propose an alternate AMP which includes manual manipulation of the elastomeric material, and (2) explain the apparent lack of AMR items in item 3.3.1-11 associated with internal surfaces.

In its letter dated November 13, 2009, the applicant responded to RAI 3.2.2.5.1-1; the response incorporates part of the applicant's response to RAI B2.1.10-1 dated August 17, 2009, as clarification on its visual inspections. In that response to RAI B2.1.10-1, the applicant stated that the External Surfaces Monitoring Program includes the "scratch, sniff, and stretch" technique described in the EPRI Aging Assessment Field Guide, which entails detection of surface material degradation and hardening by scratching, odor changes possibly indicating degradation by sniffing, and elastomer hardening or cracking by stretching. The staff finds this acceptable because aging issues such as changes in hardness and strength may be discovered using this approach. The applicant addressed the staff's question regarding the lack of AMR entries for internal surfaces in item 3.3.1-11 by citing LRA Tables 3.3.2-10 through 3.3.2-17. A review of these tables indicated that the internal surfaces of elastomers cited generic note H. The items that cite generic note H will be managed by the WCP Program. The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff finds this approach acceptable because based on the response to RAI B2.1.32-2 documented in SER Section 3.3.2.2.13, the AMP contains appropriate provisions for selection and frequency of inspections for the components under consideration. Based on its response dated September 25, 2009, to a concern raised during a public meeting, the applicant has chosen an AMP which contains appropriate inspection techniques (e.g., visual examination and physical manipulation of the elastomers). The staff's concern described in RAI 3.2.2.5.1-1 is resolved.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.5.1 criteria. For those items that apply to LRA Section 3.3.2.2.5.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.3.2.2.5.2 and Table 3.3.1, item 3.3.1-12 are not applicable to KPS. See SER Section 3.3.2.1.1.

3.3.2.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

Issue 1: Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion (Boron Carbide Plates)

Summary of Technical Information in the Application. LRA Section 3.3.2.2.6 addresses reduction of neutron-absorbing capacity and loss of material due to general corrosion in the neutron-absorbing boron carbide plates of spent fuel storage racks exposed to treated or borated water as AERMs. Additionally, the applicant stated that plant-specific OE shows no degradation of boron carbide plates in the spent fuel storage racks exposed to borated water.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in LRA Section 3.3.2.2.6 on the rationale for not requiring an AMP against the staff's recommended regulatory criteria in SRP-LR Section 3.3.2.2.6 and in GALL AMR item VII.A2-5 of the GALL Report, Volume 2.

SRP-LR Section 3.3.2.2.6 states that reduction of neutron-absorbing capacity and loss of material due to general corrosion may occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or treated borated water. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff reviewed LRA Section 3.3.2.2.6 in which the applicant evaluated if a reduction of neutron-absorbing capacity or loss of material might occur in the neutron-absorbing boron carbide plates of the spent fuel storage racks at KPS due to general corrosion. The staff questioned the rationale provided by the applicant for not requiring an AMP for the boron carbide plates. In RAI 3.3.2.2.6-1 dated July 7, 2009, the staff requested that the applicant provide additional details on boron carbide plates in the SFP.

In its response dated August 6, 2009, the applicant stated that the initial racks were installed in 1978 and in the early 1980s, vent holes were drilled to prevent wall deflection. In the mid-1980s, additional racks were installed. The applicant also stated that coupons associated with each rack installation were installed into the pool and are always placed in an area that is expected to have the highest neutron flux relative to the spent fuel rods. The applicant stated that the coupons are tested every 3 years for neutron attenuation (blackness testing), visual examination (for cracking, blistering, and surface finish), and thickness measurement. The applicant stated that the coupons have been blackness tested since 1982 and that degradation has not been detected. The applicant stated that the acceptance criterion for the coupons is a minimum B-10 areal density of 0.086 grams per square centimeter (gm/cm^2), and that, if this acceptance criterion is not met or any abnormalities are noted, those results will be documented in the corrective action program. In addition, the applicant stated that the following actions are also required: (1) the spent fuel rack loading pattern is evaluated, (2) one or more of the coupons are sent to an independent lab for B-10 areal density evaluation, and (3) the test results are evaluated to determine acceptability of use of the spent fuel racks. In addition, the applicant stated that the criticality analysis of record has 7.996 percent subcritical margin.

The applicant also provided supplemental information in a letter dated January 21, 2010. As a supplement to RAI 3.3.2.2.6-1, the applicant made a commitment, stating that the Boron Carbide Surveillance Program, which includes neutron attenuation testing, will continue to be performed during the period of extended operation every 3 years.

The staff has reviewed the response to RAI 3.3.2.2.6-1 and the supplemental information. The staff finds it to be representative and acceptable to have two sets of coupons to represent the different manufacture and installation of the racks. The staff also finds the 3 year frequency of inspection, acceptance criteria, and corrective actions, along with the subcritical margin, to be acceptable since this would provide reasonable assurance that degradation would be detected before the criticality analysis of record became non-conservative. If degradation were to occur between surveillance periods, the subcriticality margin would provide assurance that the SFP would remain subcritical. Therefore, the staff has reasonable assurance that the Boron Carbide Surveillance Program will be able to detect any degradation of the racks in a timely manner and has sufficient margin in the criticality analysis of record to provide additional assurance, if degradation were to occur between surveillances, that subcriticality will be maintained. In addition, the staff finds the commitment to be acceptable since the applicant is committing to perform testing every 3 years, which will include neutron attenuation testing. This provides additional assurance that degradation would be detected, monitored, and trended in the period of extended operation.

The applicant also provided some OE in the response to RAI 3.3.2.2.6-1, in the form of the results of the areal density/blackness testing of each coupon since 1982. Also, in response to the Palisades OE with degraded boron carbide, the applicant responded that it inspected a fuel storage rack that was removed from the pool for maintenance and did not find any degradation or conditions similar to those found at Palisades.

The staff reviewed the OE and finds it to be acceptable. The areal density results of all of the coupons provide the staff with reasonable assurance that the onset of degradation of the neutron-absorbing capacity of the boron carbide would be detected. Additionally, the applicant's actions, in response to the Palisades OE, provide the staff with reasonable assurance that it has appropriate processes in place to evaluate future OE and take appropriate actions.

After reviewing the applicant's response, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.6 criteria. For those items that apply to LRA Section 3.3.2.2.6, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>*Commitment*</u>. The applicant made an additional commitment to LRA Appendix A, Commitment No. 38, in a letter dated January 21, 2010, stating that the Boron Carbide Surveillance Program, which includes neutron attenuation testing, will continue to be performed during the period of extended operation every 3 years.

The staff finds this acceptable since it gives reasonable assurance that the neutron-absorbing capacity will be adequately managed during the period of extended operation.

<u>*Conclusion*</u>. On the basis of its review of the LRA, RAI responses, and commitments, the staff concludes that the applicant 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).

<u>Issue 2: Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion (Boral Plates)</u>

<u>*Summary of Technical Information in the Application*</u>. LRA Section 3.3.2.2.6 addresses reduction of neutron-absorbing capacity and loss of material due to general corrosion in the neutron-absorbing Boral plates of spent fuel storage racks exposed to treated or borated water as AERMs. Additionally, Holtec and industry coupon testing did not exhibit any degradation of Boral plates.

<u>*Staff Evaluation*</u>. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in LRA Section 3.3.2.2.6 on the rationale for not requiring an AMP against the staff's recommended regulatory criteria in SRP-LR Section 3.3.2.2.6 and in GALL AMR item VII.A2-5 of the GALL Report, Volume 2.

SRP-LR Section 3.3.2.2.6 states that reduction of neutron-absorbing capacity and loss of material due to general corrosion may occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or treated borated water. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff reviewed LRA Section 3.3.2.2.6 in which the applicant evaluated if a reduction of neutron-absorbing capacity and loss of material might occur in the neutron-absorbing sheets of the spent fuel storage racks at KPS due to general corrosion. The staff questioned the rationale provided by the applicant for not requiring an AMP for the neutron-absorbing capacity and loss of material. In RAIs 3.3.2.2.6-2 and 3.3.2.2.6-3 dated July 7, 2009, the staff requested that the applicant provide additional details on the Boral plates in the SFP.

The applicant responded to RAIs 3.3.2.2.6-2 and 3.3.2.2.6-3 in letters dated August 6, 2009, and January 21, 2010. In its response, the applicant stated:

> A review of plant specific and industry operating experience did not identify any reason to conclude that degradation of the capability of the Boral spent fuel storage rack neutron absorber to perform its intended function would be expected with continued service. However, absent an additional basis to support that degradation will not occur in the future, Kewaunee will establish a surveillance program to monitor the performance of the Boral neutron absorber during the period of extended operation or, alternatively, will reperform the Spent Fuel Pool Criticality Analysis such that no credit is taken for Boral in the spent fuel storage racks.
>
> The surveillance program for these racks will consist of a periodic determination of the areal density of the Boral neutron absorber using an in-situ inspection technique (such as the currently available BADGER system). The initial test of Boral areal density will be performed prior to 2017 on at least five storage cells...
>
> Selection of the cells to be tested will consider those cells that are known to have routinely been occupied with spent fuel. This will ensure that the test results will either bound or be fully representative of the untested rack cells. The surveillance program will be performed every 10 years following the initial testing. Kewaunee will continue to monitor industry operating experience related to Boral, and any necessary actions will be initiated through the Corrective Action Program.

The applicant also reaffirmed this program through Commitment No. 39 which states, "A surveillance program will be implemented to perform verification that the Boral spent fuel storage rack neutron absorber B-10 areal density is maintained within the bounds of the spent fuel pool criticality analysis. Alternatively, the criticality analysis for the spent fuel pool will be revised to eliminate credit for the Boral neutron absorber material."

The staff reviewed the responses and Commitment No. 39, and has found them to be acceptable. The formation of a Boral surveillance program, that will periodically monitor the Boral neutron absorber areal density and maintain the areal density within the bounds of the SFP criticality analysis in the period of extended operation, provides reasonable assurance that degradation of the Boral neutron-absorbing capability will be detected. The selection of the routinely occupied cells for testing provides reasonable assurance that the Boral neutron-absorbing material tested would bound or be fully representative of the untested rack cells. A frequency of 10 year inspections is acceptable since: (1) the Boral at KPS has been in service less than 10 years, (2) has a subcritical margin of 5.58 percent, and (3) KPS would continue to monitor industry OE. Therefore, the program is found to be acceptable. The commitment provides reasonable assurance that the program will be instituted and performed in the period of extended operation. Alternatively, if the applicant chooses to no longer credit Boral for neutron-absorbing capability, then this program will no longer be necessary, which is also acceptable to the staff.

After reviewing the applicant's response, the staff concludes that the applicant's responses and programs meet SRP-LR Section 3.3.2.2.6 criteria. For those items that apply to LRA Section 3.3.2.2.6, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Commitment. The applicant made an additional commitment to LRA Appendix A, Commitment No. 39 in a letter dated January 21, 2010, which states, "A surveillance program will be implemented to perform verification that the Boral spent fuel storage rack neutron absorber B-10 areal density [is] maintained within the bounds of the spent fuel pool criticality analysis. Alternatively, the criticality analysis for the spent fuel pool will be revised to eliminate credit for the Boral neutron absorber material."

The staff finds this acceptable since it gives reasonable assurance that the neutron-absorbing capacity will be adequately managed in the period of extended operation.

Conclusion. On the basis of its review of the LRA, RAI responses, and commitments, the staff concludes that the applicant 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).

3.3.2.2.7 Loss of Material Due to General, Pitting, and Crevice Corrosion

Item 1. LRA Section 3.3.2.2.7.1 and Table 3.3.1, items 3.3.1-14, 3.3.1-15, and 3.3.1-16 address loss of material due to general, pitting, and crevice corrosion that may occur in piping, piping components, and piping elements. The applicant stated that loss of material for steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, and crevice corrosion through the examination of steel components associated with item 3.3.1-14. The applicant further stated that the Fire Protection Program or the WCP Program will manage loss of material due to general, pitting, and crevice corrosion of steel RCP oil collection subsystem components (i.e., items 3.3.1-15 and 3.3.1-16).

The staff reviewed LRA Section 3.3.2.2.7.1 against the criteria in SRP-LR Section 3.3.2.2.7.1, which states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, and piping elements, including tubing, valves, and tanks in the RCP oil collection system, exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

Furthermore, SRP-LR 3.3.2.2.7.1 states that corrosion may occur at locations in the RCP oil collection tank where water from washdowns may accumulate. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff noted that for compressors (housing, oil pump, oil sight glass, and oil strainer), tubing, and valves in LRA Table 3.3.2-8, "Station and Instrument Air System"; and for filter housings, flexible connections, oil sumps, oilers, piping, pumps (lube oil), strainer housings, tubing, and valves in LRA Table 3.3.2-19, "Diesel Generator System," which referenced LRA Table 3.3.1, item 3.3.1-14, the applicant credited the Lubricating Oil Analysis Program, which is supplemented by the WCP Program to manage loss of material due to general, pitting, and crevice corrosion. The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage general, pitting, and crevice corrosion and fouling in steel piping, piping components, and piping elements exposed to lubricating oil. By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.7.1, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

The staff noted that for steel flame arrestor, piping, and valves in LRA Table 3.3.2-18, "Fire Protection System," which referenced LRA Table 3.3.1, item 3.3.1-15, the applicant credited the WCP Program to manage loss of material due to general, pitting, and crevice corrosion. By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will also be consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components." The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and inspection results be documented, even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

The staff noted that for the RCP oil collection tank in LRA Table 3.3.2-18, "Fire Protection System," which referenced LRA Table 3.3.1, item 3.3.1-16, the applicant credited the Fire Protection Program to manage loss of material due to general, pitting, and crevice corrosion. The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. By letter dated August 17, 2009, the applicant responded to RAI B.2.1.11-2, which is documented in SER Section 3.0.3.2.8. In its response, the applicant stated that the RCP oil collection system is designed to capture any oil leakage from RCP bearings which is collected in the RCP oil collection tank for disposal. The applicant further stated that this steel tank is exposed internally to an air environment and is also exposed to the lubricating oil from oil leakage of the RCP bearings. The staff noted that since this lubricating oil is meant for disposal and is from oil leakage, the Lubricating Oil Analysis Program will not be effective in managing aging. Therefore, the applicant stated that a specific visual inspection will be performed on the internal surfaces of the RCP oil collection tank prior to the period of extended operation to ensure that significant degradation is not occurring. The staff noted that a visual inspection is capable of detecting loss of material due to corrosion. The staff determined that the specific visual inspection of the internal surfaces of the RCP oil collection tank, prior to the period of extended operation, will be capable of detecting loss of material due to corrosion and will confirm that significant degradation is not occurring.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.7.1 criteria. For those items that apply to LRA Section 3.3.2.2.7.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.3.2.2.7.2 and Table 3.3.1, item 3.3.1-17 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

Item 3. LRA Section 3.3.2.2.7.3 refers to LRA Table 3.3-1, item 3.3.1-18 and addresses loss of material due to general (steel only), pitting, and crevice corrosion in stainless steel and steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The applicant stated that the aging effects are being managed by the WCP Program.

The staff reviewed LRA Section 3.3.2.2.7.3 against the criteria in SRP-LR Section 3.3.2.2.7.3, which states that loss of material due to general (steel only), pitting, and crevice corrosion may occur in steel and stainless steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in the SRP-LR, BTP RLSB-1.

The staff reviewed the applicant's WCP Program and its review is documented in SER Section 3.0.3.1.19. In the LRA, the applicant stated that the WCP Program performs visual inspection of diesel generator exhaust gas components to manage the effects of aging due to the loss of material. However, the applicant did not state the sample size of the components that will be inspected or the frequency at which the inspections will be conducted. By letter dated December 3, 2009, the staff issued RAI B2.1.32-2 requesting that the applicant provide information on the sample size and frequency of inspections of the diesel generator exhaust piping components for the loss of material. The applicant responded on January 21, 2010. The staff's evaluation of the applicant's response is documented in SER Section 3.3.2.2.13.

The staff finds the applicant's use of the WCP Program acceptable to manage the aging effect of loss of material because the steel and stainless steel diesel engine exhaust piping exposed to diesel exhaust will be internally inspected by visual examination, and the applicant will consider material, environmental, OE, and other factors in selecting the locations and frequency of inspections.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.7.3 criteria. For those items that apply to LRA Section 3.3.2.2.7.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.8 *Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion*

LRA Section 3.3.2.2.8 refers to Table 3.3.1, item 3.3.1-19 and addresses loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion for steel components exposed to soil. The applicant stated that this aging effect is managed by the Buried Piping and Tanks Inspection Program.

The staff reviewed LRA Section 3.3.2.2.8 against the criteria in SRP-LR Section 3.3.2.2.8, which states that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion could occur for steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The GALL Report recommends that the effectiveness of the applicant's buried piping and tanks inspection program should be evaluated to verify the effectiveness of the aging effects and OE. The staff reviewed the applicant's Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.4.

In its review of components associated with LRA item 3.3.1-19, for which the applicant assigned generic note C (i.e., bolting and EDG fuel oil storage tie down straps), the staff noted that the components listed do not meet the precise definition of the GALL Report. The staff accepts the applicant's proposal that these components can be addressed under this item because they are made of the same materials, are subject to the same aging effects, and those aging effects can be detected by the same inspection methods as the components included in this GALL Report item. The staff accepts that the components under consideration are sufficiently similar to those actually included in the GALL Report so as not to render them inconsistent.

GALL AMP XI.M34 recommends the use of coatings and or wrapping under the "preventive actions" program element description; however, in its review of LRA Table 3.1.1, item 3.3.1-19, the staff noted that the component mentioned is "steel (with or without coating or wrapping)." By letter dated August 28, 2009, the staff issued RAI 3.3.2.2.8-1 requesting that the applicant confirm that all buried steel piping is coated or wrapped, or propose an AMP appropriate for bare steel piping. The staff also requested that the applicant confirm that the plant has no buried piping meeting the criteria of GALL Report Volume 2, Table VII.C1-18.

In its response dated September 28, 2009, the applicant stated that all buried steel piping within the scope of license renewal is coated and wrapped. The applicant also stated that there is no buried steel piping in the open-cycle cooling water system, so GALL Report item VII.C3-09 is not applicable.

The staff finds the applicant's response to RAI 3.3.2.2.8-1 acceptable because the applicant demonstrated that LRA item 3.3.1-19 and LRA Section 3.3.2.2.8 are consistent with the corresponding items in the GALL Report. The staff's concern described in RAI 3.3.2.2.8-1 is resolved.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.8 criteria. For those items that apply to LRA Section 3.3.2.2.8, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion and Fouling

Item 1. LRA Section 3.3.2.2.9.1 and Table 3.3.1, item 3.3.1-20 address loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling in applicable diesel generator system steel piping, piping components, and piping elements exposed to fuel oil. The applicant stated that the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion for steel piping components and tanks exposed to fuel oil is managed by the Fuel Oil Chemistry Program. The applicant further stated that the Fuel Oil Tank Inspections Program will inspect the internal surfaces of buried fuel oil storage tanks. The WCP Program will provide a verification of the effectiveness of the Fuel Oil Chemistry Program to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion through the examination of steel piping components and tanks exposed to fuel oil.

The staff reviewed LRA Section 3.3.2.2.9.1 against the criteria in SRP-LR Section 3.3.2.2.9.1, which states that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling may occur in steel piping, piping components, piping elements, and tanks exposed to fuel oil. The existing AMP relies on monitoring and control of fuel oil contamination to manage loss of material due to corrosion or fouling. Corrosion or fouling may occur at locations where contaminants accumulate. The effectiveness of the AMP should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling to verify the effectiveness of the AMP. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Fuel Oil Chemistry Program, Fuel Oil Tank Inspections Program, and WCP Program; these evaluations are documented in SER Sections 3.0.3.2.10, 3.0.3.2.11, and 3.0.3.2.19, respectively. The staff determined that the Fuel Oil Chemistry Program includes periodic sampling and analysis of fuel oil to determine if contaminants, such as particulates, microbiological organisms, and water, are present. The staff also determined that this program verifies the quality of new fuel oil prior to introducing it into the fuel oil storage tanks. The staff noted that the presence of these impurities in the fuel oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material. The staff finds that these activities are consistent with the recommendations in the GALL Report and are adequate to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling in steel piping, piping components, and piping elements exposed to fuel oil. The staff determined that the Fuel Oil Tank Inspections Program includes activities to periodically drain, clean, and inspect the internal surfaces of fuel oil storage tanks. The staff further determined that this program performs visual inspections of the tank bottoms to inspect for oil and scale accumulation, and that this program also provides for UT of the tank bottom to ensure that the minimum wall thickness is maintained and degradation is not occurring. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Fuel Oil Chemistry Program where: (a) an aging effect is not expected to occur but the data are insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.9.1, the staff finds the applicant's use of the Fuel Oil Chemistry Program, Fuel Oil Tank Inspections Program, and WCP Program acceptable.

Based on its review and the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.9.1 criteria. For those items that apply to LRA Section 3.3.2.2.9.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.3.2.2.9.2 and Table 3.3.1, item 3.3.1-21 address loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion that may occur in heat exchanger components. The applicant stated that loss of material for carbon steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion through the examination of carbon steel components.

The staff reviewed LRA Section 3.3.2.2.9.2 against the criteria in SRP-LR Section 3.3.2.2.9.2, which states that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling may occur in steel heat exchanger components exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage general, pitting, crevice, and microbiologically-influenced corrosion and fouling in steel heat exchanger components exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.9.2, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.9.2 criteria. For those items that apply to LRA Section 3.3.2.2.9.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB 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 Pitting and Crevice Corrosion

Item 1. LRA Section 3.3.2.2.10.1 and Table 3.3.1, item 3.3.1-22 address elastomer lined steel or stainless steel clad piping, piping components, or piping elements exposed to treated water or treated borated water. The GALL Report recommends further evaluation of a program to manage loss of material from pitting and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that component intended functions will be maintained during the period of extended operation. The applicant stated that this item is not applicable because it has no elastomer lined steel or stainless steel clad piping, piping components, or piping elements exposed to treated water or treated borated water in the auxiliary systems. The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that the applicant's LRA does not have any AMR results for the auxiliary systems that include elastomer lined steel or stainless steel clad piping, piping components, or piping elements exposed to treated water or treated borated water. The staff also noted that a search of the applicant's USAR did not find any evidence of elastomer lined steel or stainless steel clad piping, piping components, or piping elements in the auxiliary systems exposed to treated water or treated borated water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope elastomer lined steel or stainless steel clad piping, piping components, or piping elements exposed to treated water or treated borated water in the auxiliary systems and, therefore, finds the applicant's determination acceptable.

Item 2. LRA Section 3.3.2.2.10.2 and Table 3.3.1, items 3.3.1-23 and 3.3.1-24 are applicable to BWRs only and, therefore, are not applicable to KPS. See SER Section 3.3.2.1.1.

Item 3. LRA Section 3.3.2.2.10.3 states that the applicant will credit the External Surfaces Monitoring Program and the WCP Program to manage loss of material due to pitting and crevice corrosion of copper alloy piping, piping components, and piping elements exposed to condensation (external) in the auxiliary building ventilation system, circulating water system, component cooling system, control room air conditioning system, potable water system, reactor building ventilation system, service water system, service water pretreatment system, shield building ventilation system, TSC ventilation system, and the turbine building and screenhouse ventilation system. The applicant further stated that the WCP Program is credited for those components to detect loss of material due to corrosion on copper components when some component disassembly is required in order to inspect the component.

The staff reviewed LRA Section 3.3.2.2.10.3 and Table 3.3.1, item 3.3.1-25 against the criteria in SRP-LR Section 3.3.2.2.10.3, which states that loss of material due to pitting and crevice corrosion may occur in copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external). The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and inspection results be documented, even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walkdowns, will adequately manage the loss of material due to pitting and crevice corrosion for copper alloy piping, piping components, and piping elements exposed to an external condensation environment addressed by this AMR. The staff noted that a visual inspection will be capable of identifying degradation on the external surface that will present itself in signs of corrosion, corrosion byproducts, coating degradation, discoloration on the surface, scale/deposits, and pits and surface discontinuities that are indicative of loss of material. On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.3 criteria. For those items that apply to LRA Section 3.3.2.2.10.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 4. LRA Section 3.3.2.2.10.4 addresses loss of material due to pitting and crevice corrosion that may occur in piping, piping components, and piping elements. The applicant stated that loss of material for copper alloy components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to pitting and crevice corrosion through the examination of copper alloy components.

The staff reviewed LRA Section 3.3.2.2.10.4 and Table 3.3.1, item 3.3.1-26 against the criteria in SRP-LR Section 3.3.2.2.10.4, which states that loss of material due to pitting and crevice corrosion may occur in copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage loss of material due to pitting and crevice corrosion in copper alloy piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of

GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.10.4, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.4 criteria. For those items that apply to LRA Section 3.3.2.2.10.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 5. LRA Section 3.3.2.2.10.5 addresses loss of material due to pitting and crevice corrosion in aluminum and stainless steel ducting components exposed to condensation. The applicant stated that the External Surfaces Monitoring Program and WCP Program will manage loss of material due to pitting and crevice corrosion for aluminum and stainless steel components exposed to condensation.

The staff reviewed LRA Section 3.3.2.2.10.5 and Table 3.3.1, item 3.3.1-27 against the criteria in SRP-LR Section 3.3.2.2.10.5, which states that loss of material due to pitting and crevice corrosion may occur in HVAC aluminum piping, piping components, and piping elements and stainless steel ducting components exposed to condensation. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of aluminum and stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and inspection results be documented, even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel piping, piping components, and piping elements exposed to an external condensation environment addressed by this AMR. The staff noted that a visual inspection will be capable of identifying degradation on the external surface that will present itself in signs of corrosion, corrosion byproducts, coating degradation, discoloration on the surface, scale/deposits, and pits and surface discontinuities that are indicative of loss of material. On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.5 criteria. For those items that apply to LRA Section 3.3.2.2.10.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 6. LRA Section 3.3.2.2.10.6 refers to Table 3.3-1, item 3.3.1-28 and addresses the loss of material due to pitting and crevice corrosion of copper alloy fire protection components exposed to internal condensation. The applicant stated that copper alloy components in the fire protection, waste gas compressor, and various ventilation systems, that are intermittently wetted or exposed to condensation, are managed for loss of material due to pitting and crevice corrosion by either the WCP Program or the Fire Protection Program. The applicant also stated that the loss of material due to pitting and crevice corrosion for copper alloy components exposed to condensation in the diesel generator and station and instrument air systems are managed by the Compressed Air Monitoring Program.

The staff reviewed LRA Section 3.3.2.2.10.6 against the criteria in SRP-LR Section 3.3.2.2.10.6, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation and the GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. The staff noted that the applicant identified two GALL Report recommended AMPs, the Fire Protection and Compressed Air Monitoring programs, and a plant-specific program, the WCP Program, to manage the effects of aging due to loss of material on the ventilation, station and instrument air, diesel generator, waste gas compressor, and fire protection system copper alloy piping, piping components, and piping elements. The staff finds that LRA Section 3.3.2.2.10.6 is consistent with SRP-LR Section 3.3.2.2.10.6.

The staff reviewed the 25 AMR items associated with item 3.3.1-28 in LRA Tables 3.3.2-8, 3.3.2-10, 3.3.2-12 through 3.3.2-19, and 3.3.2-21 for copper alloy piping, piping components, and piping elements exposed to moist air or internal condensation. The 25 AMR items are for air handling unit cooling coils or fins, containment fan coil units, shroud cooling units, air conditioning unit condensers or fins, after coolers, fire hydrants, hose valve head, tubing, and valves. These components provide the function of heat transfer or pressure boundary. The 25 AMR items cite generic note E, which indicates that they are consistent with the GALL Report item for material, environment, and aging effect, but a different AMP is credited or the GALL Report identifies a plant-specific AMP.

The applicant stated that it will use the WCP Program to manage the aging effects of copper alloy cooling fans, coils, fins and after coolers, which accounted for 16 of the 25 AMR items. The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The WCP Program credits periodic surveillance, visual inspections, and maintenance to manage the effects of aging. The staff noted that aging effects due to condensation of the components covered under the WCP Program could be detected by periodic visual inspections. The staff finds that the applicant has identified an appropriate program to manage the aging effects of these 16 AMR items because visual inspections will detect the aging effect and the selection and frequency of inspections is addressed in the applicant's response to RAI B2.1.32-2. The staff's review of RAI B2.1.32-2 is documented in SER Section 3.3.2.2.13.

The applicant stated that it will use the Compressed Air Monitoring Program to manage the aging effects of copper alloy after coolers, piping, tubing, and valves in the station and instrument air and diesel generator systems, which accounted for 7 of the 25 AMR items. The staff reviewed the applicant's Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.6. The Compressed Air Monitoring Program credits visual inspections and periodic testing to manage the effects of aging. The staff noted that the aging effect of loss of material for these items could be identified by visual inspection. The staff also noted that in the applicant's response to RAI B2.1.9-2, documented in SER Section 3.0.3.2.6, the applicant stated that an air dryer is maintained in service on a continuous basis during air compressor operation, so as to remove moisture from the incoming compressed air, and the air receivers are checked daily for accumulation of condensation. The staff finds that the applicant has identified an appropriate program to manage the aging effects for these 7 AMR items because visual inspections will detect the aging effects and condensation is minimized by the Compressed Air Monitoring Program.

The applicant stated that it will use the Fire Protection Program to manage the effects of aging of the remaining 2 AMR items, copper alloy fire hydrants and hose valve heads. The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. The Fire Protection Program credits periodic inspections to detect the effects of aging. The staff noted that the aging effect of loss of material for these items could be identified by visual inspection. The staff also noted that the applicant credited the WCP Program to perform inspections within the Fire Protection Program. A staff concern related to selection and frequency of inspections, related to the WCP Program, is addressed in the applicant's response and the staff's review of RAI B2.1.32-2, documented in SER Section 3.3.2.2.13. The staff finds that the applicant has identified an appropriate program to manage the aging effects of fire hydrants and the hose valve heads because visual inspections will detect the aging effect and the applicant will implement appropriate criteria for selection and frequency of inspections.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.6 criteria. For those items that apply to LRA Section 3.3.2.2.10.6, the staff concludes that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Item 7</u>. LRA Section 3.3.2.2.10.7 refers to Table 3.3.1, item 3.3.1-29 and addresses loss of material due to pitting and crevice corrosion for stainless steel piping, piping components, and piping elements exposed to soil. The applicant stated that this aging effect is managed by the Buried Piping and Tanks Inspection Program.

The staff reviewed LRA Section 3.3.2.2.10.7 against the criteria in SRP-LR Section 3.3.2.2.10.7, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in SRP-LR, BTP RLSB-1. The staff reviewed the applicant's Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.4.

The GALL AMP XI.M34 program description does not include stainless steel; however, in its review of LRA Table 3.3.1, item 3.3.1-29, the staff found that the material for the components is stainless steel. By letter dated August 28, 2009, the staff issued RAI 3.3.2.2.10.7-1 requesting that the applicant confirm whether the buried stainless steel piping is wrapped, coated, or bare and, if coated or wrapped, justify how the proposed AMP will adequately manage its aging.

In its response dated September 28, 2009, the applicant stated that the answer to this RAI was contained in its response to RAI B2.1.7, which was transmitted by letter dated August 17, 2009. The staff reviewed the response to this RAI. In its response, the applicant stated that the stainless steel piping under consideration: (1) is a vent line which was installed in 2003, (2) consists of approximately 30 feet of 2 inch nominal ASTM A-312 schedule 80 pipe, (3) is completely buried except for about 3 feet, and (4) is coated and wrapped. The applicant also stated that even though the material for this line was not in the GALL AMP, its failure was highly unlikely due to the design of the piping, recent installation, and planned inspections.

The staff finds the applicant's response to RAI 3.3.2.2.10.7-1 acceptable because there is an exceptionally small probability that the pipe under consideration will fail based on its design (i.e., pipe need not retain any pressure) and planned inspections. The staff's concern described in RAI 3.3.2.2.10.7-1 is resolved.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.7 criteria. For those items that apply to LRA Section 3.3.2.2.10.7, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 8. LRA Section 3.3.2.2.10.8 and Table 3.3.1, item 3.3.1-30 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

3.3.2.2.11 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion

LRA Section 3.3.2.2.11 and Table 3.3.1, item 3.3.1-31 are applicable to BWRs only and, therefore, not applicable to KPS. See SER Section 3.3.2.1.1.

3.3.2.2.12 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

Item 1. LRA Section 3.3.2.2.12.1 addresses loss of material due to pitting, crevice, and microbiologically-influenced corrosion in stainless steel and copper alloy piping, piping components, and piping elements exposed to fuel oil. The applicant stated that there are no aluminum components exposed to fuel oil. The applicant stated that loss of material due to pitting, crevice, and microbiologically-influenced corrosion for diesel generator system stainless steel and copper alloy piping, piping components, and piping elements exposed to fuel oil is managed by the Fuel Oil Chemistry Program. The applicant stated that the WCP Program will provide a verification of the effectiveness of the Fuel Oil Chemistry Program to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion through the examination of stainless steel and copper alloy piping, piping components, and piping elements exposed to fuel oil.

The staff reviewed LRA Section 3.3.2.2.12.1 and Table 3.3.1, item 3.3.1-32 against the criteria in SRP-LR Section 3.3.2.2.12.1, which states that loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling may occur in stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. The existing AMP relies on monitoring and control of fuel oil contamination to manage the loss of material due to corrosion or fouling. The effectiveness of the AMP should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation of programs to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion to verify the effectiveness of the AMP. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Fuel Oil Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.10 and 3.0.3.2.19, respectively. The staff determined that the Fuel Oil Chemistry Program includes periodic sampling and analysis of fuel oil to determine if contaminants, such as particulates, microbiological organisms, and water, are present. The staff also determined that this program verifies the quality of new fuel oil prior to introducing it into the fuel oil storage tanks. The staff noted that the presence of these impurities in the fuel oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion in stainless steel and copper alloy piping, piping components, and piping elements exposed to fuel oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Fuel Oil Chemistry Program where: (a) an aging effect is not expected to occur but the data are insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.12.1, the staff finds the applicant's use of the Fuel Oil Chemistry Program and WCP Program acceptable.

Based on a review of the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.12.1 criteria. For those items that apply to LRA Section 3.3.2.2.12.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.3.2.2.12.2 addresses loss of material due to pitting, crevice, and microbiologically-influenced corrosion that may occur in stainless steel piping, piping components, and piping elements exposed to a lubricating oil environment. The applicant stated that loss of material for stainless steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion through the examination of stainless steel components. The applicant further stated that loss of material due to pitting, crevice, and microbiologically-influenced corrosion for stainless steel components, associated with the RCP oil collection subsystem exposed to a lubricating oil environment, is managed by the Fire Protection and WCP programs.

The staff reviewed LRA Section 3.3.2.2.12.2 and Table 3.3.1, item 3.3.1-33 against the criteria in SRP-LR Section 3.3.2.2.12.2, which states that loss of material due to pitting, crevice, and microbiologically-influenced corrosion may occur in stainless steel piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion in stainless steel piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32. The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.3.2.2.12.2, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

The staff noted that for the stainless steel drip plan and enclosures in LRA Table 3.3.2-18, which referenced LRA Table 3.3.1, item 3.3.1-33, the applicant credited the Fire Protection Program to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. The staff noted that the applicant's Fire Protection Program includes periodic inspection of the fire suppression system and as part of the inspection, it includes examination of equipment condition. The staff finds that loss of material due to pitting, crevice, and microbiologically-influenced corrosion can be adequately managed by periodic inspections.

The staff noted that for stainless steel flexible hoses in LRA Table 3.3.2-18, "Fire Protection System," which referenced LRA Table 3.3.1, item 3.3.1-33, the applicant credited the WCP Program to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion. By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will also be consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components." The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and inspection results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.12.2 criteria. For those items that apply to LRA Section 3.3.2.2.12.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.13 Loss of Material Due to Wear

LRA Section 3.3.2.2.13 refers to Table 3.3.1, item 3.3.1-34 and addresses loss of material due to the wear of elastomer seals and components exposed internally or externally to indoor uncontrolled air. The applicant stated that this aging effect is managed by the WCP Program and the External Surfaces Monitoring Program.

The staff reviewed LRA Section 3.3.2.2.13 against the criteria in SRP-LR Section 3.3.2.2.13, which states that loss of material due to wear could occur in the elastomer seals and components exposed internally or externally to indoor uncontrolled air. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in SRP-LR, BTP RLSB-1. The staff reviewed the applicant's WCP and External Surfaces Monitoring programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.7, respectively.

In its review, the staff noted that the External Surfaces Monitoring and the WCP programs propose to manage the aging of elastomeric materials through the use of visual inspections and physical manipulations. The staff finds the use of these programs to manage the aging of these components acceptable because the visual inspection and physical manipulation techniques included are capable of detecting loss of material due to wear on the components under consideration. While the staff concurs that wear of elastomeric materials can be detected through visual inspections, the proposed AMPs do not provide sufficient information concerning the details of the inspection, frequency of inspection, and sample size to allow the staff to conclude that the use of these programs will effectively manage the aging of the elastomeric materials under consideration. By letter dated December 3, 2009, the staff issued RAI B2.1.32-2 requesting that the applicant clarify: (1) why the visual examinations of those components that are scheduled for periodic maintenance are considered to be representative of those components that may not be inspected during the period of extended operation, (2) how the results of the inspections will be applied to the population of components that may not be inspected under the program if aging is detected in the inspected components, and (3) how potential aging in the non-inspected components will be addressed.

In its response dated January 21, 2010, the applicant stated that:

> For each material-environment combination, sufficient internal surfaces inspections will be performed during scheduled surveillance and maintenance activities to provide an overall assessment of any aging degradation that may be occurring. A review of the scheduled surveillance and maintenance activities will be performed to select activities that will provide a set of inspections that will be representative of the components in the program. The review will consider component materials; operating environments; industry and plant-specific operating experience; engineering evaluations of equipment performance; and susceptibility to aging due to time in service, severity of operating conditions, and lowest design margins.
>
> The selected scheduled surveillance and maintenance activities will be performed on a repetitive basis. The use of recurring surveillance and maintenance activities provides the ability to detect aging of the material-environment combination prior to loss of function.
>
> Aging detected during the Internal Surfaces Monitoring program inspections will be documented and evaluated for applicability to similar components [(]i.e., same material environment combinations) within the total component population in accordance with the Corrective Action Program. An engineering review will be performed to evaluate the condition, the extent of the condition, and the need for corrective actions. The extent of the condition may require the inspection of additional plant equipment.

> Implementation of the Internal Surfaces Monitoring program at Kewaunee will require Engineering personnel to: (1) review the program inspection results to identify any new aging effects not previously considered, (2) monitor and/or perform walk down activities to verify adequate identification and documentation of aging effects and initiation of corrective actions, (3) perform trending of inspection results, and (4) review site operating experience through the plant corrective action program to ensure that aging effects are addressed.
>
> The combination of the Corrective Action Program evaluations and the engineering reviews discussed above provides reasonable assurance that the impact of identified aging will be considered for non-inspected components.

The staff finds the applicant's response to RAI B2.1.32-2 acceptable because: (1) the applicant will perform sufficient inspections for each material-environment combination to provide an overall assessment of any aging degradation that may be occurring; (2) the selection of inspections will consider materials, operating environments, industry and plant-specific OE, engineering evaluations of equipment performance, and susceptibility to aging due to time in service, severity of operating conditions, and lowest design margins; (3) recurring surveillance and maintenance activities provides the ability to detect aging of the material-environment combination prior to the loss of function; and (4) inspection results will be trended. The staff's concern described in RAI B2.1.32-2 is resolved.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.13 criteria. For those items that apply to LRA Section 3.3.2.2.13, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.14 Loss of Material Due to Cladding Breach

LRA Section 3.3.2.2.14 addresses pump cladding failures in charging pumps that have steel casings with stainless steel cladding, when exposed to treated water as described in NRC IN 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks." This Information Notice describes a cladding breach of the centrifugal charging pumps at North Anna Power Station. The GALL Report recommends further evaluation of a plant-specific AMP to manage the aging of this component group. The applicant stated that this line item is not applicable because its charging pumps are positive displacement pumps manufactured by Ajax Iron Works with charging pump pressure heads that are stainless steel, not steel with stainless steel cladding as described in the IN.

The staff reviewed AMR items associated with LRA Table 3.3.1, item 3.3.1-35. The staff also noted that LRA Section 3.2.2.2.6 implies that the safety injection pumps are centrifugal. The staff further noted that if any of these pumps have stainless steel cladding, then this item should be considered. By letter dated October 13, 2009, the staff issued RAI 3.3.2.2.14-1 requesting that the applicant confirm whether the safety injection pumps are steel with stainless steel cladding. Furthermore, if the safety injection pumps have stainless steel cladding, the staff requested that the applicant confirm either that the issue of loss of material due to cladding breach is being managed, or that it is not applicable to these pumps.

In its response dated November 13, 2009, the applicant stated that the safety injection pumps are steel with stainless steel cladding but that the safety injection pumps are not interchangeable with the charging pumps. The staff finds the applicant's determination that this item is not applicable acceptable because the materials of construction of the charging pumps do not match the criteria for the AMR item. The potential for cracking and subsequent corrosion of the safety injection pumps are addressed in SER Section 3.2.2.2.2. The staff's concern described in RAI 3.3.2.2.14-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.14 criteria. For those line items that apply to LRA Section 3.3.2.2.14, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.3.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.3.2-1 through 3.3.2-29, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.3.2-1 through 3.3.2-29, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections as required by 10 CFR 54.21(a)(3).

3.3.2.3.1 Loss of Material Due to Erosion from the Internal or External Surfaces of Steel Piping, Piping Components, Piping Elements, and Heat Exchanger Components Exposed to Raw Water

In LRA Tables 3.3.2-3, 3.3.2-8, 3.3.2-9, 3.3.2-20, 3.3.2-21, 3.3.2-22, 3.3.2-25, and 3.3.2-26, the applicant stated that the internal or external surfaces of steel piping, piping components, piping elements, and heat exchanger components exposed to raw water are being managed for loss of material due to erosion by the WCP Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material and component type is the internal or external surfaces of steel piping, piping components, piping elements, and heat exchanger components exposed to raw water. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to erosion.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review, the staff noted that the portion of the WCP Program being employed is that which claims consistency with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting." The staff also noted that the program description for the WCP Program states that it is applicable to piping, piping components, and ducting. The scope of the GALL Report AMP states that it is also applicable to piping, piping elements, and ducting components in an internal environment (such as indoor uncontrolled air, condensation, and steam). The staff further noted that some of the components under consideration are heat exchangers exposed to raw water and that those heat exchangers exposed to raw water fall outside the scope of both the WCP Program and the GALL Report AMP.

Also during its review, the staff noted that GL 89-13 applies to some raw water systems. The aging of systems to which GL 89-13 applies must be managed using the Open-Cycle Cooling Water Program. Based on the information provided, it is apparent that most of the components under consideration (e.g., drain systems) are outside the scope of GL 89-13 and that the use of the WCP Program is acceptable because it contains inspection techniques which will identify loss of material due to erosion. However, it is not apparent that GL 89-13 does not apply to any of the components under consideration. By letter dated January 4, 2010, the staff issued RAI 3.3.2.3-6 requesting that the applicant: (1) take an exception to the WCP Program to include heat exchanger components in the scope of the AMP, or (2) justify why such an exception is unnecessary and confirm that GL 89-13 does not apply to any of the components under consideration.

In its response dated February 2, 2010, the applicant stated that the inclusion of heat exchanger components within the WCP Program falls under the "other components" provision of both the LRA Internal Surfaces Monitoring Program (subordinate to the WCP Program) and GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting." The applicant also stated that none of the components under the scope of the WCP Program are within the scope of GL 89-13. The staff finds the applicant's currently proposed AMP acceptable because: (1) the heat exchanger components are within the scope of the GALL Report AMP, (2) the inspection techniques necessary to identify erosion in piping will also identify erosion in heat exchangers, and (3) items under the WCP Program scope are not within the scope of GL 89-13. The staff's concern described in RAI 3.3.2.3-6 is resolved. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.2 Loss of Material Due to General, Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Steel Heat Exchanger Components Exposed to Raw Water

In LRA Tables 3.3.2-3, 3.3.2-8, and 3.3.2-9, the applicant stated that internal surfaces of steel heat exchanger components exposed to raw water are being managed for loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion by the WCP Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material and component type is internal surfaces of steel heat exchanger components exposed to raw water. The staff noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion. The applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program and nonsafety-related components will be managed by the WCP Program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that for these components in LRA Table 3.3.1, item 3.3.1-77, the GALL Report recommends the use of the Open-Cycle Cooling Water Program. The staff further noted that the components under consideration are nonsafety-related components. As a result, use of the Open-Cycle Cooling Water Program is not appropriate, as this AMP is limited to components in safety-related systems which transfer heat to the ultimate heat sink. Given that the use of the Open-Cycle Cooling Water Program is not appropriate, the staff finds the applicant's use of the WCP Program acceptable because this AMP contains visual inspection procedures which are appropriate for the detection of loss of material, fouling, and coating degradation on the internal surfaces of piping components. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.3 Steel, Stainless Steel, and Copper Alloy Components Exposed to Raw Water, Aging Effect – Loss of Material Due to Erosion and Microbiologically-Influenced Corrosion

In LRA Tables 3.3.2-6, 3.3.2-7, 3.3.2-10, 3.3.2-11, 3.3.2-13, 3.3.2-14, 3.3.2-19, and 3.3.2-20, the applicant stated that steel, stainless steel, and copper alloy components exposed to raw water have an aging effect of loss of material due to erosion and MIC and that the aging effect will be managed by the Open-Cycle Cooling Water System Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not included in the GALL Report.

The staff reviewed all AMR result lines in the GALL Report where the materials type is steel, stainless steel, and copper alloy components and confirmed that there are no entries for this material where the aging effect is erosion when the environment is raw water. The applicant used generic note H for some AMR items for stainless steel where the aging effect is MIC. The staff noted that the GALL Report does have a line item, VII.H2-18, for stainless steel components exposed to raw water having an aging effect of MIC. Nevertheless, the applicant credited its Open-Cycle Cooling Water System Program and the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," therefore, the LRA AMR items meet the intent of the GALL Report.

The staff considers the Open-Cycle Cooling Water System Program to be an appropriate program for aging management of loss of material due to erosion in raw water because the program is designed to detect both corrosion and fouling of components exposed to raw water through the combined use of inspections and performance tests. Testing and inspection frequencies are adjusted based on findings.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.4 Exterior Surfaces of Non-Metallic Materials Exposed to Uncontrolled Indoor Air and Interior Surfaces of Non-Metallic Materials Exposed to Raw Water, Dry Air, Lube Oil, and Inert Gas

In LRA Tables 3.3.2-6, 3.3.2-8, 3.3.2-19, and 3.3.2-27, the applicant stated that the exterior surfaces of non-metallic materials exposed to uncontrolled indoor air and the interior surfaces of non-metallic materials exposed to raw water, dry air, lube oil, and inert gas have no aging effect and that no AMP is required. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material type is non-metallic materials and confirmed that there are no entries for this component/material and environment. The staff also noted that there is no distinct definition for non-metallic material in the GALL Report, Chapter IX. The staff further noted that many polymeric materials are adversely affected by oxidizers (e.g., chlorine), ultraviolet (UV) light, and high temperatures. Based on the information provided, the staff cannot conclude that aging effects will not occur to the combination of materials and environments under consideration. By letter dated October 13, 2009, the staff issued RAI 3.3.2.3-3 requesting that the applicant identify the specific material under consideration and justify why this material is not subject to aging under the conditions being considered.

In its response dated November 13, 2009, the applicant stated that non-metallic materials in LRA Table 3.3.2-6 are PVC and polyvinylidene fluoride associated with the service water chlorination system, and are exposed on their interior surfaces to solutions of sodium hypochlorite and exterior surfaces to air-indoor uncontrolled. The applicant also stated that it conducted an OE search for this combination of materials and environment and identified instances in which cracking was observed. The applicant revised the aging effect for these materials from none to cracking and will manage aging by the WCP Program. The staff finds this approach acceptable because the applicant has identified an appropriate aging effect and the proposed AMP contains inspection techniques designed to identify cracking on the internal surfaces of piping.

The applicant stated that the non-metallic material in LRA Table 3.3.2-8 are polycarbonate bowls for lubricators and oilers associated with the station and instrument air system and is exposed on its interior surfaces to lubricating oil and dried air. The applicant conducted an OE search for this combination of material and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and environment. The staff finds the applicant's proposal, that no aging effect exists for this combination of material and environment and that no aging management is required, acceptable because the material environment combination under consideration is commonly employed and no evidence of aging has been detected.

The applicant stated that the non-metallic material in LRA Table 3.3.2-19 is polycarbonate filter housings in the diesel generator starting air system and is exposed on its interior surfaces to dried air. The applicant conducted an OE search for this combination of material and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and environment. The staff finds the applicant's proposal, that no aging effect exists for this combination of materials and environment and that no aging management is required, acceptable because the material environment combination under consideration is commonly employed and no evidence of aging has been detected.

The applicant stated that the non-metallic material in LRA Table 3.3.2-27 is polyethylene flexible tubing used to connect a nitrogen bottle to an instrument air dryer and is exposed on its interior surfaces to inert nitrogen gas. The applicant conducted an OE search for this combination of material and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and environment. The staff finds the applicant's proposal, that no aging effect exists for this combination of material and environment and that no aging management is required, acceptable because the material environment combination under consideration is commonly employed and no evidence of aging has been detected.

The applicant stated that the external surfaces of all the materials described above are exposed to air. The staff agrees with the applicant that aging of these materials due solely to exposure to air is unlikely. The applicant also evaluated other sources of potential degradation to which these materials could be exposed. The applicant evaluated the potential for degradation due to chemical contaminants in the air, such as sulfur dioxide, high temperature (greater than 95 °F), and exposure to oxidizing agents (e.g., UV radiation or ozone). The staff finds that these are the appropriate effects to examine. The applicant stated, and the staff concurs, that degradation due to chemical contaminants is unlikely due to the rural location of the plant. The applicant stated and, based on recommendations in the GALL Report, the staff concurs, that exposure of these materials to temperatures less than 95 °F is unlikely to cause aging. The applicant stated, and the staff concurs, that the primary source of ozone to which these materials may be exposed is electrical equipment and that the remote location of these materials from ozone producing equipment will eliminate this issue. The applicant stated that UV radiation is not a source of aging because these materials are located indoors and because a review of plant experience indicated that UV radiation from fluorescent lighting was not sufficient to cause degradation. The staff concurs with the applicant that the absence of exposure of these materials to sunlight substantially eliminates the potential for aging due to UV radiation. The staff does, however, believe that in some instances, UV radiation from fluorescent lighting can cause aging. The staff accepts the applicant's review of plant operating history as evidence that, in this location, the intensity of the fluorescent lighting is not sufficient to cause aging in the materials under consideration. Based on the above, the staff finds the applicant's approach to manage the aging of the non-metallic components under consideration acceptable. The staff's concern described in RAI 3.3.2.3-3 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.5 Steel, Stainless Steel, and Copper Alloy Components Exposed to Raw Water, Aging Effect – Loss of Material Due to Erosion and Microbiologically-Influenced Corrosion

In LRA Tables 3.3.2-6, 3.3.2-7, 3.3.2-10, 3.3.2-11, 3.3.2-13, 3.3.2-14, 3.3.2-19, and 3.3.2-20, the applicant stated that steel, stainless steel, and copper alloy components exposed to raw water have an aging effect of loss of material due to erosion and MIC and that the aging effect will be managed by the Open-Cycle Cooling Water System Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not included in the GALL Report.

The staff reviewed all AMR result lines in the GALL Report where the materials type is steel, stainless steel, and copper alloy components and confirmed that there are no entries for this material where the aging effect is erosion when the environment is raw water. The applicant used generic note H for some AMR items for stainless steel where the aging effect is MIC. The staff noted that the GALL Report does have a line item, VII.H2-18, for stainless steel components exposed to raw water having an aging effect of MIC. Nevertheless, the applicant credited its Open-Cycle Cooling Water System Program and the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," therefore, the LRA AMR line items meet the intent of the GALL Report.

The staff considers the Open-Cycle Cooling Water System Program to be an appropriate program for aging management of loss of material due to erosion in raw water because the program is designed to detect both corrosion and fouling of components exposed to raw water through the combined use of inspections and performance tests. Testing and inspection frequencies are adjusted based on findings.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.6 Loss of Material Due to Microbiologically-Influenced Corrosion from the Internal Surfaces of Stainless Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Tables 3.3.2-6 and 3.3.2-20, the applicant stated that internal surfaces of stainless steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to MIC by the WCP and Open-Cycle Cooling Water System programs. The AMR items generally cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. However, there are some items that cite generic note E, indicating that the item is consistent with the GALL Report item for material, environment, and aging effect, but a different AMP is credited or the GALL Report identifies a plant-specific AMP. Some cite generic note B, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP. The applicant also stated that components that are nonsafety-related are managed by the WCP Program, and components that are safety-related are managed by the Open-Cycle Cooling Water System Program.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff noted that there are several GALL Report items that address stainless steel components exposed to raw water with an aging effect of MIC, all of which recommend the use of the Open-Cycle Cooling Water System Program. The staff also noted that nonsafety-related components are not typically addressed within the scope of the Open-Cycle Cooling Water Program because the components do not transfer heat to the ultimate heat sink. Therefore, the staff finds the use of the WCP Program acceptable because this AMP contains procedures for visual inspection of the interiors of pipes which are appropriate for the detection of loss of material due to exposure to raw water. However, it is not clear to the staff that this distinction will be met in all cases. By letter dated December 16, 2009, the staff issued RAI 3.3.2.3-5 requesting that the applicant confirm that the Open-Cycle Cooling Water Program will be used for all safety-related systems, and that the WCP Program will be used only for nonsafety-related systems.

In its response dated January 21, 2010, the applicant stated that components that are nonsafety-related are managed by the WCP Program, and components that are safety-related are managed by the Open-Cycle Cooling Water System Program. The staff finds the applicant's proposed AMPs acceptable because the appropriate AMPs are being used to manage the AMR items based on their function and both use appropriate techniques to inspect for the aging mechanism. The staff's concern described in RAI 3.3.2.3-5 is resolved. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.7 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Copper Alloy Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Table 3.3.2-6, the applicant stated that internal surfaces of copper alloy piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to pitting, crevice, and microbiologically-influenced corrosion, as well as fouling by the WCP and Open-Cycle Cooling Water System programs. When the AMP credited in the LRA is the WCP Program, the AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. When the AMP credited in the LRA is the Open-Cycle Cooling Water System Program, generic note B is cited, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP. The applicant stated that components that are nonsafety-related are managed by the WCP Program, and components that are safety-related are managed by the Open-Cycle Cooling Water System Program.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of copper alloy piping, piping components, and piping elements exposed to raw water. The staff noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to pitting, crevice, and microbiologically-influenced corrosion. As noted above, the applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff reviewed LRA Table 3.3.1, item 3.3.1-81 against SRP-LR Table 3.3-1, item 81, which recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," and found them consistent because the notes to LRA Table 3.3.2-6 state that components that are nonsafety-related are managed by the WCP Program, and components that are safety-related are managed by the Open-Cycle Cooling Water System Program. In a revision to the application, AMR line items that were proposed to be managed by the WCP Program were changed from a reference of generic note E to generic note H. The staff finds the use of the WCP Program acceptable to manage the aging of the nonsafety-related components because the program contains inspection procedures appropriate for detecting the loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.8 Loss of Material Due to Pitting and Crevice Corrosion, as well as Fouling from the Internal Surfaces of Stainless Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Table 3.3.2-6, the applicant stated that internal surfaces of stainless steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to pitting and crevice corrosion, as well as fouling by the WCP or Open-Cycle Cooling Water System programs. When the AMP credited in the LRA is the WCP Program, the AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. When the AMP credited in the LRA is the Open-Cycle Cooling Water System Program, generic note B is cited, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP.

The staff reviewed all AMR result items in the GALL Report where the material and component type is internal surfaces of stainless steel piping, piping components, and piping elements exposed to raw water and noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to pitting and crevice corrosion, as well as fouling. The applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff reviewed LRA Table 3.3.1, item 3.3.1-79 against SRP-LR Table 3.3-1, item 79, which recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," and found them consistent because components that are nonsafety-related will be managed by the WCP Program, and components that are safety-related will be managed by the Open-Cycle Cooling Water System Program. In a revision to the application, AMR items that were proposed to be managed by the WCP Program were changed from a reference of generic note E to generic note H. The staff finds the use of the WCP Program acceptable to manage the aging of the nonsafety-related components because the WCP Program contains inspection procedures appropriate for detecting loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.9 Loss of Material Due to Erosion from the Internal Surfaces of Copper Alloy and Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Tables 3.3.2-6, 3.3.2-15, and 3.3.2-20, the applicant stated that internal surfaces of copper alloy and steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to erosion by the WCP or Open-Cycle Cooling Water System programs. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result items in the GALL Report where the material and component type is internal surfaces of copper alloy and steel piping, piping components, and piping elements exposed to raw water and confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to erosion.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluations are documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The applicant stated that safety-related components will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. The staff finds the use of the WCP and Open-Cycle Cooling Water System programs acceptable to manage aging of this component group because both programs contain inspection procedures appropriate for detecting loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.10 Loss of Strength Due to Hydrolysis from the Exterior Surfaces of Non-Metallic Filters and Regulators Exposed to Dry Air

In LRA Table 3.3.2-8, the applicant stated that the exterior surfaces of non-metallic filters and regulators exposed to dry air are being managed for loss of strength due to hydrolysis by the WCP Program. The AMR item cites generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is non-metallic filters and regulators exposed to dry air. The staff confirmed that there are no entries for this component/material and environment where the aging effect is loss of strength due to hydrolysis.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff noted that the LRA AMP specifically addresses paper filter elements used in the compressed air system. The staff finds acceptable the applicant's assertion, that visual inspection, as included in the WCP Program, is sufficient to manage aging of these filters. The staff also notes, however, that the entry in LRA Table 3.3.2-8 includes both filters and regulators and that the material is listed as "Non-Metallic" rather than paper. While the staff suspects that this item refers only to paper filters, it could also refer to some unidentified non-metallic material contained in either a filter or a regulator. Additionally, the staff noted that, with the exception of elastomeric materials, the scope of the WCP Program is limited to the internal surfaces of components. This appears to be in conflict with the component under consideration as the environment is specified to be external. The staff was unclear as to whether the applicant was referring to the external surface of the filter but that the filter is contained in another, larger, enclosure, which actually makes the external surface of the filter an internal surface of the filter assembly. By letter dated December 16, 2009, the staff issued RAI 3.3.2.3-4 requesting that the applicant: (a) confirm that this item refers to only paper filters; (b) if necessary, precisely define the other materials and components included in this item; (c) if necessary, justify the use of the WCP Program for these materials and components; (d) confirm that the WCP Program is used for this component because the external surface of the filter is an internal surface or a larger assembly; and (e) if necessary, justify the use of the WCP Program for external surfaces.

In its response dated January 21, 2010, the applicant stated that the entry in LRA Table 3.3.2-8 for non-metallic material refers only to the paper (cellulose) filter element of the filter/regulators component type. The filter element is located internally to the filter/regulator assembly. The internal surfaces monitoring inspections of the WCP Program are used to manage aging effects for the filter element because the filter/regulator assembly must be disassembled to inspect the paper filter element.

The staff finds the applicant's response acceptable because the item is paper and located inside a larger assembly and, therefore, does need to be inspected when the filter/regulator assembly is disassembled. The staff's concern described in RAI 3.3.2.3-4 is resolved. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.11 Change in Material Properties Due to Thermal Exposure from the External Surfaces of Elastomeric Hoses Exposed to Uncontrolled Indoor Air

In LRA Tables 3.3.2-8 and 3.3.2-27, the applicant stated that external surfaces of elastomeric hoses exposed to uncontrolled indoor air are being managed for change in material properties due to thermal exposure by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is external surfaces of elastomeric hoses exposed to uncontrolled indoor air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is change in material properties due to thermal exposure.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff also noted that the WCP Program also includes the external surfaces of elastomers. The staff further noted that the combined use of visual inspections and physical manipulations is capable of detecting changes in material properties of elastomers. The staff finds the applicant's proposal acceptable because the applicant: (1) identified an applicable aging effect, (2) selected an AMP with an appropriate scope for the component under consideration, and (3) has chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.12 Cracking Due to Thermal Exposure from the External Surfaces of Elastomeric Hoses Exposed to Uncontrolled Indoor Air

In LRA Tables 3.3.2-8 and 3.3.2.27, the applicant stated that external surfaces of elastomeric hoses exposed to uncontrolled indoor air are being managed for cracking due to thermal exposure by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is external surfaces of elastomeric hoses exposed to uncontrolled indoor air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is cracking due to thermal exposure.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff additionally noted that the WCP Program also includes the external surfaces of elastomers, and that the combined use of visual inspections and physical manipulations is capable of detecting cracking of elastomers. The staff finds the applicant's proposal acceptable because the applicant: (1) identified an applicable aging effect, (2) selected an AMP with an appropriate scope for the component under consideration, and (3) has chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.13 Auxiliary Systems – Station and Instrument Air

In LRA Tables 3.3.2-8 and 3.3.2-19, the applicant stated that aluminum components exposed to dried air has no aging effect and that no AMP is required. The AMR line items cite generic note H, indicating that the aging effect is not evaluated in the GALL Report for this component, material, and environment combination.

The staff reviewed all AMR result lines in the GALL Report where the material is aluminum and confirmed that there are no entries for this material where the environment is dried air.

The staff notes that the GALL Report recommends that aluminum piping exposed to indoor uncontrolled and controlled air is not subject to aging and that an AMP is not required. Based on this recommendation and the fact that dried air is no more aggressive toward aluminum than indoor air, the staff determines that the applicant's proposal, that no aging effects will result from exposing aluminum to dried air and that no AMP is required, is appropriate.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.14 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion, Fouling, and Lining-Coating Degradation of Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Tables 3.3.2-8, 3.3.2-19, and 3.3.2-20, the applicant stated that steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, fouling, and lining-coating degradation by the WCP Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is steel piping, piping components, and piping elements exposed to raw water. The staff noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, fouling, and lining-coating degradation. The applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff noted that the components under consideration are nonsafety-related components. As a result, the use of the Open-Cycle Cooling Water Program is not appropriate as this AMP is limited to components in safety-related systems which transfer heat to the ultimate heat sink. Given that the use of the Open-Cycle Cooling Water Program is not appropriate, the staff finds the applicant's use of the WCP Program acceptable because this AMP contains visual inspection procedures which are appropriate for the detection of loss of material, fouling, and coating degradation on the internal surfaces of piping components. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.15 Loss of Material Due to General and Pitting Corrosion from the Internal Surfaces of Steel Piping, Piping Components, and Piping Elements Exposed to Moist Air

In LRA Table 3.3.2-8, the applicant stated that internal surfaces of steel piping, piping components, and piping elements exposed to moist air are being managed for loss of material due to general and pitting corrosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the internal surfaces of steel piping, piping components, and piping elements exposed to moist air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is general and pitting corrosion.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment and that for these components in LRA Table 3.3.1, item 3.3.1-53, corresponding to SRP-LR Table 3.3-1, item 53 (exposure to condensation-internal versus moist air), the GALL Report recommends the use of GALL AMP XI.M24, "Compressed Air Monitoring," because the components under consideration are included in the station and instrument air system. The staff also noted that both the Compressed Air Monitoring Program, recommended by the GALL Report, and the WCP Program, as proposed by the applicant, contain inspection procedures appropriate for the detection of loss of material due to corrosion on the internal surfaces of piping. The staff further noted, however, that the Compressed Air Monitoring Program contains many aspects, in addition to piping inspections, to manage aging. Given the additional aging management controls contained in the Compressed Air Monitoring Program, it is not clear to the staff that the aging of these compressed air components can be adequately managed solely through the visual inspections contained in the WCP Program. By letter dated December 16, 2009, the staff issued RAI 3.3.2.3-8 requesting that the applicant justify the use of the WCP Program for compressed air system components, or adopt an AMP containing all aspects of the Compressed Air Monitoring Program recommended by the GALL Report.

In its response dated January 21, 2010, the applicant stated that the components for the item in question are traps that provide a drain path for condensed moisture in the system and, therefore, the air quality controls of the Compressed Air Monitoring Program would not be effective. The staff finds the applicant's currently proposed AMP acceptable because the WCP Program is capable of detecting the aging effects by visual inspections. The staff's concern described in RAI 3.3.2.3-8 is resolved. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.16 Interior Surfaces of Elastomeric Materials Exposed to Inert Gas

In LRA Tables 3.3.2-8 and 3.3.2-27, the applicant stated that interior surfaces of elastomeric materials exposed to inert gas have no aging effect associated with this combination of material and environment and that no AMP is required. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material/component type is interior surfaces of elastomeric materials exposed to inert gas and confirmed that there are no entries for this component/material and environment. However, in its review of these items, the staff noted that mechanisms other than the nature of the gas in contact with the interior surfaces of elastomeric materials (e.g., temperature and vibration) could cause aging of those materials. Based on the numerous causes for aging of elastomeric materials, the staff cannot conclude from the information provided that the components under consideration will not undergo aging. By letter dated October 13, 2009, the staff issued RAI 3.3.2.3.-1 requesting that the applicant include these components in an appropriate AMP or provide sufficient information to allow the staff to conclude that, under the circumstances being considered, no aging will occur.

In its response dated November 13, 2009, the applicant stated that no aging was expected on the internal surfaces of the hoses under consideration because the internal environment was nitrogen (dry gas). The applicant also stated that the external surfaces of these hoses were exposed to air. The applicant further stated that aging of the hoses due to exposure to air was possible and that it would be managed through the use of the WCP Program. The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. This AMP contains specific inspection procedures to detect aging of elastomers on both internal and external surfaces. The staff finds the applicant's approach to managing the aging of these hoses acceptable because: (1) no aging is expected on the inner surface of the hose due to its exposure to a dry inert gas, and (2) aging which occurs from the exterior of the hose will be managed by the WCP Program, which contains requirements for visual inspection of the exterior surfaces of the hoses. The staff's concern described in RAI 3.3.2.3-1 is resolved. In addition, a staff concern related to selection and frequency of inspections is addressed in the applicant's response, and the staff's evaluation of RAI B2.1.32-2 is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.17 *Changes in Material Properties and Cracking of the Exterior Surfaces of Elastomeric Materials Exposed to Uncontrolled Indoor Air*

In LRA Tables 3.3.2-10 through 3.3.2-17, the applicant stated that exterior surfaces of elastomeric materials exposed to uncontrolled indoor air are being managed for changes in material properties and cracking by the External Surfaces Monitoring Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material/component type is exterior surfaces of elastomeric materials exposed to uncontrolled indoor air and confirmed that there are no entries for this component/material and environment.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. In its review of these items, the staff noted that the proposed AMP uses visual inspection to identify aging. The staff also noted that identification of cracking in elastomers may be difficult using only visual inspection techniques. The staff further noted that changes in material properties, such as hardness and elasticity, cannot be reliably identified using only visual inspection techniques. By letter dated October 13, 2009, the staff issued RAI 3.3.2.3.-1 requesting that the applicant propose an AMP which includes visual inspection and manual manipulation of a sufficient number or area of elastomeric material at a sufficient inspection frequency to adequately detect cracking or changes in the material properties of those materials.

In its response dated November 13, 2009, the applicant cited its response to RAI B2.1.10-1. In that response, the applicant stated that the External Surfaces Monitoring Program includes the "scratch, sniff, and stretch" technique described in the EPRI Aging Assessment Field Guide, which entails detection of surface material degradation and hardening by scratching, odor changes possibly indicating degradation by sniffing, and elastomer hardening or cracking by stretching. The staff finds this acceptable because aging issues, such as changes in hardness and strength, may be discovered using this approach. The applicant also stated that inspections of accessible elastomeric components were routinely conducted and inspections of ventilation system components were conducted at least once per refueling cycle. The staff finds this acceptable because aging issues, such as changes in hardness and strength, may be discovered using this approach, and the frequency and extent of inspections are adequate. The staff's concern described in RAI 3.3.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.18 Reduction in Heat Transfer Due to Fouling from the Exterior Surfaces of Aluminum Cooling and Condenser Fins Exposed to Moist Air

In LRA Tables 3.3.2-10, 3.3.2-13, 3.3.2-15, 3.3.2-17, and 3.3.2-19, the applicant stated that exterior surfaces of aluminum cooling and condenser fins exposed to moist air are being managed for reduction in heat transfer due to fouling by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is exterior surfaces of aluminum cooling and condenser fins exposed to moist air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is reduction in heat transfer due to fouling.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP only includes visual inspections of internal surfaces. The staff additionally noted that the environment listed for these items is external moist air. The staff further noted that visual inspections, as contained in the proposed AMP, are capable of identifying reduction in heat transfer due to fouling. Finally, the staff noted that the fins under consideration are contained in a larger structure. Since these fins may be inspected only when the larger structure is open for inspection, they are functionally internal surfaces to the larger structure. The staff finds the use of the WCP Program acceptable for managing this aging because: (1) the applicant identified an applicable aging effect, (2) appropriate visual inspections are included in the proposed AMP, and (3) the fins under consideration are functionally internal surfaces falling within the scope of the proposed AMP. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.19 Hardening and Loss of Strength Due to Elastomer Degradation from the Internal Surfaces of Elastomeric Flexible Connections Exposed to Moist Air and Uncontrolled Indoor Air

In LRA Tables 3.3.2-10 through 3.3.2-17, the applicant stated that internal surfaces of elastomeric flexible connections exposed to moist air and uncontrolled indoor air are being managed for hardening and loss of strength due to elastomer degradation by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of elastomeric flexible connections exposed to moist air and uncontrolled indoor air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is hardening and loss of strength due to elastomer degradation.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff further noted that the combined use of visual inspections and physical manipulations are capable of detecting hardening and loss of strength of elastomers. The staff finds the applicant's proposal acceptable because the applicant has identified an applicable aging effect and has chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.20 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Tables 3.3.2-13, 3.3.2-14, 3.3.2-15, 3.3.2-17, 3.3.2-21, 3.3.2-22, 3.3.2-25, 3.3.2-26, and 3.3.2.18, the applicant stated that internal surfaces of steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, as well as fouling by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of steel piping, piping components, and piping elements exposed to raw water. The staff noted that the GALL Report recommends either a plant-specific AMP or GALL AMP XI.M27, "Fire Water System," for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, as well as fouling. The staff also noted that the components under consideration are generally waste and drain systems. The staff further noted that none of these systems are safety-related and none are related directly to fire protection.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff finds the proposed AMP acceptable to manage aging for these components as it contains internal inspection techniques suitable for detecting corrosion or fouling on the internal surfaces of piping systems. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.21 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Copper Alloy Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Table 3.3.2-15, the applicant stated that internal surfaces of copper alloy piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to pitting, crevice, and microbiologically-influenced corrosion, as well as fouling by the WCP or Open-Cycle Cooling Water System programs. When the AMP credited in the LRA is the WCP Program, the AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. When the AMP credited in the LRA is the Open-Cycle Cooling Water System Program, generic note B is cited, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP. The applicant stated that components that are nonsafety-related are managed by the WCP Program, and components that are safety-related are managed by the Open-Cycle Cooling Water System Program.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of copper alloy piping, piping components, and piping elements exposed to raw water. The staff noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to pitting, crevice, and microbiologically-influenced corrosion, as well as fouling. As noted above, the applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff reviewed LRA Table 3.3.1, item 3.3.1-82 against SRP-LR Table 3.3-1, item 82, which recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," and found them consistent because the notes in LRA Table 3.3.2-15 state that components that are nonsafety-related are managed by the WCP and components that are safety-related are managed by the Open-Cycle Cooling Water System Program. In a revision to the application, AMR line items that were proposed to be managed by the WCP Program were changed from a reference of generic note E to generic note H. The staff finds the use of the WCP Program acceptable to manage aging of the nonsafety-related components because the WCP Program contains inspection procedures appropriate for detecting loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.22 Loss of Heat Transfer Due to Fouling from the Internal Surfaces of Copper Alloy Heat Exchanger Tubes Exposed to Raw Water

In LRA Table 3.3.2-15, the applicant stated that internal surfaces of copper alloy heat exchanger tubes exposed to raw water are being managed for loss of heat transfer due to fouling by the WCP or Open-Cycle Cooling Water System programs. When the AMP credited in the LRA is the WCP Program, the AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. When the AMP credited in the LRA is the Open-Cycle Cooling Water System Program, generic note B is cited, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of copper alloy piping, piping components, and piping elements exposed to raw water. The staff noted that the entries recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to pitting, crevice, and microbiologically-influenced corrosion, as well as fouling. The applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff reviewed LRA Table 3.3.1, item 3.3.1-83 against SRP-LR Table 3.3-1, item 83, which recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," and found them consistent because components that are nonsafety-related will be managed by the WCP Program and components that are safety-related will be managed by the Open-Cycle Cooling Water System Program. In a revision to the application, AMR line items that were proposed to be managed by the WCP Program were changed from a reference of generic note E to generic note H. The staff finds the use of the WCP Program acceptable to manage the aging of nonsafety-related components because the WCP Program contains inspection procedures appropriate for detecting loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.23 Loss of Material Due to General Corrosion from the Internal and External Surfaces of Steel Components Exposed to Uncontrolled Indoor Air

In LRA Tables 3.3.2-17 and 3.3.2-28, the applicant stated that the internal and external surfaces of steel components exposed to uncontrolled indoor air are being managed for loss of material due to general corrosion by the WCP Program. The AMR line items cite generic note H.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the scope of the LRA AMP for metallic materials is limited to internal surfaces. The staff further noted that the visual inspections included in the AMP are capable of detecting loss of material due to general corrosion. The staff, therefore, finds the applicant's proposal to manage the loss of material from the internal surfaces of these components under consideration in LRA Table 3.3.2-28 acceptable because the components are within the scope of the AMP and appropriate inspection methods are included in the proposed AMP. However, the staff questions the use of the WCP Program for the management of the loss of material from the external surfaces of the compressor included in LRA Table 3.3.2-17, because external surfaces are not within the scope of the proposed AMP. By letter dated January 4, 2010, the staff issued RAI 3.3.2.3-7 requesting that the applicant justify the use of the WCP Program for external surfaces, or select an AMP which is appropriate for use on external surfaces.

In its response dated February 2, 2010, the applicant stated that the WCP Program includes the Internal Surfaces Monitoring Program under its scope. The applicant also stated that the applicable items in LRA Table 3.3.2-17 were under the inspection scope of the Internal Surfaces Monitoring Program because they are the external surfaces of subcomponents within the air conditioning unit's outer housings and, thus, require disassembly to inspect. The staff finds the applicant's response acceptable because given the position of the components, the WCP Program is the appropriate AMP. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.24 Loss of Material or Microbiologically-Influenced Corrosion of Stainless Steel Tubing, Valves, and Strainers Exposed to Raw Water

LRA Table 3.3.2-18 summarizes results of the AMRs for fire protection systems. In LRA Table 3.3.2-18, the applicant stated that for stainless steel tubing, valves, and strainers exposed to raw water, the aging effects of loss of material or MIC are not evaluated in the GALL Report. The applicant stated that these components are managed by the Fire Protection Program. The applicant referenced generic note H for these items, indicating that the aging effect of this component, material, and environment combination is not evaluated in the GALL Report.

The staff evaluated the applicant's claim that the aging effect for this component, material, and environment combination is not evaluated in the GALL Report. The staff reviewed all AMR result lines in the GALL Report and found none where the material is stainless steel, the environment is raw water, and the aging effect is loss of material or MIC. The staff confirmed that the applicant's use of generic footnote H is acceptable. The staff evaluated the use of stainless steel strainers, tubing, and valves in a raw water environment and noted that the material generally performs satisfactorily in a raw water environment without excessive corrosion or loss of material.

The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. The staff noted that the applicant's Fire Protection Program includes periodic flushing and chemical treatment of the water-based fire suppression system. The staff also noted that it is an industry practice to examine the equipment condition of water-based fire suppression system components during periodic flushing and after chemical treatment. The staff finds that loss of material or MIC can, therefore, be adequately managed by periodic flushing and chemical treatment. The staff further noted that the applicant has identified an appropriate program to manage the aging effects of stainless steel strainers, tubing, and valves.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant 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).

3.3.2.3.25 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion from the Internal Surfaces of Aluminum Flame Arrestors, Hoods, and Caps Exposed to Outdoor Air

In LRA Table 3.3.2-19, the applicant stated that internal surfaces of aluminum flame arrestors, hoods, and caps exposed to outdoor air are being managed for loss of material due to pitting, crevice, and galvanic corrosion by the WCP Program. The AMR items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of aluminum flame arrestors, hoods, and caps exposed to outdoor air. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to pitting, crevice, and galvanic corrosion.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes visual inspection of internal surfaces. The staff further noted that visual inspections are capable of detecting loss of material due to pitting, crevice, and galvanic corrosion. The staff finds the applicant's proposal acceptable because the applicant has identified an applicable aging effect and has chosen an AMP which contains appropriate inspection techniques to identify those aging effects. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.26 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion from the Internal Surfaces of Steel Piping, Piping Components, and Piping Elements Exposed to Treated Closed-Cycle Cooling Water

In LRA Table 3.3.2-19, the applicant stated that internal surfaces of steel piping, piping components, and piping elements exposed to treated closed-cycle cooling water are being managed for loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion by the WCP Program. The AMR line items cite generic note B, indicating that the item is consistent with the GALL Report for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP and generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of steel piping, piping components, and piping elements exposed to treated closed-cycle cooling water. The staff noted that for Table 3.3.1, item 3.3.1-47, GALL AMP XI.M21, "Closed-Cycle Cooling Water System," is recommended for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion. The staff also noted that note 3 for LRA Table 3.3.2-19 states that:

> Aging effects for the internal surfaces of the TSC diesel generator cooling water components are managed by the Work Control Process. Aging effects for the internal surfaces of the emergency diesel generator cooling water components are managed by the Closed Cycle Cooling Water System aging management program, which is confirmed by the Work Control Process.

The staff further noted that the EDG is a safety-related component and the TSC diesel generator is not. The staff agrees with the applicant that it is appropriate to manage the aging of components in the EDG which are exposed to treated water using the Closed-Cycle Cooling Water System Program. The staff also agrees with the applicant that it is not appropriate to manage the aging of components of the TSC generator using the Closed-Cycle Cooling Water System Program because the scope of this AMP is limited to safety-related components. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff finds the applicant's proposal to manage aging using the portion of the WCP Program which is consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components," acceptable because: (1) the scope of this AMP includes internal surfaces of piping and ducting components not included in other AMPs, and (2) the WCP Program contains visual inspection techniques appropriate to the identification of loss of material for these components. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.27 Loss of Material Due to Pitting and Crevice Corrosion from the Internal Surfaces of Stainless Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Table 3.3.2-20, the applicant stated that internal surfaces of stainless steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to pitting and crevice corrosion by the WCP and Open-Cycle Cooling Water System programs. When the AMP credited in the LRA is the WCP Program, the AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report. When the AMP credited in the LRA is the Open-Cycle Cooling Water System Program, generic note B is cited, indicating that the item is consistent with the GALL Report item for component, material, environment, and aging effect, but the AMP takes some exceptions to the GALL Report AMP.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of stainless steel piping, piping components, and piping elements exposed to raw water. The staff noted that these items recommend GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to pitting and crevice corrosion. The applicant stated that safety-related systems will be managed by the Open-Cycle Cooling Water System Program, and nonsafety-related components will be managed by the WCP Program. This review confirmed that the applicant's use of generic notes B and H are acceptable.

The staff reviewed the applicant's WCP and Open-Cycle Cooling Water System programs and its evaluation is documented in SER Sections 3.0.3.2.19 and 3.0.3.2.14, respectively. The staff reviewed LRA Table 3.3.1, item 3.3.1-78 against SRP-LR Table 3.3-1, item 78, which recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," and found them consistent because components that are nonsafety-related will be managed by the WCP Program and components that are safety-related will be managed by the Open-Cycle Cooling Water System Program. In a revision to the application, AMR line items that were proposed to be managed by the WCP Program were changed from a reference of generic note E to generic note H. The staff finds the use of the WCP Program acceptable to manage the aging of the nonsafety-related components because the WCP Program contains inspection procedures appropriate for detecting loss of material from the inside surfaces of piping exposed to raw water. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.28 Loss of Material Due to Microbiologically-Influenced Corrosion of Stainless Steel Piping, Piping Components, and Piping Elements Exposed to Soil

In LRA Table 3.3.2-20, the applicant stated that stainless steel piping, piping components, and piping elements exposed to soil have an aging effect of loss of material due to MIC and that the aging effect will be managed by the Buried Piping and Tanks Inspection Program. The AMR line item cites generic note H, indicating that the aging effect for this component, material, and environmental combination is not in the GALL Report.

The staff reviewed all AMR result lines in the GALL Report where the material is stainless steel piping, piping components, and piping elements and confirmed that there are no entries for this material where the environment is soil. The staff reviewed the applicant's Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.4.

The GALL AMP XI.M34 program description does not include stainless steel; however, in its review of LRA Table 3.3.2-20, the staff found that the material for the components is stainless steel. By letter dated August 28, 2009, the staff issued RAI 3.3.2.3.20-1 requesting that the applicant confirm whether the buried stainless steel piping is wrapped, coated, or bare and, if coated or wrapped, justify how the proposed AMP will adequately manage its aging.

In its response dated September 28, 2009, the applicant stated that the answer to this RAI was contained in its response to RAI B2.1.7 which was transmitted by letter dated August 17, 2009. The staff reviewed the response to this RAI, in which the applicant stated that the stainless steel piping under consideration is a vent line which: (1) was installed in 2003, (2) consists of approximately 20 feet of 2 inch nominal ASTM A-312 schedule 80 pipe, (3) is all buried except for about 3 feet, and (4) is coated and wrapped. The applicant also stated that even though the material for this line was not in the GALL Report AMP, its failure was highly unlikely due to the design of the piping, recent installation, and planned inspections.

The staff finds the applicant's response to RAI 3.3.2.3.20-1 acceptable because there is an exceptionally small probability that the pipe under consideration will fail based on its design (i.e., pipe need not retain any pressure) and planned inspections. The staff's concern described in RAI 3.3.2.3.20-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.29 Hardening and Loss of Strength Due to Elastomer Degradation from the Internal Surfaces of Elastomeric Hoses and Flow Elements Exposed to Raw Water

In LRA Tables 3.3.2-22 and 3.3.2-26 and Table 3.3.1, item 3.3.1-75, the applicant stated that internal surfaces of elastomeric hoses and flow elements exposed to raw water are being managed for hardening and loss of strength due to elastomer degradation by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of elastomeric hoses and flow elements exposed to raw water. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is hardening and loss of strength due to elastomer degradation. The staff notes that GALL Report Table VII.C1, item 1 does address elastomers exposed to raw water with an aging effect of hardening and loss of strength due to elastomer degradation and recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System." The staff also noted that neither of these systems, liquid waste processing and discharge, nor miscellaneous drains and sumps, transfer heat to the ultimate heat sink and, therefore, they do not fall under the scope of this GALL Report recommended program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff further noted that the combined use of visual inspections and physical manipulations are capable of detecting hardening and loss of strength of elastomers. The staff finds the applicant's proposal acceptable because the applicant has identified an applicable aging effect and has chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.30 Loss of Material Due to Erosion from the Internal Surfaces of Elastomeric Hoses and Flow Elements Exposed to Raw Water

In LRA Tables 3.3.2-22 and 3.3.2.1-26, the applicant stated that internal surfaces of elastomeric hoses and flow elements exposed to raw water are being managed for loss of material due to erosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is internal surfaces of elastomeric hoses and flow elements exposed to raw water. The staff confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to erosion. The staff notes that GALL Report Table VII.C1, item 2, does address elastomers exposed to raw water with an aging effect of loss of material due to erosion and recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System." The staff also noted that neither of these systems, liquid waste processing and discharge, and miscellaneous drains and sumps, transfer heat to the ultimate heat sink and, therefore, they do not fall under the scope of this GALL Report recommended program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of the AMR line items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff further noted that the combined use of visual inspections and physical manipulations are capable of detecting loss of material from elastomers. The staff finds the applicant's proposal acceptable because the applicant has identified an applicable aging effect and has chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.31 Stainless Steel Components Exposed to Air-Indoor Controlled (External)

LRA Tables 3.3.2-10 and 3.3.2-11 address temperature elements fabricated from stainless steel exposed to air-indoor controlled (external) that do not have an aging effect, therefore, an AMP is not required. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed LRA Table 3.0-1, "Service Environments," and noted that the applicant defines air-indoor controlled as "air-conditioned plant areas where the temperature and humidity levels are controlled. Condensation does not typically occur in an air-indoor controlled environment." The staff noted the GALL Report, Chapter IX defines air-indoor controlled as "the environment to which the specified internal or external surface of the component or structure is exposed: indoor air in a humidity controlled (e.g., air conditioned) environment." The staff determined that the applicant's environment is consistent with the environment described in the GALL Report.

The staff reviewed the GALL Report, Section VII.J and noted that GALL AMR item VII.J-15 states that piping, piping components, and piping elements fabricated of stainless steel that are exposed to air-indoor uncontrolled (external) do not experience an AERM. The staff noted that the air-indoor controlled is humidity controlled, which will preclude the formation of condensation which can occur in an air-indoor uncontrolled environment. Based on its review, the staff finds that stainless steel components exposed to air-indoor that is humidity controlled, which precludes the formation of condensation, do not experience an AERM because it is more conservative than the recommendation of GALL AMR item VII.J-15. The staff finds the applicant has appropriately determined that stainless steel exposed to air-indoor controlled (external) does not have an AERM.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.32 Stainless Steel Components Subject to Loss of Material Due to Erosion Exposed to Raw Water

LRA Table 3.3.2-3 addresses the SFP heat exchanger tubes and tubesheet fabricated from stainless steel exposed to raw water (external), which are subject to loss of material due to erosion. LRA Table 3.3.2-9 addresses the boric acid evaporator distillate sample cooler tubing fabricated from stainless steel exposed to raw water (external), which is subject to loss of material due to erosion. LRA Table 3.3.2-21 addresses orifices, piping, strainer housings, and valves fabricated from stainless steel exposed to raw water (external), which are subject to loss of material due to erosion. LRA Table 3.3.2-22 addresses tanks, pumps, filter housings, flow elements, flow orifices, flow transmitters, piping, strainer housings, tubing, and valves fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to erosion. LRA Table 3.3.2-23 addresses radiation detectors fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to erosion. LRA Table 3.3.2-25 addresses flow elements, mixers (static), and piping fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to erosion. LRA Table 3.3.2-26 addresses piping, orifices, pumps, and valves fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to erosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.33 Stainless Steel Components Subject to Loss of Material Due to Pitting and Crevice Corrosion Exposed to Air-Outdoor, Air-Moist, Raw Water, and Treated Water-Closed-Cycle Cooling

LRA Table 3.3.2-14 addresses the containment fan coil unit drip pan exposed to raw water (external) and piping exposed to raw water (internal) fabricated from stainless steel, which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-18 addresses flexible hoses, valves, and tubing fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-19 addresses flame arrestor, hoods, and caps exposed to air-outdoor (internal) and flexible connections and sight glass components exposed to treated water-closed-cycle cooling (internal) fabricated from stainless steel, which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-20 addresses flow elements, flow indicators, piping, and tubing fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-21 addresses filter housings, orifices, piping, tubing, and valves fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-22 addresses the distillate cooler (shell only), the evaporator condenser (shell only), the waste evaporator sample cooler (shell only), level switches, piping, and tubing fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-23 addresses radiation detectors, tubing, and valves fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-26 addresses piping and valves fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-27 addresses hoses fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program, and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.34 Copper Alloy Components Subject to Loss of Material Due to Erosion and Loss of Material Due to Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion and Fouling Exposed to Raw Water

LRA Table 3.3.2-8 addresses aftercooler (tubes) fabricated from copper alloy exposed to raw water (external), which are subject to loss of material due to erosion and loss of material due to pitting, crevice, galvanic, and microbiologically-influenced corrosion and fouling. LRA Table 3.3.2-20 addresses valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to erosion. LRA Table 3.3.2-21 addresses heat exchanger (tubes) fabricated from copper alloy exposed to raw water (external) and valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to erosion. LRA Table 3.3.2-25 addresses valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to erosion.

The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.35 Copper Alloy Components Subject to Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion and Fouling Exposed to Raw Water

LRA Table 3.3.2-20 addresses flow indicators, tubing, and valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. LRA Table 3.3.2-21 addresses heat exchanger (tubes) fabricated from copper alloy exposed to raw water (external) and valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. LRA Table 3.3.2-25 addresses tubing and valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. LRA Table 3.3.2-28 addresses piping and valves fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.38 Stainless Steel Components Subject to Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion and Fouling Exposed to Raw Water

LRA Table 3.3.2-3 addresses the SFP heat exchanger tubes and tubesheet fabricated from stainless steel exposed to raw water (external), which are subject to loss of material due to *pitting, crevice, and microbiologically-influenced corrosion and fouling*. LRA Table 3.3.2-9 addresses the boric acid evaporator distillate sample cooler tubing fabricated from stainless steel exposed to raw water (external), which is subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. LRA Tables 3.3.2-21, 3.3.2-22, 3.3.2-23, 3.3.2-25, and 3.3.2-26 address piping, piping components, piping elements, heat exchanger components, radiation detectors, and tanks exposed to raw water which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.36 Copper Alloy Components Subject to Reduction of Heat Transfer Due to Fouling Exposed to Raw Water and Air-Moist

LRA Table 3.3.2-8 addresses aftercooler (tubes) fabricated from copper alloy exposed to raw water (external), which are subject to reduction of heat transfer due to fouling. LRA Table 3.3.2-10 addresses air handling units (cooling coils/fins) fabricated from copper alloy exposed to air-moist (external), which are subject to reduction of heat transfer due to fouling. LRA Table 3.3.2-13 addresses fan coil units (cooling coils/fins) fabricated from copper alloy exposed to air-moist (external), which are subject to reduction of heat transfer due to fouling. LRA Table 3.3.2-14 addresses containment fan coil units (cooling coils) fabricated from copper alloy exposed to air-moist (external) and shroud cooling coils (cooling coils) fabricated from copper alloy exposed to air-indoor uncontrolled (external), which are subject to reduction of heat transfer due to fouling. LRA Table 3.3.2-15 addresses fan coil units (cooling coils/fins) fabricated from copper alloy exposed to air-moist (external), which are subject to reduction of heat transfer due to fouling. LRA Table 3.3.2-17 addresses air conditioning units (battery room cooling coils/fins and condenser/fins) fabricated from copper alloy exposed to air-moist (external), which are subject to reduction of heat transfer due to fouling. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect reduction of heat transfer due to fouling. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting reduction of heat transfer due to fouling by indications of any fouling (buildup from whatever source) on the surface of these components. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.37 Stainless Steel Components Subject to Loss of Material Due to Fretting Exposed to Raw Water and Treated Water-Closed-Cycle Cooling

LRA Table 3.3.2-3 addresses the SFP heat exchanger tubes fabricated from stainless steel exposed to raw water (external), which are subject to loss of material due to fretting. LRA Table 3.3.2-9 addresses the letdown heat exchanger tubes fabricated from stainless steel exposed to treated water-closed-cycle cooling (external), which are subject to loss of material due to fretting. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.39 Copper Alloy Components Subject to Loss of Material Due to Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion Exposed to Treated Water-Closed-Cycle Cooling and Air-Outdoor

LRA Table 3.3.2-19 addresses radiator (tubes) fabricated from copper alloy exposed to treated water-closed-cycle cooling (internal), which are subject to loss of material due to pitting, crevice, galvanic, and microbiologically-influenced corrosion, and radiator (tubes) fabricated from copper alloy exposed to air-outdoor (external), which are subject to loss of material due to pitting and crevice corrosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.40 Stainless Steel Components Subject to Loss of Material Due to Microbiologically-Influenced Corrosion and Loss of Material Due to Pitting and Crevice Corrosion and Fouling Exposed to Raw Water and Treated Water-Closed-Cycle Cooling

LRA Table 3.3.2-6 addresses filter housings (service water to chlorination pumps) and flexible hoses fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling. LRA Table 3.3.2-9 addresses boric acid evaporator distillate sample cooler (tubing) fabricated from stainless steel exposed to raw water (external), which is subject to loss of material due to MIC. LRA Table 3.3.2-19 addresses flexible connections (including braided lines) and sight glasses fabricated from stainless steel exposed to treated water-closed-cycle cooling water (internal), which are subject to loss of material due to MIC. LRA Table 3.3.2-20 addresses flow elements, flow indicators, piping, and tubing fabricated from stainless steel exposed to raw water (internal), which are subject to loss of material due to MIC. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) require that the extent of the inspection and its results be documented even when no signs of aging degradation are found so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to erosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.41 Stainless Steel and Copper Alloy Components Subject to Loss of Material Due to Pitting and Crevice Corrosion Exposed to Air-Outdoor (External)

LRA Table 3.3.2-18 addresses fire hydrants and hose valve heads fabricated from copper alloy exposed to air-outdoor (external), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-19 addresses flame arrestors, hoods, caps, flexible connections (including braided lines), and sight glasses fabricated from stainless steel exposed to air-outdoor (external), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.3.2-20 addresses piping fabricated from stainless steel exposed to air-outdoor (external), which are subject to loss of material due to pitting and crevice corrosion. The applicant credited the External Surfaces Monitoring Program for aging management of loss of material due to pitting and crevice corrosion in an air-outdoor (external) environment for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel and copper alloy components exposed to an external condensation environment addressed by this AMR. The staff noted that a visual inspection will be capable of identifying degradation on the external surface that will present itself in signs of corrosion, corrosion byproducts, coating degradation, discoloration on the surface, scale/deposits, and pits and surface discontinuities that are indicative of loss of material. On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.42 Copper Alloy Components Exposed to Air-Indoor Controlled (Internal)

In LRA Table 3.3.2-10, the applicant stated that tubing fabricated from copper alloy material exposed to air-indoor controlled (internal) does not have an aging effect, therefore, an AMP is not required. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

During its review, the staff noted that the LRA did not provide a justification as to why copper exposed to air-indoor controlled (internal) does not have an aging effect. By letter dated August 28, 2009, the staff issued RAI 3.3.2.3.10-1 requesting that the applicant: (1) describe the environmental conditions that exist in the internal environment of these components and (2) justify why these components are not subject to an AERM when exposed to air-indoor controlled (internal).

In its response dated September 28, 2009, the applicant stated that the air-indoor controlled (internal) environment for copper alloy tubing was incorrectly included in LRA Table 3.3.2-10. The applicant further stated that the correct environment for this component is air-moist (internal) and the aging effect of loss of material due to pitting and crevice corrosion will be managed by the WCP Program, which is already included in the LRA. The staff's evaluation of this AMR line item is documented in SER Section 3.3.2.2.10.6.

Based on its review, the staff finds the applicant's response to RAI 3.3.2.3.10-1 acceptable because the applicant has identified and corrected the error, and aging management for copper alloy tubing is provided by the WCP Program and is evaluated in SER Section 3.3.2.2.10.6. The staff's concern described in RAI 3.3.2.3.10-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately amended its LRA to identify the correct environment for copper alloy tubing in LRA Table 3.3.2-10 and has proposed the WCP Program for aging management as evaluated in SER Section 3.3.2.2.10.6.

3.3.2.3.43 Loss of Material Due to Microbiologically-Influenced Corrosion for Stainless Steel and Steel

In LRA Table 3.3.2-7, the applicant stated that the stainless steel flow elements, flow orifices, piping, strainer housings, tubing and valves, and steel component cooling heat exchangers (shell), component cooling pumps and surge tank, piping, tubing, and valves exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. The applicant further stated, in LRA Table 3.3.2-7, that steel component cooling heat exchangers (tubesheets) exposed to treated water-closed-cycle cooling (external) are being managed for loss of material due to MIC. In LRA Table 3.3.2-9, the applicant stated that the stainless steel distillate cooler (tubing and tubesheet), excess letdown heat exchanger (tubing and tubesheet), letdown heat exchanger (tubes and tubesheet), and seal water heat exchanger (tubes and tubesheet) exposed to treated water-closed-cycle cooling (external) and the steel shells for the distillate cooler, excess letdown heat exchanger, letdown heat exchanger, and seal water heat exchanger exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-9, the applicant stated that the stainless steel evaporator condenser (channel head, tubesheet, and tubing) and vent condenser (channel head, tubesheet, and tubes) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-10, the applicant stated that the stainless steel piping and chiller pumps and steel expansion tanks, piping, and valves exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to

MIC. In LRA Table 3.3.2-19, the applicant stated that the stainless steel tubing and valves and steel diesel generator cooling water heat exchangers (shell), lube oil coolers (lube oil cooler channel head), turbocharger aftercoolers (channel head, tubes, tubesheet), piping, tubing, and valves exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-21, the applicant stated that the steel heat exchanger channel heads and tubesheets exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-29, the applicant stated that the steel and stainless steel sample heat exchanger shells exposed to treated water-closed-cycle cooling (internal) and stainless steel sample heat exchangers tubes exposed to treated water-closed-cycle cooling (external) are being managed for loss of material due to MIC. The applicant credited the Closed-Cycle Cooling Water System Program and the WCP Program to manage this aging effect for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff further determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of loss of material through program inspections that provide verification of the effectiveness of the Closed-Cycle Cooling Water System Program. The staff also determined that these inspections will be performed by using NDE techniques that are effective and capable for the identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. Based on its review, the staff finds the applicant's use of the programs identified above acceptable because the chemistry control will provide an environment that is not conducive for loss of material to occur and the applicant will verify the effectiveness of the chemistry control with performance monitoring and examinations performed by its WCP Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.2.3.44 Loss of Material Due to Microbiologically-Influenced Corrosion for Copper Alloy

In LRA Table 3.3.2-7, the applicant stated that the copper alloy tubing and valves exposed to treated water-closed-cycle cooling (internal) and component cooling heat exchangers (tubes) exposed to treated water-closed-cycle cooling (external) are being managed for loss of material due to MIC. In LRA Table 3.3.2-10, the applicant stated that the copper alloy air handling units (cooling coils/fins) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-19, the applicant stated that the copper alloy diesel generator cooling water heat exchangers (tubes and tubesheets) exposed to treated water-closed-cycle cooling (external) and lube oil coolers (tubesheets and tubes), tubing, and valves exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. In LRA Table 3.3.2-21, the applicant stated that the copper alloy heat exchangers (tubes) exposed to treated water-closed-cycle cooling (internal) are being managed for loss of material due to MIC. The applicant credited the Closed-Cycle Cooling Water System Program and the WCP Program to manage this aging effect for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.2.5 and 3.0.3.2.19, respectively. The staff determined that the Closed-Cycle Cooling Water System Program includes chemistry control and performance monitoring. The staff also determined that the program establishes appropriate corrosion control and chemistry specifications, including the use of inhibitors. The staff further determined that the performance of these systems are monitored to verify the effectiveness of the chemistry controls, which include system operation monitoring, system testing, heat exchanger thermal performance testing, heat exchanger tube eddy current testing, and pump performance testing.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of loss of material through program inspections that provide verification of the effectiveness of the Closed-Cycle Cooling Water System Program. The staff also determined that these inspections will be performed by using NDE techniques that are effective and capable for the identification of these potential aging effects, and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. Based on its review, the staff finds the applicant's use of the programs identified above acceptable because the chemistry control will provide an environment that is not conducive for loss of material to occur and the applicant will verify the effectiveness of the chemistry control with performance monitoring and examinations performed by its WCP Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.3.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the ESF system components within the scope of license renewal and subject to an AMR 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).

3.4 Aging Management of Steam and Power Conversion Systems

This section of the SER documents the staff's review of the applicant's AMR results for the steam and power conversion system components and component groups of the following systems:

- turbine system
- main steam and steam dump system
- bleed steam system
- feedwater system
- condensate system
- steam generator blowdown treatment system
- auxiliary feedwater system
- air removal system
- heater and moisture separator drains system
- heating steam system
- main generator (mechanical) and auxiliaries system
- secondary sampling system
- turbine oil purification system
- turbine room traps and drains system

3.4.1 Summary of Technical Information in the Application

LRA Section 3.4 provides AMR results for the steam and power conversion system components and component groups. In LRA Table 3.4.1, "Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of NUREG-1801," the applicant provided a summary comparison of its AMRs to those evaluated in the GALL Report for steam and power conversion system components and component groups.

The applicant's AMRs evaluated and incorporated plant-specific and industry OE in the determination of AERMs from plant-specific condition reports and discussions with site personnel and from the GALL Report and issues identified since its publication.

3.4.2 Staff Evaluation

The staff reviewed LRA Section 3.4 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for steam and power conversion system components, within the scope of license renewal and subject to an AMR, 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).

The staff conducted an onsite audit of AMPs to confirm the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.4.2.1 and 3.4.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.4.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's OE to verify the applicant's claims.

Table 3.4-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.4 and addressed in the GALL Report.

Table 3.4-1 Staff Evaluation for Steam and Power Conversion System Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Sections 3.4.2.2.1 and 4.3)
Steel piping, piping components, and piping elements exposed to steam (3.4.1-2)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.2.1)
Steel heat exchanger components exposed to treated water (3.4.1-3)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.2.1)
Steel piping, piping components, and piping elements exposed to treated water (3.4.1-4)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.2.1)
Steel heat exchanger components exposed to treated water (3.4.1-5)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel and stainless steel tanks exposed to treated water (3.4.1-6)	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program, Primary Water Chemistry Program, and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Sections 3.4.2.2.2.1 and 3.4.2.2.7.1)
Steel piping, piping components, and piping elements exposed to lubricating oil (3.4.1-7)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.2.2.2)
Steel piping, piping components, and piping elements exposed to raw water (3.4.1-8)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling	Plant-specific	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.2.3)
Stainless steel and copper alloy heat exchanger tubes exposed to treated water (3.4.1-9)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.4.1)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil (3.4.1-10)	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.2.4.2)
Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil (3.4.1-11)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No (for Buried Piping and Tanks Surveillance) Yes (for Buried Piping and Tanks Inspection)	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.2.5.1)
Steel heat exchanger components exposed to lubricating oil (3.4.1-12)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.2.5.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel piping, piping components, piping elements exposed to steam (3.4.1-13)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)
Stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water > 60 °C (140 °F) (3.4.1-14)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.6)
Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water (3.4.1-15)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.7.1)
Stainless steel piping, piping components, and piping elements; tanks; and heat exchanger components exposed to treated water (3.4.1-16)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	WCP Program, Primary Water Chemistry Program, and Secondary Water Chemistry Program	Consistent with the GALL Report (See SER Section 3.4.2.2.7.1)
Stainless steel piping, piping components, and piping elements exposed to soil (3.4.1-17)	Loss of material due to pitting and crevice corrosion	Plant-specific	Yes	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.2.7.2)
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.4.1-18)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.2.7.3)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil (3.4.1-19)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis Program and WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.2.8)
Steel tanks exposed to air-outdoor (external) (3.4.1-20)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
High-strength steel closure bolting exposed to air with steam or water leakage (3.4.1-21)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Steel bolting and closure bolting exposed to air with steam or water leakage, air-outdoor (external), or air-indoor uncontrolled (external) (3.4.1-22)	Loss of material due to general, pitting, and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water > 60 °C (140 °F) (3.4.1-23)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)
Steel heat exchanger components exposed to closed-cycle cooling water (3.4.1-24)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.3.7)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.4.1-25)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.3.7)
Copper alloy piping, piping components, and piping elements exposed to closed-cycle cooling water (3.4.1-26)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.3.7)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.4.1-27)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP In GALL Report	Further Evaluation In GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel external surfaces exposed to air-indoor uncontrolled (external), condensation (external), or air-outdoor (external) (3.4.1-28)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-29)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Flow-Accelerated Corrosion Program	Consistent with the GALL Report
Steel piping, piping components, and piping elements exposed to air-outdoor (internal) or condensation (internal) (3.4.1-30)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	WCP Program	Consistent with the GALL Report
Steel heat exchanger components exposed to raw water (3.4.1-31)	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.3.8)
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.4.1-32)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	WCP Program	Consistent with the GALL Report (See SER Section 3.4.2.3.8)
Stainless steel heat exchanger components exposed to raw water (3.4.1-33)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling	Open-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water (3.4.1-34)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Not applicable to KPS	Not applicable to KPS (See SER Section 3.4.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy > 15% Zn piping, piping components, and piping elements exposed to closed-cycle cooling water, raw water, or treated water (3.4.1-35)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials Program	Consistent with the GALL Report
Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water (3.4.1-36)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials Program	Consistent with the GALL Report
Steel, stainless steel, and Ni-based alloy piping, piping components, and piping elements exposed to steam (3.4.1-37)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	WCP Program, Secondary Water Chemistry Program, and/or Steam Generator Tube Integrity Program	Consistent with the GALL Report (See SER Sections 3.4.2.1.2 and 3.4.2.1.3)
Steel bolting and external surfaces exposed to air with borated water leakage (3.4.1-38)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Stainless steel piping, piping components, and piping elements exposed to steam (3.4.1-39)	Cracking due to SCC	Water Chemistry	No	WCP Program and Secondary Water Chemistry Program	Consistent with the GALL Report
Glass piping elements exposed to air, lubricating oil, raw water, and treated water (3.4.1-40)	None	None	No	None	Consistent with the GALL Report
Stainless steel, copper alloy, and Ni-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.4.1-41)	None	None	No	None	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.4.1-42)	None	None	No	None	Consistent with the GALL Report
Steel and stainless steel piping, piping components, and piping elements in concrete (3.4.1-43)	None	None	No	None	Consistent with the GALL Report
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.4.1-44)	None	None	No	None	Consistent with the GALL Report

The staff's review of the steam and power conversion system component groups followed several approaches. One approach, documented in SER Section 3.4.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.4.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.4.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the steam and power conversion system components is documented in SER Section 3.0.3.

3.4.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.4.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the steam and power conversion system components:

- Bolting Integrity Program
- Boric Acid Corrosion Program
- External Surfaces Monitoring Program
- Flow-Accelerated Corrosion Program
- Lubricating Oil Analysis Program
- Secondary Water Chemistry Program
- Selective Leaching of Materials Program
- Work Control Process Program

LRA Tables 3.4.2-1 through 3.4.2-14 summarize the AMRs for the steam and power conversion system components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report and determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed whether the AMR line item of the different component was applicable to the component under review. The staff confirmed whether it had reviewed and accepted the exceptions to the GALL Report AMPs. It also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report, and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation follows.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.2.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

3.4.2.1.1 AMR Results Identified as Not Applicable

LRA Table 3.4.1, items 3.4.1-5 and 3.4.1-13 discuss the applicant's determination on the GALL Report AMR line items that are applicable only to BWR-designed reactors. In the applicant's AMR discussions for these line items, no additional information is provided. The staff confirmed that these AMR line items in Table 1 of the GALL Report, Volume 1 are only applicable to BWR-designed reactors and that KPS is a PWR with a dry ambient containment. Based on this determination, the staff finds that the applicant has provided an acceptable basis for concluding that AMR items 3.4.1-5 and 3.4.1-13 in Table 1 of the GALL Report, Volume 1 are not applicable to KPS.

LRA Table 3.4.1, item 3.4.1-20 addresses steel tanks exposed to air-outdoor (external). The GALL Report recommends the use of GALL AMP XI.M29, "Aboveground Steel Tanks," to manage loss of material, general, pitting, and crevice corrosion for this component group. The applicant stated that this item is not applicable because there are no steam and power conversion system steel tanks exposed to an air-outdoor (external) environment. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion systems that include steel tanks exposed to air-outdoor. The staff also noted that a search of the applicant's USAR did not find any evidence of in-scope steel tanks in the steam and power conversion systems exposed to air-outdoor. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel tanks exposed to air-outdoor in the steam and power conversion systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, item 3.4.1-23 addresses stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water greater than 60 °C (140 °F). The GALL Report recommends the use of GALL AMP XI.M21, "Closed-Cycle Cooling Water System," to manage cracking due to SCC for this component group. The applicant stated that this item is not applicable because there are no steam and power conversion system components exposed to a closed-cycle cooling water environment greater than 60 °C (140 °F). The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion system that include stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water greater than 60 °C (140 °F). The staff also noted that a search of USAR Chapter 10, "Steam and Power Conversion System," did not find any evidence of stainless steel piping, piping components, and piping elements in the steam and power conversion system exposed to closed-cycle cooling water greater than 60 °C (140 °F). Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water greater than 60 °C (140°F) and, therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, item 3.4.1-27 addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water. The GALL Report recommends the use of GALL AMP XI.M21, "Closed-Cycle Cooling Water System," to manage the reduction of heat transfer due to fouling for this component group. The applicant stated that this item is not applicable because there are no steel, stainless steel, or copper alloy heat exchanger tubes exposed to a closed-cycle cooling water environment that perform a heat transfer intended function per 10 CFR 54.4(a). The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion system that include steel, stainless steel, or copper alloy heat exchanger tubes exposed to a closed-cycle cooling water environment that perform a heat transfer intended function per 10 CFR 54.4(a). The staff also noted that a search of USAR Chapter 10, "Steam and Power Conversion System," did not find any evidence of steel, stainless steel, or copper alloy heat exchanger tubes exposed to a closed-cycle cooling water environment that perform a heat transfer intended function per 10 CFR 54.4(a). Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel, stainless steel, or copper alloy heat exchanger tubes exposed to a closed-cycle cooling water environment that perform a heat transfer intended function per 10 CFR 54.4(a) and, therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, item 3.4.1-33 addresses stainless steel heat exchanger components exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion and fouling for this component group. The applicant stated that this line item is not applicable because there are no stainless steel heat exchanger components exposed to a raw water environment. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion systems that include stainless steel heat exchanger components exposed to raw water. The staff also noted that a search of the applicant's USAR did not find any evidence of stainless steel heat exchanger components in the steam and power conversion systems exposed to raw water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope stainless steel heat exchanger components exposed to raw water in the steam and power conversion systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, item 3.4.1-34 addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water. The GALL Report recommends the use of GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage reduction of heat transfer due to fouling for this component group. The applicant stated that this line item is not applicable because there are no steel, stainless steel, or copper alloy heat exchanger components exposed to a raw water environment that have a heat transfer intended function per 10 CFR 54.4(a). The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion systems that include steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water. The staff also noted that a search of the applicant's USAR did not find any evidence of steel, stainless steel, and copper alloy heat exchanger tubes in the steam and power conversion systems exposed to raw water. Based on its review of the LRA and USAR, the staff confirmed that there are no in-scope steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water in the steam and power conversion systems and, therefore, finds the applicant's determination acceptable.

3.4.2.1.2 Loss of Material Due to Pitting and Crevice Corrosion of Steel, Stainless Steel, and Nickel-Based Alloy Piping, Piping Components, and Piping Elements Exposed to Steam

LRA Table 3.4.1, item 3.4.1-37 addresses the loss of material due to pitting and crevice corrosion of steel, stainless steel, and Ni-based alloy piping, piping components, and piping elements exposed to steam. As used in the Table 2 line items subordinate to item 3.4.1-37, the environment is expanded to include treated secondary water. Additionally, components were expanded to include heat exchangers, specifically in Tables 3.3.2-9 and 3.3.2-10.

This SER entry does not include items subordinate to item 3.4.1-37, which addresses steam generator components of Table 3.1.2-4. Those steam generator components are addressed in SER Section 3.4.2.1.3 below.

The LRA credits the Secondary Water Chemistry and WCP programs to manage this aging effect for steel, stainless steel, and Ni-based alloy piping, piping components, and piping and heat exchanger components. The GALL Report recommends the water chemistry program to manage this aging effect. Additionally, for some of the AMR line items, the GALL Report recommends the use of the one-time inspection program. The AMR line items cite generic notes: (1) A, indicating that the line item is consistent with the GALL Report item for component, material, environment, and aging effect and the LRA AMP is consistent with the GALL Report AMP; (2) C, indicating that the component is different, but consistent with the GALL Report item for material, environment, and aging effect and the LRA AMP is consistent with the GALL Report AMP; and (3) E, indicating that the LRA AMR is consistent with the GALL Report item for material, environment, and aging effect, but a different AMP is credited. The applicant proposed that all the items for which the Secondary Water Chemistry Program is credited are either fully consistent with the GALL Report (generic note A) or fully consistent with the GALL Report except for the component (generic note C). The applicant proposed that all the items for which the WCP Program is credited are consistent with the GALL Report in all respects except a different AMP is credited (generic note E).

The staff reviewed the applicant's Secondary Water Chemistry and WCP programs and its evaluation is documented in SER Sections 3.0.3.1.11 and 3.0.3.2.19, respectively. The staff finds the applicant's proposal for managing the aging of these components acceptable because: (1) all the components included in item 3.4.1-37 citing generic note C are subject to similar aging effects and lose material at similar rates when compared to components specifically included in item 3.4.1-37, (2) the Secondary Water Chemistry Program ensures that chemistry parameters are maintained consistent with minimizing corrosion, and (3) the WCP Program was developed in part to perform inspections to confirm the effectiveness of the chemistry control program by inspecting susceptible internal surfaces of components, such as those in stagnant flow locations.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.1.3 Loss of Material Due to Pitting and Crevice Corrosion of Nickel-Alloy Components Exposed to Treated Water and/or Steam

This section discusses those items of LRA Table 3.4.1, item 3.4.1-37 not addressed in Section 3.4.2.1.2 above.

LRA Table 3.4.1, item 3.4.1-37 and LRA Table 3.1.2-4 address AMR items for the loss of material due to pitting and crevice corrosion for Ni-alloy components exposed to treated water and/or steam-secondary for the following seven steam generator components:

- feedwater inlet ring J nozzles
- feedwater nozzle (and Ni-alloy cladding)
- feedwater nozzle thermal sleeve
- steam nozzle flow restrictor

- tube bundle support hardware
- tube plugs
- tube and sleeves

The staff reviewed LRA Table 3.1.2-4 and noted that for the two aging effects described in the SRP-LR and LRA Table 3.1.1, items 3.1.1-72 and 3.1.1-74, the applicant identified the aging effect of cracking but proposed loss of material due to pitting and crevice corrosion for these seven components, instead of loss of material due to fretting and wear (item 3.1.1-72) and loss of material due to crevice corrosion and fretting (item 3.1.1-74).

Although the GALL Report does not have a corresponding AMR for these seven steam generator components, the staff finds the applicant's identification of aging effects acceptable according to the selection criteria of the applicant. However, the applicant stated it would manage the aging effect of loss of material due to pitting and crevice corrosion using the Secondary Water Chemistry Program, described by the AMP for SRP-LR and LRA item 3.4.1-37, without providing any explanation or justification for the adequacy of this program.

The staff noted that the specific item described in the LRA from the SRP-LR and the GALL Report (e.g., SP-18) relates to aging management of Ni-alloy components exposed to dry steam, whereas the seven components listed above are exposed to treated water and/or steam-secondary, as indicated in LRA Table 3.1.2-4. For example, the staff noted that the tube plugs are clearly not exposed to dry steam. But, in spite of this environmental inconsistency with the GALL Report, the applicant stated that this AMP is consistent with the GALL Report in all aspects (note A) for five of these seven steam generator components.

The staff considers that the environment identified in LRA Table 3.4.1, item 3.4.1-37 (e.g., dry steam) is not appropriate for the seven steam generator components listed above in accordance with the environment they are exposed (i.e., treated water and/or steam-secondary). The staff also finds that the applicant did not provide enough information to verify whether the Secondary Water Chemistry Program is sufficient to manage the aging effect of loss of material due to pitting and crevice corrosion for these components, or whether, alternatively, the applicant should use a condition monitoring or an ISI program to confirm that the Secondary Water Chemistry Program is achieving its preventive purposes.

By letter dated November 20, 2009, the staff issued RAI B2.1.30-16 requesting that the applicant explain why its credited program for aging management for the seven steam generator components listed above is appropriate, when the environment associated with LRA item 3.4.1-37 (e.g., dry steam) and that to which these components are exposed (e.g., treated water and/or steam-secondary) are different. The staff also requested that the applicant: (1) justify why it considers the Secondary Water Chemistry Program sufficient to manage the loss of material due to pitting and crevice corrosion for these components, without any other condition monitoring or ISI-based program to confirm its effectiveness; or (2) describe its plans to implement a condition monitoring or ISI-based program.

In its response dated December 28, 2009, the applicant stated that the dry steam environment was combined with the treated water and/or steam-secondary environment for the purposes of AMRs because the potential aging effects are the same. The applicant also stated that the loss of material due to pitting and crevice corrosion for the Ni-based alloy feedwater inlet ring J nozzles, feedwater nozzle (and Ni-alloy cladding), feedwater nozzle thermal sleeve, steam nozzle flow restrictor, tube bundle support hardware, tube plugs, and tube and sleeves is adequately managed by the Secondary Water Chemistry Program. According to the applicant, the Secondary Water Chemistry Program includes specifications for chemical species, sampling, and analysis frequencies, and corrective actions for control of the environment to which surfaces of components are exposed. The applicant also explained that, additionally, this program maintains water quality (pH and conductivity) in accordance with industry guidelines, as described in LRA Section B2.1.28. However, the applicant further stated that in response to staff concerns, the Steam Generator Tube Integrity Program will be conservatively credited as an additional AMP for the components listed above, with the exception of the steam nozzle flow restrictor, to provide verification that the loss of material due to pitting and crevice corrosion does not occur.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-16 acceptable for the feedwater inlet ring J nozzles, feedwater nozzle (and Ni-alloy cladding), feedwater nozzle thermal sleeve, tube bundle support hardware, tube plugs, and tube and sleeves because: (a) the applicant amended its LRA to credit its Steam Generator Tube Integrity Program to verify Secondary Water Chemistry Program effectiveness, and (b) this program is adequate to verify that loss of material due to pitting and crevice corrosion in these components exposed to treated water and/or steam-secondary does not occur.

In its response dated December 28, 2009, the applicant further stated that for the steam nozzle flow restrictor, the Secondary Water Chemistry Program alone will adequately manage the loss of material due to pitting and crevice corrosion. As the applicant further explained, this component is exposed to a dry steam environment, which is less corrosive than treated water as stated in NUREG-1833, "Technical Bases for Revision to the License Renewal Guidance Documents," item SP-18.

Based on its review, the staff finds the applicant's response to RAI B2.1.30-16 acceptable for the steam nozzle flow restrictor because the environment of this component and the program as cited by the applicant are adequate and consistent with the GALL Report technical bases.

Accordingly, in its response dated December 28, 2009, the applicant amended its LRA to include the following paragraphs to LRA Table 3.4.1, item 3.4.1-37:

> Consistent with NUREG-1801.
>
> For the steam generator steam nozzle restrictor, loss of material due to pitting and crevice corrosion is managed by the Secondary Water Chemistry program.
>
> For the steam generator feedwater inlet ring J nozzles, feedwater nozzle (and nickel alloy cladding), feedwater nozzle thermal sleeve, tube bundle support hardware, tube plugs, and tube and sleeves, loss of material due to pitting and crevice corrosion is managed by the Secondary Water Chemistry program and the Steam Generator Tube Integrity program since the environment is secondary treated water and not steam.

The staff finds this change to LRA Table 3.4.1, item 3.4.1-37 acceptable because it correctly describes the programs the applicant credited for managing the aging effect of loss of material due to pitting and crevice corrosion in steam generator secondary-side components, for which the staff has identified another environment than the one originally selected in the LRA.

Based on its review, the staff found that the applicant has adequately addressed the issues in RAI B2.1.30-16 and amended its LRA appropriately. The staff's concern described in RAI B2.1.30-16 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.4.2.2 provides further evaluation of aging management, as recommended by the GALL Report for the steam and power conversion system components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling
- reduction of heat transfer due to fouling
- loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion
- cracking due to SCC
- loss of material due to pitting and crevice corrosion
- loss of material due to pitting, crevice, and microbiologically-influenced corrosion
- loss of material due to general, pitting, crevice, and galvanic corrosion

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine whether they adequately address those issues and reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.4.2.2. The staff's review of the applicant's further evaluations follows.

3.4.2.2.1 Cumulative Fatigue Damage

LRA Section 3.4.2.2.1 states that fatigue is a TLAA, as defined in 10 CFR 54.3. An applicant must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). SER Section 4.3 documents the staff's review of the applicant's evaluation of this TLAA.

3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

Item 1. LRA Section 3.4.2.2.2.1 refers to Table 3.4.1, items 3.4.1-2, 3.4.1-3, 3.4.1-4, and 3.4.1-6 and addresses steel piping, piping components, and piping elements exposed to steam or treated water, steel heat exchanger components exposed to treated water, and steel and stainless steel tanks exposed to treated water, which are being managed for the loss of material due to general, pitting, and crevice corrosion by the Secondary Water Chemistry Program. The applicant stated that the effectiveness of the Secondary Water Chemistry Program will be verified by the WCP Program.

The staff reviewed LRA Section 3.4.2.2.2.1 against the criteria in SRP-LR Section 3.4.2.2.2.1, which states that loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The GALL Report recommends GALL AMP XI.M2, "Water Chemistry," and states that the AMP be augmented by verifying the effectiveness of water chemistry control. The GALL Report states that a one-time inspection (GALL AMP XI.M32) of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Secondary Water Chemistry and WCP programs and its evaluations are documented in SER Sections 3.0.3.1.11 and 3.0.3.2.19, respectively. The staff also reviewed AMR items associated with LRA Table 3.4.1, items 3.4.1-2, 3.4.1-3, 3.4.1-4, and 3.4.1-6, which are associated with LRA Section 3.4.2.2.2.1. In its review, the staff noted that the applicant assigned each component two line items, one in which the Secondary Water Chemistry AMP is credited and the other in which the WCP Program is credited. The applicant proposed that all the items for which the Water Chemistry program is credited are fully consistent with the GALL Report. The applicant proposed that all the items for which the WCP Program is credited are consistent with the GALL Report in all respects except a different AMP is credited, citing generic note E. The applicant stated that the WCP Program provides the opportunity to inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, during preventive and corrective maintenance activities on an ongoing basis. The applicant also stated that the WCP Program provides input to the corrective action program if aging effects are identified. The applicant further stated that the corrective action program will evaluate the cause and extent of the condition and, if required, recommend enhancements to ensure continued effectiveness of the Secondary Water Chemistry Program.

In its review of components associated with LRA items 3.4.1-2, 3.4.1-3, 3.4.1-4, and 3.4.1-6, for which the applicant assigned generic note E, the staff noted that the GALL Report differentiates between treated water and steam, while the environment indicated in the LRA is "treated water and/or steam." The staff also noted that, in this case, the AMPs recommended by the GALL Report are identical for water and steam so that the distinction is inconsequential. The staff finds the use of the WCP Program acceptable to confirm the adequacy of the Secondary Water Chemistry Program because the WCP Program has been proposed by the applicant and evaluated by the staff to be consistent with the One-Time Inspection Program, which is recommended by the GALL Report. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.2.1 criteria. For those line items that apply to LRA Section 3.4.2.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.4.2.2.2.2 and Table 3.4.1, item 3.4.1-7 address loss of material due to general, pitting, and crevice corrosion that may occur in piping, piping components, and piping elements. The applicant stated that loss of material for steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, and crevice corrosion through the examination of steel components.

The staff reviewed LRA Section 3.4.2.2.2.2 against the criteria in SRP-LR Section 3.4.2.2.2.2, which states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for the identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.4.2.2.2.2, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.2.2 criteria. For those line items that apply to LRA Section 3.4.2.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB 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, Crevice, and Microbiologically-Influenced Corrosion and Fouling

LRA *Section* 3.4.2.2.3 *refers to Table* 3.4-1, *item* 3.4.1-8 *and addresses steel piping, piping* components, and piping elements exposed to raw water. The applicant stated that for this item, the only source of raw water to the steam and power conversion systems is the service water system (raw water) backup supply source for the AFW pumps. The applicant also stated that the backup water source is maintained isolated from the AFW system by normally closed motor-operated valves. The applicant further stated that the backup water supply piping and components are evaluated for the effects of aging with the service water system in LRA Section 3.3, "Aging Management of Auxiliary Systems." Based on the above, the applicant stated that the AFW pump suction piping was not evaluated for aging effects due to the backup water supply environment. The staff reviewed the LRA and USAR and did not find any evidence of in-scope steel piping, piping components, and piping elements exposed to raw water in the steam and power conversion systems, except for the backup supply source for the AFW pumps.

The staff reviewed LRA Section 3.4.2.2.3 against the criteria in SRP-LR Section 3.4.2.2.3, which states that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling could occur in steel piping, piping components, and piping elements exposed to raw water. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. The GALL Report states that acceptance criteria are described in SRP-LR, BTP RLSB-1.

In its review of LRA Section 3.4.2.2.3, the staff noted that the applicant stated that the auxiliary feed pump suction piping was not evaluated for aging effects due to the backup water supply environment. By letter dated October 13, 2009, the staff issued RAI 3.4.2.2.3-1 requesting that the applicant confirm that the entire AFW system will be evaluated for aging and to modify this AMR item and other AMR items as appropriate to allow the staff to confirm that each portion of the AFW system is being evaluated through the use of appropriate AMPs and AMR items.

In its response dated November 13, 2009, the applicant stated that the entire auxiliary feed water system, including the AFW pump suction piping downstream of the normally closed motor-operated valves, was evaluated for aging effects due to exposure to the treated water from the condensate storage tank, as indicated for the component type "pipe" in LRA Table 3.4.2-7. The staff finds this response acceptable because all parts of the AFW system were evaluated for aging effects and because the most appropriate environment was selected for each portion of the system. The staff's concern described in RAI 3.4.2.2.3-1 is resolved.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.2.3 criteria. For those items that apply to LRA Section 3.4.2.2.2.3, the

staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.4 Reduction of Heat Transfer Due to Fouling

Item 1. LRA Section 3.4.2.2.4.1 refers to Table 3.4.1, item 3.4.1-09, which addresses the reduction of heat transfer due to fouling for stainless steel and copper alloy heat exchanger tubes exposed to treated water. The applicant stated that this aging effect will be managed by the Secondary Water Chemistry Program and that this AMP's effectiveness will be confirmed by the WCP Program. The applicant also stated that the WCP Program will visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical environments, including stagnant locations.

The staff reviewed LRA Section 3.4.2.2.4.1 against the criteria in SRP-LR Section 3.4.2.2.4.1, which states that reduction of heat transfer due to fouling may occur in stainless steel and copper alloy heat exchanger tubes exposed to treated water, and that management of this aging effect relies on water chemistry control. The GALL Report recommends the use of the water chemistry program augmented by a plant-specific verification program to manage the effects of fouling on stainless steel and copper alloy heat exchanger tubes exposed to treated water. As noted in the SRP-LR, since control of water chemistry may not always have been adequate to preclude fouling, the GALL Report recommends that the effectiveness of the chemistry control program be verified to ensure that the reduction of heat transfer due to fouling does not occur. A one-time inspection is noted as an acceptable method to ensure that the reduction of heat transfer is not occurring and that the components' intended functions will be maintained during the period of extended operation. The staff noted that GALL AMP XI.M2, "Water Chemistry," indicates that water chemistry programs can be generally effective in removing impurities, except in low flow or stagnant flow areas.

The staff evaluated the applicant's Secondary Water Chemistry Program and WCP Program and its review is documented in SER Section 3.0.3.1.11 and Section 3.0.3.2.19, respectively. The staff noted that the effectiveness of the Secondary Water Chemistry Program is verified through the WCP Program, which will visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations. The staff finds the applicant's use of the Secondary Water Chemistry Program, in conjunction with verification through the WCP Program, acceptable to manage the reduction of heat transfer due to fouling because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.4.2.2.4.1 and the GALL Report, (2) the Secondary Water Chemistry Program periodically monitors and controls contaminants below levels known to result in a reduction in heat transfer, and (3) the WCP Program verifies effectiveness by inspecting heat transfer surfaces for fouling.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.4.1 criteria. For those items that apply to LRA Section 3.4.2.2.4.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Item 2</u>. LRA Section 3.4.2.2.4.2 refers to Table 3.4.1, item 3.4.1-10, which addresses the reduction of heat transfer due to fouling for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The applicant stated that the reduction of heat transfer due to fouling for applicable components is managed by the Lubricating Oil Analysis Program. The applicant also stated that the WCP Program will confirm the effectiveness of the Lubricating Oil Analysis Program by visually inspecting the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations.

The staff reviewed LRA Section 3.4.2.2.4.2 against the criteria in SRP-LR Section 3.4.2.2.4.2, which states that loss of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The GALL Report recommends the use of the lubricating oil analysis program and further evaluation to verify the effectiveness of the lubricating oil programs. The SRP-LR notes that the existing AMP relies on monitoring and control of lube oil chemistry to mitigate the reduction of heat transfer due to fouling; however, control of lube oil contaminants may not always be fully effective in precluding corrosion. A one-time inspection of selected components at susceptible locations is an acceptable method to determine that corrosion is not occurring and that the intended functions will be maintained during the period of extended operation.

The staff evaluated the applicant's Lubricating Oil Analysis Program and WCP Program and its review is documented in SER Section 3.0.3.1.4 and Section 3.0.3.2.19, respectively. The staff finds the applicant's use of the Lubricating Oil Analysis Program, in conjunction with effectiveness verification through the WCP Program, is acceptable to manage the reduction of heat transfer due to fouling because: (1) these AMPs are consistent with the recommended programs in SRP-LR Section 3.4.2.2.4.2 and the GALL Report, (2) the Lubricating Oil Analysis Program periodically samples the oil to confirm oil quality, and (3) the WCP Program verifies effectiveness by inspecting heat transfer surfaces for fouling.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.4.2 criteria. For those items that apply to LRA Section 3.2.2.2.4.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB 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 Microbiologically-Influenced Corrosion

<u>Item 1</u>. LRA Section 3.4.2.2.5.1 and Table 3.4.1, item 3.4.1-11 addresses buried steel piping, piping components, piping elements and tanks (with or without coating or wrapping) exposed to soil. The GALL Report recommends the Buried Piping and Tanks Inspection Program to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion for this component group. The applicant stated that this item is not applicable because there are no in-scope components constructed of steel piping exposed to soil in the steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion systems that include steel exposed to soil. The staff also reviewed the USAR to verify the same. Based on its review of the LRA and USAR, the staff confirmed that the applicant's plant does not have any in-scope components constructed of steel exposed to soil in the steam and power conversion systems and, therefore, finds the applicant's determination acceptable.

Item 2. LRA Section 3.4.2.2.5.2 and LRA Table 3.4.1, item 3.4.1-12 address the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion that may occur in steel heat exchanger components exposed to lubricating oil. The applicant stated that the loss of material for carbon steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion through the examination of carbon steel components.

The staff reviewed LRA Section 3.4.2.2.5.2 against the criteria in SRP-LR Section 3.4.2.2.5.2 which states that loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion may occur in steel heat exchanger components exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion in steel heat exchanger components exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.4.2.2.5.2, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.5.2 criteria. For those items that apply to LRA Section 3.4.2.2.5.2, the

staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.6 Cracking Due to Stress-Corrosion Cracking

LRA Section 3.4.2.2.6 addresses cracking due to SCC for applicable components exposed to a treated water and/or steam environment, which is managed by the Secondary Water Chemistry Program. The applicant stated that in lieu of a one-time inspection, the WCP Program is used to provide confirmation of the effectiveness of the Secondary Water Chemistry Program. The applicant further stated that the WCP Program provides the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, during preventive and corrective maintenance activities on an ongoing basis. Furthermore, the WCP Program provides input to the corrective action program if aging effects are identified. The applicant stated that the corrective action program would evaluate the cause and extent of the condition and, if required, recommend enhancements to ensure the continued effectiveness of the Secondary Water Chemistry Program.

The staff reviewed LRA Section 3.4.2.2.6 against the criteria in SRP-LR Section 3.4.2.2.6, which states that cracking due to SCC could occur in the stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60 °C (140 °F), and for stainless steel piping, piping components, and piping elements exposed to steam. The existing AMP relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC does not occur. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that component intended functions will be maintained during the period of extended operation.

LRA Table 3.4.1, item 3.4.1-14 describes the cracking due to SCC of stainless steel components, from the steam and power conversion system, that were exposed to treated water greater than 60 °C (140 °F) and/or steam. The AMR items corresponding to item 3.4.1-14 include piping/tubing, piping elements, tanks, and heat exchanger components (Tables 3.4.2-2 through 3.4.2-6, 3.4.2-10, and 3.4.2-12). The applicant stated that cracking due to SCC of these stainless steel components is managed by the Secondary Water Chemistry Program and WCP Program, which is a plant-specific program. The applicant further stated that the programs are consistent with the GALL Report.

The staff reviewed LRA item 3.4.1-14 in comparison with the GALL Report Volume 1 Table 4, ID 14. The staff noted that for these AMR items, the SRP-LR states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the Secondary Water Chemistry Control Program should be verified. The GALL Report further states that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring. In its review, the staff found that the applicant stated that the WCP Program provides an opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations during preventive and corrective maintenance activities. In addition, the staff finds that the applicant's WCP Program is an acceptable alternative to GALL AMP XI.M32, "One-Time Inspection," for the purpose of verifying the effectiveness of water chemistry control. The staff reviewed the applicant's Secondary Water Chemistry Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.11 and 3.0.3.2.19, respectively. The staff, therefore, finds that the applicant's proposed AMP is equivalent to that recommended in the GALL Report.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.6 criteria. For those items that apply to LRA Section 3.4.2.2.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.7 Loss of Material Due to Pitting and Crevice Corrosion

Item 1. LRA Section 3.4.2.2.7.1 refers to Table 3.4.1, items 3.4.1-6, 3.4.1-15, and 3.4.1-16 and addresses steel and stainless steel tanks; aluminum and copper alloy piping, piping components, and piping; stainless steel piping, piping components, and piping elements; tanks; and heat exchanger components exposed to treated water, which are being managed for loss of material due to general (steel only), pitting, and crevice corrosion by the WCP Program and either the Secondary Water Chemistry or Primary Water Chemistry program, as appropriate. The applicant stated that the effectiveness of the Primary Water Chemistry and the Secondary Water Chemistry programs will be confirmed by the WCP Program.

The staff reviewed LRA Section 3.4.2.2.7.1 against the criteria in SRP-LR Section 3.4.2.2.7.1, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel, aluminum, and copper alloy piping, piping components, and piping elements and for stainless steel tanks and heat exchanger components exposed to treated water. The GALL Report recommends that GALL AMP XI.M2, "Water Chemistry," be used to manage the effects of the loss of material due to general, pitting, and crevice corrosion. The GALL Report also states that control of water chemistry does not preclude corrosion at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the water chemistry program be verified to ensure that corrosion is not occurring. The GALL Report further states that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Primary Water Chemistry, Secondary Water Chemistry, and WCP programs and its evaluations are document in SER Sections 3.0.3.1.9, 3.0.3.1.11, and 3.0.3.2.19, respectively. The applicant stated that the WCP Program provides the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, during preventive and corrective maintenance activities on an ongoing basis. The applicant also stated that the WCP Program provides input to the corrective action program if aging effects are identified. The applicant further stated that the corrective action program will evaluate the cause and extent of the condition and, if required, recommend enhancements to ensure continued effectiveness of both chemistry control programs. The staff also reviewed AMR items associated with LRA Table 3.4.1, items 3.4.1-6, 3.4.1-15, and 3.4.1-16, which are associated with LRA Section 3.4.2.2.7.1. In its review, the staff noted that for these items the applicant assigned each component two items, one in which the Primary or Secondary Water Chemistry Program is credited and the other in which the WCP Program is credited. The applicant proposed that nearly all the items for which the Water Chemistry Program is credited are fully consistent with the GALL Report. In a few instances, a different, but related component, is listed and the applicant cited generic note C. The applicant proposed that all the items for which the WCP Program is credited are consistent with the GALL Report in all respects except a different AMP is credited, citing generic note E.

In its review of components associated with LRA items 3.4.1-6, 3.4.1-15, and 3.4.1-16, for which the applicant cited generic note C (i.e., pump oil cooler tubes, cooler coil and tubesheet, evaporator heat exchanger shell), the staff noted that these items do not strictly meet the definition of piping, piping components, or piping elements. The staff also noted that these components are subject to the loss of material from the same mechanisms and at roughly the same rate as piping such that an inspection program suitable for piping is expected to be suitable for these components. The staff finds that the components under consideration are sufficiently similar to those actually included in the GALL Report so as not to render them inconsistent with the GALL Report.

In its review of other components associated with LRA items 3.4.1-6, 3.4.1-15, and 3.4.1-16, for which the applicant assigned generic note E, the staff noted that the GALL Report differentiates between treated water and steam, while the environment indicated in the application is "treated water and/or steam." The staff also noted that, in this case, the AMPs recommended by the GALL Report are identical for water and steam so that the distinction is inconsequential. The staff finds the use of the WCP Program to confirm the adequacy of the Water Chemistry Program acceptable because the WCP Program has been proposed by the applicant and evaluated by the staff to be consistent with the One-Time Inspection Program, which is recommended by the GALL Report. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.7.1 criteria. For those items that apply to LRA Section 3.4.2.2.7.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 2. LRA Section 3.4.2.2.7.2 and Table 3.4.1, item 3.4.1-17 addresses stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to manage the effects of pitting and crevice corrosion for this component group. The applicant stated that this item is not applicable because there are no in-scope components constructed of stainless steel exposed to soil in the steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that the applicant's LRA does not have any AMR results for the steam and power conversion systems that include stainless steel exposed to soil. The staff also reviewed the USAR to verify the same. Based on its review of the LRA and USAR, the staff confirmed that the applicant's plant does not have any in-scope components constructed of stainless steel exposed to soil in the steam and power conversion systems and, therefore, finds the applicant's determination acceptable.

Item 3. LRA Section 3.4.2.2.7.3 addresses the loss of material due to pitting and crevice corrosion that may occur in piping, piping components, and piping elements. The applicant stated that loss of material for copper alloy components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to pitting and crevice corrosion through the examination of copper alloy components.

The staff reviewed LRA Section 3.4.2.2.7.3 against the criteria in SRP-LR Section 3.4.2.2.7.3, which states that loss of material due to pitting and crevice corrosion may occur in copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material due to pitting and crevice corrosion in copper alloy piping, piping components, and piping elements exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.4.2.2.7.3, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.7.3 criteria. For those items that apply to LRA Section 3.4.2.2.7.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.8 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

LRA Section 3.4.2.2.8 addresses loss of material due to pitting, crevice, and microbiologically-influenced corrosion that may occur in piping, piping components, and piping elements and heat exchanger components. The applicant stated that loss of material for stainless steel components exposed to lubricating oil is managed by the Lubricating Oil Analysis Program. The WCP Program will provide a verification of the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion through the examination of stainless steel components.

The staff reviewed LRA Section 3.4.2.2.8 against the criteria in SRP-LR Section 3.4.2.2.8, which states that loss of material due to pitting, crevice, and microbiologically-influenced corrosion may occur in stainless steel piping, piping components, and piping elements and heat exchanger components exposed to lubricating oil. The existing program periodically samples and analyzes lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always be fully effective in precluding corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil programs. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion in stainless steel piping, piping components, and piping elements and heat exchanger components exposed to lubricating oil. The staff noted that the applicant has credited the WCP Program in lieu of GALL AMP XI.M32, "One-Time Inspection." By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection." The staff determined that the applicant's WCP Program will manage the aging effects of cracking, loss of material, and reduction of heat transfer through program inspections that provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. On the basis that the applicant's AMPs are consistent with those recommended in SRP-LR Section 3.4.2.2.8, the staff finds the applicant's use of the Lubricating Oil Analysis Program and WCP Program acceptable.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.8 criteria. For those items that apply to LRA Section 3.4.2.2.8, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion

LRA Section 3.4.2.2.9 and Table 3.4.1, item 3.4.1-5 are only applicable to BWRs and, therefore, not applicable to KPS. See SER Section 3.4.2.1.1.

3.4.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.4.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.4.2-1 through 3.4.2-14, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.4.2-1 through 3.4.2-14, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.4.2.3.1 Interior Surfaces of Steel Components Exposed to Hydraulic Oil

In LRA Table 3.4.2-1, the applicant stated that the interior surfaces of steel components exposed to hydraulic oil have no aging effect. The applicant also stated that no AMP is required. The AMR line items cite generic note H, indicating that the component, material, and environment combination listed is not addressed in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the environment is fuel oil or lubricating oil. The staff noted that the GALL Report recommends the consideration of the aging effects of loss of material. The staff also noted that in each case the GALL Report recommends AMPs consisting of monitoring oil chemistry coupled with an inspection program. Based on these recommendations in the GALL Report, the staff must also consider that loss of material for steel components exposed to hydraulic oil may be possible. By letter dated December 16, 2009, the staff issued RAI 3.4.2.3-3 requesting that the applicant select an AMP appropriate for the management of aging in steel components exposed to hydraulic oil or to justify why aging of steel components in hydraulic oil is not possible.

In its response dated January 21, 2010, the applicant stated that the hydraulic oil environment is specifically electro-hydraulic control (EHC) fluid and that based on a review of plant-specific OE, water pooling is not expected to occur in the EHC system due to high standards for fluid quality in this system. The staff noted that the applicant performs monthly EHC fluid samples in which the water content in the sample is determined. The staff also noted that in order for corrosion to occur, there must be water contamination as well as separation and pooling of the water. In its response to RAI 3.4.2.3.1, dated September 28, 2009, the applicant stated that the stainless steel EHC reservoir is the most likely component to experience the water separation and pooling, therefore, loss of material due to pitting and crevice corrosion will be managed by the Lubricating Oil Analysis Program and its effectiveness will be confirmed by the WCP Program. The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff noted that it is reasonable to state that the reservoir will be the most likely component to experience water separation and pooling. The staff further noted if water contamination or corrosion products are present, they will settle to the bottom of the reservoir where the monthly sample is being taken from.

The staff finds the applicant's response to RAI 3.4.2.3.1-3 acceptable because: (1) the applicant currently performs monthly sampling of the EHC fluid and is able to determine if there is water contamination, and (2) the applicant has credited its Lubricating Oil Analysis Program to manage loss of material and will confirm its effectiveness with the WCP Program for license renewal. The staff's concern described in RAI 3.4.2.3.1-3 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.2 Stainless Steel and Copper Alloy Components Exposed to Hydraulic Oil (Internal)

LRA Table 3.4.2-1 addresses: (1) copper alloy tubing, valves, and EHC system oil coolers and (2) stainless steel piping, tubing, valves, and EHC reservoirs exposed to an internal hydraulic oil environment that do not have an AERM, therefore, an AMP is not required. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed LRA Table 3.0-1, "Service Environments," which states that moisture and water pooling are not assumed in a hydraulic oil environment. The staff also noted that the LRA did not provide a basis as to why these copper alloy and stainless steel components exposed to hydraulic oil (internal) do not have an aging effect, or why moisture and water pooling are not assumed in a hydraulic oil environment. By letter dated August 28, 2009, the staff issued RAI 3.4.2.3.1-1 requesting that the applicant provide its basis for stating that: (1) moisture and water pooling are not assumed in a hydraulic oil environment, and (2) copper alloy and stainless steel components exposed to hydraulic oil do not have an AERM. Alternatively, the staff requested that the applicant provide an appropriate program for aging management.

In its response dated September 28, 2009, the applicant stated that this hydraulic oil environment is specifically EHC fluid. The applicant further stated that the statement that moisture and water pooling are not assumed in a hydraulic oil environment was based on a review of plant-specific OE and discussions with the station personnel. The staff noted that the applicant performs monthly EHC fluid samples in which the water content in the sample is determined. The staff noted that in order for corrosion to occur, there must be water contamination as well as separation and pooling of the water. The applicant stated that the stainless steel EHC reservoir is the most likely component to experience the water separation and pooling, therefore, loss of material due to pitting and crevice corrosion will be managed by the Lubricating Oil Analysis Program and its effectiveness will be confirmed by the WCP Program. The staff noted that it is reasonable to state that the reservoir will be the most likely component to experience water separation and pooling. The staff further noted if water contamination or corrosion products are present, they will settle to the bottom of the reservoir where the monthly sample is being taken from.

Based on its review, the staff finds the applicant's response to RAI 3.4.2.3.1-1 acceptable because: (1) the applicant currently performs monthly sampling of the EHC fluid and is able to determine if there is water contamination, and (2) the applicant has credited its Lubricating Oil Analysis Program to manage loss of material and will confirm its effectiveness with the WCP Program for license renewal. The staff's concern described in RAI 3.4.2.3.1-1 is resolved.

The staff reviewed the applicant's Lubricating Oil Analysis Program and WCP Program and its evaluations are documented in SER Sections 3.0.3.1.4 and 3.0.3.2.19, respectively. The staff determined that the Lubricating Oil Analysis Program includes periodic sampling and analysis of lubricating oil to determine if contaminants, such as particulates, metals, and water, are present. The staff noted that the presence of these impurities in the lubricating oil can create an environment that is conducive to age-related degradation, such as loss of material and reduction of heat transfer. The staff determined that the activities performed as part of this program will be capable of preserving an environment that will not promote loss of material and reduction of heat transfer. The staff finds that these activities are consistent with the recommendations in the GALL Report and will adequately manage the loss of material in copper alloy and stainless steel piping, piping components, and piping elements exposed to lubricating oil. The staff determined that the applicant's WCP Program will provide verification of the effectiveness of the Lubricating Oil Analysis Program where: (a) an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence; (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected; or (c) the characteristics of the aging effect include a long incubation period. The staff further determined that these inspections will be performed by using NDE techniques that are effective and capable for identification of these potential aging effects and that the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.4.2.3.3 Stainless Steel Components Subject to Loss of Material Due to Pitting, Crevice and Microbiologically-Influenced Corrosion Exposed to Air-Moist and Treated Water-Closed-Cycle Cooling

LRA Table 3.4.2-2 addresses flex connections, piping, and rupture discs fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.4.2-3 addresses expansion joints and piping fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.4.2-6 addresses rupture discs fabricated from stainless steel exposed to air-moist (internal), which are subject to loss of material due to pitting and crevice corrosion. LRA Table 3.4.2-12 addresses coolers (shell of sample coolers), feedwater sample line chiller (evaporator tank and recirculating pump), piping, tubing, and valves fabricated from stainless steel exposed to treated water-closed-cycle cooling (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The applicant credited the WCP Program for managing the loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of stainless steel to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) will require that the extent of the inspection and its results be documented even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.4.2.3.4 Copper Alloy Components Subject to Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion and Loss of Material Due to Erosion Exposed to Raw Water (Internal)

LRA Table 3.4.2-10 addresses heating coils fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion. LRA Table 3.4.2-11 addresses generator hydrogen coolers (coils) fabricated from copper alloy exposed to raw water (internal), which are subject to loss of material due to pitting, crevice, and microbiologically-influenced corrosion and loss of material due to erosion. The applicant credited the WCP Program for aging management of loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) will require that the extent of the inspection and its results be documented even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.4.2.3.5 Copper Alloy Components Subject to Loss of Material Due to Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion Exposed to Treated Water-Closed-Cycle Cooling

LRA Table 3.4.2-12 addresses tubing and valves fabricated from copper alloy exposed to treated water-closed-cycle cooling (internal) which are subject to the loss of material due to pitting, crevice, galvanic, and microbiologically-influenced corrosion. The applicant credited the WCP Program for managing the loss of material for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

By letter dated September 25, 2009, the applicant amended its LRA so that its WCP Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The applicant clarified the details of how this amendment would affect LRA Section 3 and stated that if the WCP Program is credited for aging management without a corresponding chemistry control program being credited for that particular AMR line item, then the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is the intended program that is being credited to manage the identified aging effect as a stand-alone program. The staff determined that those AMR line items discussed in this section are crediting the portion of the WCP Program that corresponds to GALL AMP XI.M38 as a stand-alone program.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. The staff determined that this program will manage the aging effects of loss of material for the in-scope SCs through inspections implemented in accordance with the work management process, which will perform visual inspections of components fabricated of copper alloy to detect loss of material. The staff further determined that this program will: (1) perform inspections of components during surveillance and maintenance activities to provide for the detection of degradation prior to the loss of intended function and (2) will require that the extent of the inspection and its results be documented even when no signs of aging degradation are found, so that there is a meaningful trending of aging effects. The staff noted that the visual inspection techniques are established and are capable of detecting loss of material due to corrosion by the presence of localized discoloration and surface irregularities, such as rust, scale, deposits, surface pitting, surface discontinuities, and coating degradation. On the basis of periodic visual inspections being performed during surveillance and maintenance activities of these components by the WCP Program, the staff finds the applicant's use of the WCP Program acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.4.2.3.6 Exterior Surfaces of Non-Metallic Materials Exposed to Uncontrolled Indoor Air and Interior Surfaces of Non-Metallic Materials Exposed to Treated Water or Steam

In LRA Table 3.4.2-12, the applicant stated that the interior surfaces of non-metallic materials exposed to treated water or steam and the exterior surfaces of non-metallic materials exposed to uncontrolled indoor air have no aging effect and that no AMP is required. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material type is non-metallic materials exposed to treated water or steam and confirmed that there are no entries for this component/material and environment. The staff noted that there is not a distinct definition for non-metallic material in GALL Report Chapter IX. The staff also noted that many polymeric materials are adversely affected by oxidizers (e.g., chlorine), UV light, and high temperatures. Based on the information provided, the staff cannot conclude that no aging effects will occur to the combination of materials and environments under consideration. By letter dated October 13, 2009, the staff issued RAI 3.4.2.3.12-1 requesting that the applicant identify the specific material under consideration and justify why this material is not subject to aging under the conditions being considered.

In its response dated November 13, 2009, the applicant stated that the non-metallic materials in the LRA Table 3.4.2-12 are polysulfone, polyethersulfone, and PVC in the secondary sampling system and are exposed on their interior surfaces to sample fluids from chemistry-controlled secondary plant systems. The applicant also stated that, these materials are not exposed to chemical contaminants or temperatures greater than 95 °F. The staff finds the applicant's proposal, that these materials are not subject to aging and that no aging management is required, acceptable because: (1) these materials are not known to degrade in pure water, (2) chemical contaminants which could cause material degradation are not expected to be present, and (3) the GALL Report indicates that thermal aging is not expected at temperatures below 95 °F.

The applicant stated that the external surfaces of all the materials described above are exposed to air. The staff agrees with the applicant that aging of these materials due solely to exposure to air is unlikely. The applicant also evaluated other sources of potential degradation to which these materials could be exposed. The applicant evaluated the potential for degradation due to chemical contaminants in the air (e.g., sulfur dioxide), high temperature (greater than 95 °F), and exposure to oxidizing agents (e.g., UV radiation or ozone). The staff finds that these are the appropriate effects to examine. The applicant stated, and the staff concurs, that degradation due to chemical contaminants is unlikely due to the rural location of the plant. The applicant stated and, based on recommendations in the GALL Report, the staff concurs that exposure of these materials to temperatures less than 95 °F is unlikely to cause aging. The applicant stated, and the staff concurs, that the primary source of ozone to which these materials may be exposed is electrical equipment and that the remote location of these materials from ozone producing equipment will eliminate this issue. The applicant also stated that UV radiation is not a source of aging because these materials are located indoors and because a review of plant experience indicated that UV radiation from fluorescent lighting was not sufficient to cause degradation. The staff concurs with the applicant that the absence of exposure of these materials to sunlight substantially eliminates the potential for aging due to UV radiation. However, the staff does believe that, in some instances, UV radiation from fluorescent lighting can cause aging. The staff accepts the applicant's review of plant operating history as evidence that, in this location, the intensity of the fluorescent lighting is not sufficient to cause aging in the materials under consideration. Based on the above, the staff finds the applicant's approach to manage the aging of the non-metallic components under consideration acceptable. The staff's concern described in RAI 3.4.2.3.12 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.7 Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion from the Internal Surfaces of Steel and Stainless Steel Piping, Piping Components, Piping Elements, and Heat Exchanger Components Exposed to Treated Closed-Cycle Cooling Water

In LRA Table 3.4.2-12, the applicant stated that the internal surfaces of steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to treated closed-cycle cooling water are being managed for loss of material due to general, pitting, crevice, and galvanic corrosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the internal surfaces of steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to treated closed-cycle cooling water and noted that the GALL Report recommends GALL AMP XI.M21, "Closed-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, and galvanic corrosion. The staff also noted that the components in LRA Table 3.4.2-12 are nonsafety-related and, therefore, the Closed-Cycle Cooling Water System Program is not appropriate. However, contrary to the applicant's assertion, the staff further noted that the aging effect being considered has been evaluated in the GALL Report for the components, materials, and environment combination listed, which corresponds to SRP-LR Table 3.4.1 items 24, 25, and 26.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff finds the applicant's proposal to manage this aging, through the use of that portion of the WCP which is consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components," acceptable because: (1) the scope of this AMP includes internal surfaces of piping and ducting components not included in other AMPs, and (2) the WCP Program contains visual inspection techniques appropriate for the identification of loss of material for these components. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B 2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.8 Loss of Material Due to General, Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Steel Heat Exchanger Components Exposed to Raw Water

In LRA Tables 3.4.2-1, 3.4.2-4, 3.4.2-9, 3.4.2-10, 3.4.2-11, and 3.4.2-12, the applicant stated that the internal surfaces of steel heat exchanger components exposed to raw water are being managed for loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the internal surfaces of steel heat exchanger components exposed to raw water and noted that the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," for this component, material, and environment where the aging effect is loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion. The staff also noted that the components in LRA Tables 3.4.2-1, 3.4.2-4, 3.4.2-9, 3.4.2-10, 3.4.2-11, and 3.4.2-12 are nonsafety-related and, therefore, the Open-Cycle Cooling Water System Program is not appropriate. However, contrary to the applicant's assertion, the staff further noted that the aging effect being considered has been evaluated in the GALL Report for the components, materials, and environment combination listed, which corresponds to SRP-LR Table 3.4.1, items 31 and 32.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. Given that the use of the Open-Cycle Cooling Water System Program is not appropriate, the staff finds the applicant's use of the WCP Program acceptable as this AMP contains visual inspection procedures which are appropriate for the detection of loss of material due to corrosion on the internal surfaces of heat exchanger components. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.9 Loss of Material Due to Erosion from the Internal Surfaces of Steel Heat Exchanger Components Exposed to Raw Water

In LRA Tables 3.4.2-1, 3.4.2-4, 3.4.2-9, 3.4.2-10, 3.4.2-11, and 3.4.2-12, the applicant stated that the internal surfaces of steel heat exchanger components exposed to raw water are being managed for loss of material due to erosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the internal surfaces of steel heat exchanger components exposed to raw water and confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to erosion.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the components under consideration are nonsafety-related components. As a result, the use of the Open-Cycle Cooling Water System Program is not appropriate as this AMP is limited to components in safety-related systems which transfer heat to the ultimate heat sink. Given that the use of the Open-Cycle Cooling Water System Program is not appropriate, the staff finds the applicant's use of the WCP Program acceptable because this AMP contains visual inspection procedures which are appropriate for the detection of erosion on the internal surfaces of heat exchanger components. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.10 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion, as well as Fouling from the Internal Surfaces of Steel Piping, Piping Components, and Piping Elements Exposed to Raw Water

In LRA Table 3.4.2-10, the applicant stated that the internal surfaces of steel piping, piping components, and piping elements exposed to raw water are being managed for loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the component, material, and environment type is internal surfaces of steel piping, piping components, and piping elements exposed to raw water, and noted that the GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," where the aging effect is loss of material due to general, pitting, crevice, and galvanic corrosion, or GALL AMP XI.M27, "Fire Water System," where the aging effect is loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, as well as fouling. The staff also noted that the components in LRA Table 3.4.2-10 are nonsafety-related and, therefore, the Open-Cycle Cooling Water System Program is not appropriate. The staff further noted that the components are not associated with the fire protection system and that, therefore, the Fire Water System Program would also not be an appropriate program to manage aging for these components.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. Given that the use of the Fire Water System and Open-Cycle Cooling Water System programs are not appropriate, the staff concurs with the applicant's use of the WCP Program as this AMP contains visual inspection procedures which are appropriate for the detection of loss of material on the steel piping, piping components, and piping elements. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.11 Loss of Material Due to Microbiologically-Influenced Corrosion from the Internal Surfaces of Steel Heat Exchanger Components Exposed to Treated Closed-Cycle Cooling Water

In LRA Table 3.4.2-12, the applicant stated that internal surfaces of steel heat exchanger components exposed to treated closed-cycle cooling water are being managed for loss of material due to MIC by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the internal surfaces of steel heat exchanger components exposed to treated closed-cycle cooling water and confirmed that there are no entries for this component, material, and environment where the aging effect is loss of material due to MIC.

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that these components are nonsafety-related components. The staff finds the applicant's proposal, to manage aging using the portion of the WCP Program which is consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components," acceptable because: (1) the scope of this AMP includes internal surfaces of piping and ducting components not included in other AMPs, and (2) the WCP Program contains visual inspection techniques appropriate to the identification of loss of material for these components. In addition, a staff concern related to the selection and frequency of inspections is addressed in RAI B2.1.32-2, and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.12 Cracking Due to Stress-Corrosion Cracking for Copper Alloy

In LRA Tables 3.4.2-5, 3.4.2-6, 3.4.2-8, 3.4.2-9, 3.4.2-12, and 3.4.2-14, the applicant stated that the copper alloy valves exposed to treated water and steam-secondary (internal) are being managed for cracking due to SCC. In LRA Table 3.4.2-7, the applicant stated that the copper alloy AFW pump oil coolers (tubes and tubesheet) and turbine driven AFW pump turbine bearing coolers (coil) exposed to treated water and steam-secondary (internal) are being managed for cracking due to SCC. In LRA Table 3.4.2-10, the applicant stated that the copper alloy boric acid evaporator condenser return unit heat exchanger (shell), heating coils, and valves exposed to treated water and steam-secondary (internal) are being managed for cracking due to SCC. The applicant credited the Secondary Water Chemistry Program and the WCP Program to manage this aging effect for the components described above. The AMR items cite generic note H, which indicates that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the applicant's Secondary Water Chemistry Program and WCP Program; these evaluations are documented in SER Sections 3.0.3.1.11 and 3.0.3.2.19, respectively. The staff determined that the Secondary Water Chemistry Program includes periodic monitoring and control of contaminants such as chloride, fluoride, dissolved oxygen, and sulfate concentrations below specified levels that may result in loss of material, and that the program also maintains water quality (pH and conductivity). The staff also determined that the applicant's program specifies sampling and analysis frequencies and corrective actions if specified limits are exceeded. The staff further determined that: (1) the applicant's WCP Program will manage the aging effects of loss of material through program inspections which provide verification of the effectiveness of Secondary Water Chemistry Program; (2) these inspections will be performed by using NDE techniques that are effective and capable of identifying these potential aging effects; and (3) the sample size and location will be based on an assessment of materials, environments, plausible aging effects, and OE. Based on its review, the staff finds the applicant's use of the programs identified above acceptable because the chemistry control will provide an environment that is not conducive for cracking to occur and the applicant will verify the effectiveness of the chemistry control with examinations performed by its WCP Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.4.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the steam and power conversion system components within the scope of license renewal and subject to an AMR 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).

3.5 Aging Management of Containments, Structures, and Component Supports

This section of the SER documents the staff's review of the applicant's AMR results for the structures and component supports components and component groups of the following:

- reactor containment vessel
- structures and structural components, which include the following:
  - shield building
  - administration building
  - auxiliary building
  - screenhouse access tunnel
  - technical support center
  - turbine building
  - yard structures
  - discharge structure
  - discharge tunnel and pipe
  - intake structure
  - screen house
- component supports
- miscellaneous structural commodities
- NSSS supports

3.5.1 Summary of Technical Information in the Application

LRA Section 3.5 provides AMR results for the structures and component supports components and component groups. LRA Table 3.5.1, "Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of NUREG-1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the structures and component supports components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry OE in the determination of AERMs. The plant-specific evaluation included condition reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry OE included a review of the GALL Report and OE issues identified since the issuance of the GALL Report.

The applicant credited the following programs for managing the aging effects for the structures and component supports:

- ASME Section XI, Subsection IWE Program
- ASME Section XI, Subsection IWF Program
- Bolting Integrity Program
- Boric Acid Corrosion Program
- Buried Piping and Tanks Inspection Program
- External Surfaces Monitoring Program
- Fire Protection Program
- Primary Water Chemistry Program
- Reactor Containment Leakage Testing 10 CFR 50, Appendix J Program

- Structures Monitoring Program
- Work Control Process Program

3.5.2 Staff Evaluation

The staff reviewed LRA Section 3.5 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for the structures and component supports components, within the scope of license renewal and subject to an AMR, 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).

The staff conducted a review of the AMR items that the applicant had identified as being consistent with the GALL Report to confirm the applicant's claim that certain AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. Details of the staff's audit evaluation are documented in SER Section 3.5.2.1.

The staff also conducted a review of selected AMRs consistent with the GALL Report and for which further evaluation is recommended. The staff confirmed that the applicant's further evaluations were consistent with the SRP-LR Section 3.5.2.2 acceptance criteria. The staff's evaluations are documented in SER Section 3.5.2.2.

The staff also conducted a technical review of the remaining AMRs not consistent with or not addressed in the GALL Report. The technical review evaluated whether all plausible aging effects have been identified and whether the aging effects listed were appropriate for the material-environment combinations specified. The staff's evaluations are documented in SER Section 3.5.2.3.

For SSCs which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's OE to verify the applicant's claims.

Table 3.5-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.5 and addressed in the GALL Report.

Table 3.5-1 Staff Evaluation for Structures and Component Supports Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
PWR Concrete (Reinforced and Prestressed) and Steel Containments					
Concrete elements: walls, dome, basemat, ring girder, buttresses, containment (as applicable) (3.5.1-1)	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	ISI (IWL) and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater if environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Not applicable	See SER Section 3.5.2.2.1.1
Concrete elements: all (3.5.1-2)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.1.2)
Concrete elements: foundation, subfoundation (3.5.1-3)	Reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a de-watering system is relied upon to control erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Not applicable	See SER Section 3.5.2.2.1.2

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Concrete elements: dome, wall, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable) (3.5.1-4)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific AMP is to be evaluated.	Yes	Not applicable	See SER Section 3.5.2.2.1.3
Steel elements: drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, suppression chamber (as applicable) (3.5.1-5)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel elements: steel liner, liner anchors, integral attachments (3.5.1-6)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	ASME Section XI, Subsection IWE Program and 10 CFR Part 50, Appendix J Program	Consistent with the GALL Report (See SER Section 3.5.2.2.1.4)
Prestressed containment tendons (3.5.1-7)	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable (See SER Section 3.5.2.2.1.5)
Steel and stainless steel elements: vent line, vent header, vent line bellows, and downcomers (3.5.1-8)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers (3.5.1-9)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	See SER Section 3.5.2.2.1.6

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel penetration sleeves, penetration bellows, dissimilar metal welds (3.5.1-10)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examinations/ evaluations for bellows assemblies and dissimilar metal welds.	Yes	ASME Section XI, Subsection IWE Program and 10 CFR Part 50, Appendix J Program	Consistent with the GALL Report (See SER Section 3.5.2.2.1.7)
Stainless steel vent line bellows (3.5.1-11)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examination/ evaluation for bellows assemblies and dissimilar metal welds.	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows, suppression pool shell, unbraced downcomers (3.5.1-12)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes	ASME Section XI, Subsection IWE Program and 10 CFR Part 50, Appendix J Program	Consistent with the GALL Report (See SER Section 3.5.2.2.1.8)
Steel, stainless steel elements, dissimilar metal welds: torus, vent line, vent header, vent line bellows, downcomers (3.5.1-13)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Concrete elements: dome, wall, basemat ring girder, buttresses, containment (as applicable) (3.5.1-14)	Loss of material (scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	Not applicable	See SER Section 3.5.2.2.1.9

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Concrete elements: walls, dome, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable) (3.5.1-15)	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R.	Yes	Not applicable	See SER Section 3.5.2.2.1.10
Seals, gaskets, and moisture barriers (3.5.1-16)	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	No	ASME Section XI, Subsection IWE Program and 10 CFR Part 50, Appendix J Program	Consistent with the GALL Report
Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure *mechanisms* (3.5.1-17)	Loss of leak tightness in closed position due to *mechanical* wear of locks, hinges, and closure mechanisms	10 CFR Part 50, Appendix J and plant TSs	No	10 CFR Part 50, Appendix J Program and plant TSs	Consistent with the GALL Report
Steel penetration sleeves and dissimilar metal welds; personnel airlock, equipment hatch, and CRD hatch (3.5.1-18)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	ASME Section XI, Subsection IWE Program and 10 CFR Part 50, Appendix J Program	Consistent with the GALL Report
Steel elements: stainless steel suppression chamber shell (inner surface) (3.5.1-19)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel elements: suppression chamber liner (interior surface) (3.5.1-20)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel elements: drywell head and downcomer pipes (3.5.1-21)	Fretting or lock-up due to mechanical wear	ISI (IWE)	No	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Prestressed containment: tendons and anchorage components (3.5.1-22)	Loss of material due to corrosion	ISI (IWL)	No	Not applicable	Not applicable (KPS does not have a prestressed containment)
Safety-Related and Other Structures, and Component Supports					
All Groups except Group 6: interior and above-grade exterior concrete (3.5.1-23)	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.1)
All Groups except Group 6: interior and above-grade exterior concrete (3.5.1-24)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.1)
All Groups except Group 6: steel components: all structural steel (3.5.1-25)	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the Structures Monitoring Program is to include provisions to address protective coating, monitoring, and maintenance.	Yes	Structures Monitoring Program, External Surfaces Monitoring Program, and Fire Protection Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.1)
All Groups except Group 6: accessible and inaccessible concrete: foundation (3.5.1-26)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Sections 3.5.2.2.2.1 and 3.5.2.2.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
All Groups except Group 6: accessible and inaccessible interior and exterior concrete (3.5.1-27)	Cracking due to expansion due to reaction with aggregates	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Sections 3.5.2.2.2.1 and 3.5.2.2.2.2.2)
Groups 1-3, 5-9: all (3.5.1-28)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Sections 3.5.2.2.2.1 and 3.5.2.2.2.2.3)
Groups 1-3, 5-9: foundation (3.5.1-29)	Reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Not applicable	Not applicable (See SER Sections 3.5.2.2.2.1 and 3.5.2.2.2.2.3)
Group 4: radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; steam generator supports (3.5.1-30)	Lock-up due to wear	ISI (IWF) or Structures Monitoring Program	Yes	Structures Monitoring Program or ASME Section XI, Subsection IWF Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Groups 1-3, 5, 7-9: below-grade concrete components, such as exterior walls below grade and foundation (3.5.1-31)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling), aggressive chemical attack; cracking, loss of bond, and loss of material (spalling, scaling), corrosion of embedded steel	Structures Monitoring Program. Examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program and Commitments	Consistent with the GALL Report (See SER Section 3.5.2.2.2.2.4)
Groups 1-3, 5, 7-9: exterior above- and below-grade reinforced concrete foundations (3.5.1-32)	Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide	Structures Monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.2.5)
Groups 1-5: concrete (3.5.1-33)	Reduction of strength and modulus due to elevated temperature	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable (See SER Section 3.5.2.2.2.3)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Group 6: concrete; all (3.5.1-34)	Increase in porosity and permeability, cracking, and loss of material due to aggressive chemical attack; cracking, loss of bond, and loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or Federal Energy Regulatory Commission (FERC)/US Army Corps of Engineers dam inspections and maintenance programs. For inaccessible concrete, an examination of representative samples of below-grade concrete and periodic monitoring of groundwater, if the environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program and Commitments	Consistent with the GALL Report (See SER Section 3.5.2.2.2.4.1)
Group 6: exterior above- and below-grade concrete foundation (3.5.1-35)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.4.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Group 6: all accessible and inaccessible reinforced concrete (3.5.1-36)	Cracking due to expansion/ reaction with aggregates	For accessible areas, inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.4.3)
Group 6: exterior above- and below-grade reinforced concrete foundation interior slab (3.5.1-37)	Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide	For accessible areas, inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.4.3)
Groups 7, 8: tank liners (3.5.1-38)	Cracking due to SCC; loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated	Yes	Not applicable	See SER Section 3.5.2.2.2.5
Support members, welds, bolted connections, and support anchorage to building structure (3.5.1-39)	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Yes	Structures Monitoring Program, External Surfaces Monitoring Program, and Fire Protection Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.6)
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates (3.5.1-40)	Reduction in concrete anchor capacity due to local concrete degradation service-induced cracking, or other concrete aging mechanisms	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.6)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Vibration isolation elements (3.5.1-41)	Reduction or loss of isolation function radiation hardening, temperature, humidity, and sustained vibratory loading	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with the GALL Report (See SER Section 3.5.2.2.2.6)
Groups B1.1, B1.2, and B1.3: support members: anchor bolts and welds (3.5.1-42)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	See SER Section 3.5.2.2.2.7
Groups 1-3, 5, 6: all masonry block walls (3.5.1-43)	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	No	Structures Monitoring Program and Fire Protection Program	Consistent with the GALL Report (See SER Section 3.5.2.1.3)
Group 6: elastomer seals, gaskets, and moisture barriers (3.5.1-44)	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	No	Structures Monitoring Program, WCP Program, and Fire Protection Program	Consistent with the GALL Report (See SER Section 3.5.2.1.6)
Group 6: exterior above- and below-grade concrete foundation; interior slab (3.5.1-45)	Loss of material due to abrasion, cavitation	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No	Structures Monitoring Program	Consistent with the GALL Report
Group 5: fuel pool liners (3.5.1-46)	Cracking due to SCC; loss of material due to pitting and crevice corrosion	Water Chemistry and monitoring of SFP water level in accordance with TSs and leakage from the leak chase channels.	No	Primary Water Chemistry Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Group 6: all metal structural members (3.5.1-47)	Loss of material due to general (steel only), pitting, and crevice corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	No	Structures Monitoring Program	Consistent with the GALL Report
Group 6: earthen water control structures-dams, embankments, reservoirs, channels, canals, and ponds (3.5.1-48)	Loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, and seepage	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs	No	Not applicable	Not applicable (See SER Section 3.5.2.1.1)
Support members, welds, bolted connections, and support anchorage to building structure (3.5.1-49)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and ISI (IWF)	No	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Groups B2 and B4: galvanized steel, aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure (3.5.1-50)	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	No	Structures Monitoring Program and External Surfaces Monitoring Program	Consistent with the GALL Report
Group B1.1: high-strength low-alloy bolts (3.5.1-51)	Cracking due to SCC; loss of material due to general corrosion	Bolting Integrity Program	No	Bolting Integrity Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Groups B2 and B4: sliding support bearings and sliding support surfaces (3.5.1-52)	Loss of mechanical function due to corrosion, distortion, dirt, and overload; fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with the GALL Report
Groups B1.1, B1.2, and B1.3: support members: welds, bolted connections, and support anchorage to building structure (3.5.1-53)	Loss of material due to general and pitting corrosion	ISI (IWF)	No	ASME Section XI, Subsection IWF Program	Consistent with the GALL Report
Groups B1.1, B1.2, and B1.3: constant and variable load spring hangers, guides, and stops (3.5.1-54)	Loss of mechanical function due to corrosion, distortion, dirt, and overload; fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ASME Section XI, Subsection IWF Program	Consistent with the GALL Report
Steel, galvanized steel, and aluminum support members; welds; bolted connections; support anchorage to building structure (3.5.1-55)	Loss of material due to boric acid corrosion	Boric Acid Corrosion Program	No	Boric Acid Corrosion Program	Consistent with the GALL Report
Groups B1.1, B1.2, and B1.3: sliding surfaces (3.5.1-56)	Loss of mechanical function due to corrosion, distortion, dirt, and overload; fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ASME Section XI, Subsection IWF Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Groups B1.1, B1.2, and B1.3: vibration isolation elements (3.5.1-57)	Reduction or loss of isolation function radiation hardening, temperature, humidity, and sustained vibratory loading	ISI (IWF)	No	Not applicable	Not applicable (See SER Section 3.5.2.1.1)
Galvanized steel and aluminum support members, welds, bolted connections, and support anchorage to building structure exposed to air-indoor uncontrolled (3.5.1-58)	None	None	Not applicable	None	Consistent with the GALL Report
Stainless steel support members, welds, bolted connections, and support anchorage to building structure (3.5.1-59)	None	None	Not applicable	None	Consistent with the GALL Report

The staff's review of the structures and component supports followed any one of several approaches. One approach, documented in SER Section 3.5.2.1, reviewed AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.5.2.2, reviewed AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.5.2.3, reviewed AMR results for components that the applicant indicated are not consistent with, or not addressed in, the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the structures and component supports is documented in SER Section 3.0.3.

3.5.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.5.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the structures and component supports components:

- ASME Section XI, Subsection IWE Program
- ASME Section XI, Subsection IWF Program
- Bolting Integrity Program
- Boric Acid Corrosion Program
- Buried Piping and Tanks Inspection Program
- External Surfaces Monitoring Program
- Fire Protection Program

- Primary Water Chemistry Program
- Reactor Containment Leakage Testing 10 CFR 50, Appendix J Program
- Structures Monitoring Program
- Work Control Process Program

LRA Tables 3.5.2-1 through 3.5.2-15 summarize AMRs for the structures and component supports and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency and for which it does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components of these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant noted for each AMR line item how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E, indicating how the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and verified that the identified exceptions to the GALL Report AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from the GALL Report component, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report with the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from the GALL Report component, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report. The staff verified whether the AMR line item of the different component was applicable to the component under review and whether the identified exceptions to the GALL Report AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but credits a different AMP. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the credited AMP would manage the aging effect consistently with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

The staff reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the SCs support components that are subject to an AMR. On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.5.1, the applicant's references to the GALL Report are acceptable and no further staff review is required, with the exception of the following AMRs that the applicant had identified were consistent with the AMRs of the GALL Report and for which the staff determined were in need of additional clarification and assessment. The staff's evaluations of these AMRs are provided in the subsections that follow.

3.5.2.1.1 AMR Results Identified as Not Applicable

In LRA Table 3.5.1, items 5, 8, 11, 13, 19, 20, 21, and 49, the applicant stated that the corresponding AMR items in the GALL Report are not applicable because these items are only applicable to particular components in BWR reactor designs, and KPS is a Westinghouse-designed PWR facility. The staff confirmed that the stated AMR items in the GALL Report are only applicable to BWR-designed facilities and are not applicable to the LRA.

LRA Table 3.5.1, items 48 and 57 are identified as "Not Applicable" since the component, material, and environment combination does not exist within the scope of license renewal at KPS. For each of these items, the staff reviewed the LRA and the applicant's supporting documents, and confirmed the applicant's claim that the component, material, and environment combination does not exist within the scope of license renewal. Since KPS does not have the component, material, and environment combination for these Table 1 items, the staff finds that these AMRs are not applicable.

3.5.2.1.2 Loss of Material for Carbon Steel Exposed to an Indoor Uncontrolled Air Environment

In LRA Tables 3.5.2-2, 3.5.2-13, and 14, the applicant proposed to manage loss of material for carbon steel exposed to an indoor uncontrolled air environment by using the Fire Protection or the External Surfaces Monitoring programs. The AMR line items cite generic note E, which indicates that a different AMP is credited in the GALL Report.

The staff reviewed the AMR line and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," the applicant has proposed using the Fire Protection or the External Surfaces Monitoring programs (SER Sections 3.0.3.2.8 and 3.0.3.2.7, respectively). The staff was not clear how the above programs satisfy the criteria of the Structures Monitoring Program. Therefore, the staff issued RAI 3.5.2.2.2.6-1 dated August 28, 2009, requesting that the applicant explain how the above mentioned AMPs meet or exceed the inspection recommendations of the Structures Monitoring Program. By letter dated September 28, 2009, the applicant explained that the External Surfaces Monitoring and Fire Protection programs meet or exceed the inspection requirements of the GALL Report recommended Structures Monitoring Program. Additional information was also included in the response to RAI 3.5.2.3-5, dated September 28, 2009. A more detailed discussion and review of the applicant's response is contained in SER Section 3.5.2.2.2.6.

On the basis of its review of the AMR results and the RAI as described in the preceding paragraphs, and its comparison of the applicant's results to corresponding recommendations in the GALL Report, the staff finds the applicant has addressed the AERMs adequately, as recommended by the GALL Report. The staff finds that the applicant 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).

3.5.2.1.3 Cracking Due to Restraint Shrinkage, Creep, and Aggressive Environment

In LRA Table 3.5.1, item 3.5.1-43, the applicant stated that cracking due to restraint shrinkage, creep, and aggressive environment is managed by the Structures Monitoring Program. During its review, the staff noted that in the AMP for the AMR results line that points to LRA Table 3.5.1, item 3.5.1-43, the applicant included a reference to note E for five groups, which states, "The Fire Protection Program is utilized in addition to the Structures Monitoring Program to examine masonry walls for the specific masonry walls identified in the Fire Protection Program."

The staff reviewed the AMR line items referenced to note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," the applicant has proposed using the Fire Protection Program. The applicant stated that the AMR result line items that reference LRA Table 3.5.1, item 3.5.1-43 are also listed as fire barriers that are in the scope for 10 CFR 54.4(a)(2) criterion and, therefore, the Fire Protection Program was also credited. The Fire Protection Program and Structures Monitoring Program perform visual inspections to examine masonry walls on a periodic basis to manage cracking due to restraint shrinkage, creep, and aggressive environments. On the basis that periodic visual inspections are performed, the staff finds the applicant's use of the Fire Protection Program, in conjunction with the Structures Monitoring Program, to be acceptable.

On the basis of its review of AMR result lines, as described in the preceding paragraphs, and its comparison of the applicant's results to corresponding recommendations in the GALL Report, the staff finds that the applicant addressed the AERMs adequately, as recommended by the GALL Report.

3.5.2.1.4 Increase in Porosity and Permeability, Cracking, and Loss of Material Due to Aggressive Chemical Attack

In LRA Table 3.5.2-1, the applicant proposed to manage increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack in an inaccessible soil environment by using the Structures Monitoring Program. The AMR line item cites generic note E, which indicates that a different AMP is credited in the GALL Report.

The staff reviewed the AMR line and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends GALL AMP XI.S2, "ASME Section XI, Subsection IWL," the applicant has proposed using the Structures Monitoring Program. The staff confirmed that the Structures Monitoring Program conducts appropriate opportunistic visual inspections for the above aging effects when the concrete is exposed for any reason. Therefore, the staff finds the applicant's AMR results to be acceptable. In addition, the concrete being inspected does not serve a containment pressure-retaining function; therefore, the staff agrees that the Structures Monitoring Program is the appropriate AMP.

On the basis of its review of the AMR results and its comparison of the applicant's results to corresponding recommendations in the GALL Report, the staff finds that the applicant addressed the AERMs appropriately, as recommended by the GALL Report. The staff finds that the applicant 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).

3.5.2.1.5 Loss of Material, Pitting, and Crevice Corrosion

LRA Table 3.5.2-14 credits the External Surfaces Monitoring Program for junction, terminal, and pull boxes of the material, environment, and aging effect (MEA) combination stainless steel or steel (M), air-indoor (E), and loss of material, pitting, and crevice corrosion (AERM).

The applicant applied industry standard note E, which indicates that the above items are consistent with the GALL Report for component, material, environment, and aging effect, but a different AMP is credited or the GALL Report identifies a plant-specific AMP.

The GALL Report recommends the Structures Monitoring Program for the same MEA combination. The applicant's External Surfaces Monitoring Program does not monitor the inside of the components and does not include stainless steel. Also, the inspection frequency and sampling method for these components are not clear in the applicant's proposed program. By letter dated August 28, 2009, the staff issued RAI 3.5.2.3-5 requesting that the applicant justify the reason for using the External Surfaces Monitoring Program for managing the aging effect of loss of material, pitting, and crevice corrosion of junction, terminal, and pull boxes.

In its response dated September 28, 2009, the applicant stated that the External Surfaces Monitoring Program requires comprehensive visual inspections during both normal operation and refueling outages. The frequency of inspection is based on the availability and history, but they are performed at least once during each refueling cycle or during other major maintenance outages, which are more frequent than the 5-year interval of the Structures Monitoring Program. In response to RAI B2.1.10-1, by letter dated August 17, 2009, the applicant stated that it would add an exception to the recommendation of GALL AMP XI.M36 to manage aging of stainless steel, aluminum, copper, and elastomer. The applicant further stated that similar to the Structures Monitoring Program, the External Surfaces Monitoring Program manages the loss of material of steel or stainless steel by visual inspection; and the scope of the program element allows managing the loss of material from internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces such that external surface conditions are representative of internal surface conditions. In its RAI response, the applicant further stated that indications of degradation are addressed through the corrective action program and if needed, the corrective action program initiates further inspection, including inside the components.

The staff finds the applicant's response to the RAI acceptable because the External Surfaces Monitoring Program meets or exceeds the requirements of the Structures Monitoring Program in relation to managing the aging effect of loss of material, pitting, and crevice corrosion of junction, terminal, and pull boxes. The staff's concern described in RAI 3.5.2.3-5 is resolved.

The staff concludes that the applicant has demonstrated that the effects of aging for these structures will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.6 Loss of Sealing Due to Deterioration of Seals, Gaskets, and Moisture Barriers

In LRA Table 3.5.2-14, for items that reference Table 3.5-1, item 3.5.1-44, and note E, the applicant credited the Fire Protection Program for managing loss of sealing due to deterioration of elastomer seals in an air-indoor uncontrolled environment.

The staff reviewed the AMR results discussed above and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, the GALL Report line items that address this AERM (III.A6-12) identify GALL AMP XI.S6, "Structures Monitoring Program," as the appropriate AMP. The staff's review of the Structures Monitoring Program and Fire Protection Program is documented in SER Section 3.0.3. The recommended GALL Report AMP proposes to manage aging through the use of visual inspections. The staff reviewed the applicant's use of the Fire Protection Program and finds it acceptable because it uses equivalent visual inspections on a shorter interval than the GALL Report recommended Structures Monitoring Program. Since the applicant has committed to an AMP which is equivalent to the GALL Report recommended AMP, the staff finds these AMR results to be acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.7 Loss of Material Due to Pitting and Crevice Corrosion

LRA Tables 3.5.2-1 and 3.5.2-11 credit the Structures Monitoring Program for managing aging of containment sumps and trash grill anchorages in the intake structure with the MEA combination of stainless steel, raw water, and loss of material due to pitting, crevice, and microbiologically-influenced corrosion (AERM).

The applicant references GALL Report item 3.3.1-80 and industry standard note E, which indicate that the above items are consistent with the GALL Report for component, material, environment, and aging effect, but a different AMP is credited.

The GALL Report line item recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," for the same MEA combination. The GALL Report AMP recommends using visual inspections to manage this MEA combination. The staff confirmed that the Structures Monitoring Program conducts periodic visual inspections with an appropriate inspection frequency for the above MEA combination. The staff finds the applicant is crediting an AMP which includes the recommended inspections and, therefore, the staff finds the applicant's AMR results acceptable.

The staff concludes that the applicant has demonstrated that the effects of aging for these structures will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

In LRA Section 3.5.2.2, the applicant further evaluated aging management, as recommended by the GALL Report, for the containments, structures, and component supports components, and provided information concerning how it will manage aging effects in the following three areas:

(1) PWR containment:

- aging of inaccessible concrete areas
- cracks and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations, if not covered by the Structures Monitoring Program
- reduction of strength and modulus of concrete structures due to elevated temperature
- loss of material due to general, pitting, and crevice corrosion
- loss of prestress due to relaxation, shrinkage, creep, and elevated temperature
- cumulative fatigue damage
- cracking due to SCC
- cracking due to cyclic loading
- loss of material (scaling, cracking, and spalling) due to freeze-thaw
- cracking due to expansion and reaction with aggregate and increase in porosity and permeability due to leaching of calcium hydroxide

(2) Safety-related and other structures and component supports:

- aging of structures not covered by the Structures Monitoring Program
- aging management of inaccessible areas
- reduction of strength and modulus of concrete structures due to elevated temperature
- aging management of inaccessible areas for Group 6 structures
- cracking due to SCC and loss of material due to pitting and crevice corrosion

- aging of supports not covered by the Structures Monitoring Program
- cumulative fatigue damage due to cyclic loading

For component groups evaluated in the GALL Report, for which the applicant claimed consistency with the report and for which the report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues further evaluated. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.5.2.2. The staff's review of the applicant's further evaluation follows.

3.5.2.2.1 Pressurized Water Reactor Containment

The staff reviewed LRA Section 3.5.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.1, which addresses several areas:

<u>Item 1, Aging of Inaccessible Concrete Areas</u>. LRA Section 3.5.2.2.1.1 states that the RCV is a steel structure supported on a foundation basemat. The foundation basemat, including concrete fill, is a below-grade inaccessible concrete area that is supported on soil. The LRA also states that the Structures Monitoring Program requires an examination of below-grade concrete whenever it is exposed by excavation.

The staff reviewed LRA Section 3.5.2.2.1.1 against the criteria in SRP-LR Section 3.5.2.2.1.1, which states that corrosion of embedded steel could occur in inaccessible areas of concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. However, the GALL Report recommends further evaluation of plant-specific programs to manage aging effects for inaccessible areas if the environment is aggressive.

Since the KPS containment is a free standing steel vessel, no KPS concrete serves a containment pressure-retaining function. Therefore, the concrete does not need to be evaluated in this section. SER Section 3.5.2.2.2.2 documents the staff's review of the applicant's evaluation of aging of inaccessible concrete areas, including the containment basemat which provides structural support.

<u>Item 2, Cracks and Distortion Due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, Cracking, and Differential Settlement Due to Erosion of Porous Concrete Subfoundations, if Not Covered by the Structures Monitoring Program</u>. The applicant stated in LRA Section 3.5.2.2.1.2 that the building structures are founded on stiff to hard silty clays. The applicant also stated that building settlement readings have been measured and recorded periodically since plant construction. No significant variations in building settlement have been observed. The applicant also stated that a dewatering system was not used and there is no porous concrete below any foundation. The applicant further stated that the Structures Monitoring Program is used to inspect for visual cracks and distortion and that settlement readings are taken every 5 years.

The staff reviewed LRA Section 3.5.2.2.1.2 against the criteria in SRP-LR Section 3.5.2.2.1.2, which states that the cracks and distortion due to increased stress levels from settlement could occur in concrete and steel containments. Also, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in all types of containments. The existing program relies on the Structures Monitoring Program to manage these aging effects. SRP-LR Section 3.5.2.2.1.2 also states that the GALL Report recommends no further evaluation if this activity is within the scope of the applicant's Structures Monitoring Program.

The Structures Monitoring Program, described in LRA Section B2.1.31, is an existing program that is consistent, with enhancements, with GALL AMP XI.S6, "Structures Monitoring Program." The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff noted that the applicant conservatively elected to use the Structures Monitoring Program to monitor the above-grade exposed containment concrete for the aging effect of cracking and distortion due to settlement. However, the staff was unable to verify the applicant's claim that no significant variations in building settlement have been observed and that the settlement readings are taken every 5 years. Therefore, on August 28, 2009, the staff issued RAI 3.5.2.2.1.2-1 requesting that the applicant provide this information for the staff to review. In its response dated September 28, 2009, the applicant stated that the building settlement readings are currently taken every 5 years at eight detection points. Variations in readings greater than plus or minus 0.050 inches per year are reported to the engineering group for review and evaluation. The applicant also provided a table that shows the latest gauge readings, recorded in August 2002 and November 2007. The average settlement per year is not significant when compared to the acceptance criteria (0.012 vs. 0.050 inches per year).

On the basis of its review, the staff finds the applicant's response acceptable because the average settlement per year is not significant when compared to the acceptance criteria (0.012 vs. 0.050 inches per year). The staff also finds that the applicant's Structures Monitoring Program includes activities that are consistent with the recommendations in the GALL Report, and are adequate to manage cracks and distortion due to increased stress levels from settlement, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations. Therefore, the staff finds that no further evaluation is required.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.5.2.2.1.2 criteria. For those items that apply to LRA Section 3.5.2.2.1.2, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 3, Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature. LRA Section 3.5.2.2.1.3 states that the RCV basemat and concrete fills are the only elements required to be addressed in this section. The applicant stated that neither of these elements is exposed to an environment that exceeds the elevated temperature limits (150 °F for general areas and 200 °F for local areas).

The staff reviewed LRA Section 3.5.2.2.1.3 against the criteria in SRP-LR Section 3.5.2.2.1.3, which recommends further evaluation of plant-specific AMPs if any portion of the concrete containment components exceeds the specified temperature limits of 150 °F for general areas and 200 °F for local areas.

The staff finds the applicant's evaluation, that this aging effect is not applicable, acceptable because the concrete remains below the allowable temperature limits.

Item 4, Loss of Material Due to General, Pitting, and Crevice Corrosion. In LRA Section 3.5.2.2.1.4, the applicant stated that the RCV is a steel shell structure with a hemispherical dome and ellipsoidal bottom. The applicant also stated that the lower portion of the RCV is embedded by internal and external concrete. The applicant further stated that the RCV is housed within the shield building. The applicant stated that concrete is designed in accordance with ACI 318-63, "Building Code Requirements for Reinforced Concrete," and ACI 201.2R-77, which provide a good quality, dense, well-cured, and low permeability concrete. The applicant further stated that loss of material due to general, pitting, and crevice corrosion is managed by the ASME Section XI, Subsection IWE and Reactor Containment Leakage Testing 10 CFR 50, Appendix J programs. Therefore, the applicant concluded that loss of material due to corrosion is not expected.

The staff reviewed LRA Section 3.5.2.2.1.4 against the criteria in SRP-LR Section 3.5.2.2.1.4, which states that loss of material due to general, pitting, and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. SRP-LR Section 3.5.2.2.1.4 further states that the existing program relies on the ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J programs to manage loss of material due to general, pitting, and crevice corrosion. However, the staff was unable to verify the applicant's statement that the KPS reactor containment building concrete in contact with the steel shell is designed in accordance with ACI 318-63 and ACI 201.2R-77 specifications. Therefore, on August 28, 2009, the staff issued RAI 3.5.2.2.1.4-1 requesting that the applicant provide this information for the staff to review. In its response dated September 28, 2009, the applicant stated that the concrete mixes were designed with water-cement ratios that ranged between 0.41 to 0.52 and air entrained between 3 percent and 7 percent. A more detailed discussion of the staff's review of the equivalence of KPS concrete to the ACI 201.2R-77 recommendations is documented in SER Sections 3.5.2.2.2.2.1 and 3.5.2.2.2.2.2.

The staff finds the applicant's response acceptable because the concrete mixes were designed with water-cement ratios and air entrainment within the limit of ACI 318-63, "Building Code Requirements for Reinforced Concrete," recommendation. Therefore, the staff agrees that no additional plant-specific program is required for corrosion in inaccessible areas.

Based on the programs identified above, the staff concludes that the applicant's programs meet the criteria of SRP-LR Section 3.5.2.2.1.4. For those items that apply to LRA Section 3.5.2.2.1.4, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 5, Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature. LRA Section 3.5.2.2.1.5 states that the RCV is not a prestressed concrete structure and, therefore, this item is not applicable.

The staff finds the applicant's evaluation, that this aging effect is not applicable, acceptable on the basis that the KPS containment is a free standing steel vessel with no prestressed concrete.

Item 6, Cumulative Fatigue Damage. LRA Section 3.5.2.2.1.6 states that there are no fatigue analyses in the CLB applicable to penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows). Therefore, cumulative fatigue damage of penetrations is not a TLAA as defined in 10 CFR 54.3.

SRP-LR Section 3.5.3.2.1.6 states that if included in the CLB, fatigue analyses of suppression pool steel shells and penetrations for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c).

The staff confirmed that cumulative fatigue damage of penetrations is not a TLAA for KPS. A further review of the applicant's TLAA for the containment vessel and penetrations is documented in SER Section 4.6.

Item 7, Cracking Due to Stress-Corrosion Cracking. LRA Section 3.5.2.2.1.7 states that SCC is applicable to carbon and low-alloy steel in air only if the fabrication material is high yield strength steel. SCC of stainless steel in air is only applicable to sensitized stainless steel that is exposed to intermittent wetting. The LRA further states that the RCV penetrations, including nozzles, bellows, and dissimilar metal welds, are not fabricated from high yield strength steel and the stainless steel materials are not subject to intermittent wetting. Therefore, cracking due to SCC does not require aging management since the conditions necessary for SCC do not exist.

The staff reviewed LRA Section 3.5.2.2.1.7 against the criteria in SRP-LR Section 3.5.2.2.1.7, which states that SCC of stainless steel penetration sleeves and dissimilar metal welds can occur in all types of PWR and BWR containments. The existing program relies on the ASME Section XI, Subsection IWE and Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J programs to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations implemented to detect these aging effects.

The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the applicant's LRA does not have any AMR results for RCV penetrations that are fabricated from high yield strength steel or stainless steel subject to intermittent wetting. The staff also reviewed the USAR and did not find any evidence of high yield strength steel or stainless steel containment penetrations exposed to intermittent wetting. In addition, the staff reviewed the AMR results to verify that the containment penetrations will continue to be examined under the ASME Section XI, Subsection IWE and Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J programs during the period of extended operation. Based on its review, the staff confirmed that the conditions conducive to SCC do not exist for the containment penetrations; therefore, additional examinations to detect this aging effect are not required.

Item 8, Cracking Due to Cyclic Loading. LRA Section 3.5.2.2.1.8 states that cracking due to cyclic loading is managed by the ASME Code Section XI, Subsection IWE and Reactor Containment Leakage Testing 10 CFR 50, Appendix J programs. The applicant also stated that Type A and B leakage testing per 10 CFR 50, Appendix J will be adequate to detect leakage.

The staff reviewed LRA Section 3.5.2.2.1.8 against the criteria in SRP-LR Section 3.5.2.2.1.8, which states that cracking due to cyclic loading of suppression pool steel and stainless steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) could occur for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers. The existing program relies on the ASME Section XI, Subsection IWE and Reactor Containment Leakage Testing 10 CFR Part 50, Appendix J programs to manage this aging effect. However, VT-3 inspection may not detect fine cracks. The GALL Report recommends further evaluation for detection of this aging effect.

The staff reviewed the applicant's USAR and confirmed that KPS containment hot penetrations use a two-ply bellows system with a connection between bellows that allows for integrity testing. This design allows the Appendix J Type B tests to adequately detect leakage and fine cracks in the bellows. The applicant performs Type B tests on the bellows every third refueling outage, or approximately every 5 years. Since the design of the containment bellows allows adequate Type B testing on an appropriate frequency, the staff finds that the credited AMPs will be adequate to detect aging, and no further evaluation is necessary.

Based on the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.5.2.2.1.8 criteria. For those items that apply to LRA Section 3.5.2.2.1.8, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 9, Loss of Material (Scaling, Cracking, and Spalling) Due to Freeze-Thaw. LRA Section 3.5.2.2.1.9 states that the RCV is totally enclosed within the shield building and the foundation basemat. The applicant stated that loss of material due to freeze-thaw is not applicable.

The staff reviewed LRA Section 3.5.2.2.1.9 against the criteria in SRP-LR Section 3.5.2.2.1.9, which recommends further evaluation of loss of material due to freeze-thaw for plants with concrete containments located in moderate to severe weathering conditions.

The staff finds that the applicant's evaluation, that this aging effect is not applicable, is acceptable because the containment is a free standing steel vessel. The steel vessel, as discussed in LRA Section 2.4.1, is supported directly on a grout base with concrete fill, which is enclosed within the shield building and will not experience freeze-thaw cycles. Therefore, loss of material due to freeze-thaw is not applicable to this support concrete.

Item 10, Cracking Due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide. LRA Section 3.5.2.2.1.10 states that the containment foundation basemat is a below-grade inaccessible concrete area supported on soil. The applicant stated that the installation of the concrete was in accordance with ACI and ASTM specifications and materials at the time of construction, which are in accordance with the recommendations in ACI 201.2R-77. The LRA further states that the aggregates complied with ASTM C-33, "Specifications for Concrete Aggregates," and were evaluated for potential alkali reactivity and tested to the requirements of ASTM C-227 and ASTM C-289 (for potential reactivity) and ASTM C-295, "Petrographic Examination of Aggregates." Therefore, the applicant concluded that aging management is not required.

The staff reviewed LRA Section 3.5.2.2.1.10 against the criteria in SRP-LR Section 3.5.2.2.1.10, which states that cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide could occur in concrete elements of concrete and steel containments. The GALL Report recommends further evaluation if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

Since the KPS containment is a free standing steel vessel, no KPS concrete serves a containment pressure-retaining function. Therefore, the concrete does not need to be evaluated in this section. SER Section 3.5.2.2.2.2 documents the staff's review of the applicant's evaluation of cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide for the remaining in-scope concrete structures.

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

Item 1, Aging of Structures Not Covered by the Structures Monitoring Program. LRA Section 3.5.2.2.2.1 states that the Structures Monitoring, External Surfaces Monitoring, and Fire Protection programs are used to inspect the accessible areas for the aging effects and mechanisms discussed below. Additional discussion of specific aging effects follows.

The staff reviewed LRA Section 3.5.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.1, which states that the GALL Report recommends further evaluation of certain structure and aging effect combinations if they are not covered by the Structures Monitoring Program, including: (1) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, and 9 structures; (2) increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, and 9 structures; (3) loss of material due to corrosion for Groups 1-5, 7, and 8 structures; (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, and 7-9 structures; (5) cracking due to expansion and reaction with aggregates for Groups 1-5 and 7-9 structures; (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3 and 5-9 structures; and (7) reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1-3 and 5-9 structures.

In addition, SRP-LR Section 3.5.2.2.2.1 states that lock-up due to wear may occur for Lubrite® radial beam seats in BWR drywells, RPV support shoes for PWRs with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or the ASME Code Section XI, Subsection IWF Program to manage this aging effect. The GALL Report recommends further evaluation only for structure-aging effect combinations not within the ASME Code Section XI, Subsection IWF or Structures Monitoring programs.

(1) Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling) Due to Corrosion of Embedded Steel for Groups 1-5, 7, and 9 Structures – The staff reviewed LRA Section 3.5.2.2.2.1.1 against the criteria in SRP-LR Section 3.5.2.2.2.1.1, which states that the GALL Report recommends further evaluation of certain structure and aging effect combinations if they are not covered by the Structures Monitoring Program.

    The applicant stated in the LRA that the Structures Monitoring Program is used to inspect the accessible areas for the aging mechanisms associated with cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, and 9 structures.

    Through a review of the LRA, the staff determined that the cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, and 9 structures are included within the Structures Monitoring Program by the applicant. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1.1 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(2) Increase in Porosity and Permeability, Cracking, and Loss of Material (Spalling, Scaling) Due to Aggressive Chemical Attack for Groups 1-5, 7, and 9 Structures – The applicant stated in the LRA that increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for accessible concrete areas of Groups 1-5, 7, and 9 structures is managed by the Structures Monitoring Program.

The staff confirmed that Groups 1-5, 7, and 9 structures subject to this AMR are all within the scope of the Structures Monitoring Program. Therefore, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff's reviews for the increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for inaccessible concrete elements of containments and Groups 1-5, 7, and 9 structures are documented in SER Sections 3.5.2.2.1.1 and 3.5.2.2.2.2.4, respectively.

(3) Loss of Material Due to Corrosion for Groups 1-5, 7, and 8 Structures – The staff reviewed LRA Section 3.5.2.2.2.1.3 against the criteria in SRP-LR Section 3.5.2.2.2.1.3, which states that the GALL Report recommends further evaluation of certain structure and aging effect combinations if they are not covered by the Structures Monitoring Program.

The applicant stated in the LRA that the Structures Monitoring Program is used to inspect the accessible areas for the aging mechanisms associated with loss of material due to corrosion for Groups 1-5, 7, and 8 structures.

Through a review of the LRA, the staff determined that the loss of material due to corrosion for Groups 1-5, 7, and 8 structures are included within the Structures Monitoring Program by the applicant. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1.3 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(4) Loss of Material (Spalling, Scaling) and Cracking Due to Freeze-Thaw for Groups 1-3, 5, and 7-9 Structures – The applicant stated in the LRA that loss of material (spalling, scaling) and cracking due to freeze-thaw for accessible concrete areas of Groups 1-5, 7, and 9 structures is managed by the Structures Monitoring Program.

The staff confirmed that Groups 1-3, 5, and 7-9 structures subject to this AMR are all within the scope of the Structures Monitoring Program. Therefore, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff's reviews for the loss of material (spalling, scaling) and cracking due to freeze-thaw for concrete elements of containments, and below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures, are documented in SER Sections 3.5.2.2.1.9, and 3.5.2.2.2.2.1, respectively.

(5) Cracking Due to Expansion and Reaction with Aggregates for Groups 1-5 and 7-9 Structures – The applicant stated in the LRA that cracking due to expansion and reaction with aggregates for accessible concrete areas of Groups 1-5 and 7-9 structures is managed by the Structures Monitoring Program.

The staff finds that Groups 1-5 and 7-9 structures subject to this AMR are all within the scope of the Structures Monitoring Program. Therefore, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff's reviews for the cracking due to expansion and reaction with aggregates for concrete elements of containments and inaccessible areas of Groups 1-5 and 7-9 structures are documented in SER Sections 3.5.2.2.1.10 and 3.5.2.2.2.2.2, respectively.

(6) Cracks and Distortion Due to Increased Stress Levels from Settlement for Groups 1-3 and 5-9 Structures – The staff reviewed LRA Section 3.5.2.2.2.1.6 against the criteria in SRP-LR Section 3.5.2.2.2.1.6, which states that the GALL Report recommends further evaluation of certain structure and aging effect combinations if they are not covered by the Structures Monitoring Program.

The applicant stated in the LRA that the Structures Monitoring Program is used to inspect accessible areas for the aging mechanisms associated with cracking and distortion due to increased stress levels from settlement for Groups 1-3 and 5-9 structures.

Through a review of the LRA, the staff determined that the cracking and distortion due to increased stress levels from settlement for Groups 1-3 and 5-9 structures are included within the Structures Monitoring Program by the applicant. Therefore, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.1.1 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(7) Reduction in Foundation Strength, Cracking, Differential Settlement Due to Erosion of Porous Concrete Subfoundation for Groups 1-3 and 5-9 Structures – The applicant stated in the LRA that reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations for Groups 1-3 and 5-9 structures is not applicable because no porous concrete subfoundation is used below any foundation and no dewatering system is installed for control of settlement.

The staff finds that the applicant's evaluation of this aging effect as not applicable is acceptable because KPS has no porous concrete subfoundations.

(8) Lock-up Due to Wear for Lubrite® Radial Beam Seats in RPV Support Shoes for PWR with Nozzle Supports, Steam Generator Supports, and Other Sliding Support Bearings and Sliding Support Surfaces – The staff reviewed LRA Section 3.5.2.2.2.1.8 against the criteria in SRP-LR Section 3.5.2.2.2.1.8, which states that lock-up due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The GALL Report recommends further evaluation only for structure and aging effect combinations that are not within the ASME Code Section XI, Subsection IWF Program or Structures Monitoring Program.

In LRA Section 3.5.2.2.2.1.8, the applicant stated that lock-up due to wear is not an AERM for this material because of the wear resistance inherent in the design of the material and the low number of times that movement occurs. However, the applicant further stated that Lubrite® plates are included within the Structures Monitoring Program and the ASME Section XI, Subsection IWF Program to confirm the absence of AERMs for this component. Since the components are included within the scope of the appropriate programs, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.1.8 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program and the ASME Section XI, Subsection IWF Program are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.2, respectively.

Based on the programs and analyses discussed above, the staff concludes that the applicant's programs meet the criteria of SRP-LR Section 3.5.2.2.2.1. For those items that apply to LRA Section 3.5.2.2.2.1, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Item 2, Aging Management of Inaccessible Areas</u>. The staff reviewed LRA Section 3.5.2.2.2.2 against the following criteria in SRP-LR Section 3.5.2.2.2.2:

(1) Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures.

LRA Section 3.5.2.2.2.2.1 states that KPS is located in a severe weathering area. The applicant stated that the concrete structures were designed in accordance with ACI 318-63, except for the TSC which was designed in accordance with ACI 318-77 (a later addition to the building was designed in accordance with ACI 318-2002). The applicant also stated that plant documents indicate that concrete mixes were designed with water-cement ratios ranging from 0.41 to 0.52 with entrained air content between 3 percent and 7 percent. The applicant further stated that a review of OE has not revealed any freeze-thaw related degradation; however, the Structures Monitoring Program will examine exposed portions of below-grade concrete whenever excavation occurs.

The staff reviewed LRA Section 3.5.2.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.2.1, which states that the GALL Report recommends further evaluation of this aging effect for inaccessible areas of these structures for plants located in moderate to severe weathering conditions.

The GALL Report recommends a water-to-cement ratio between 0.35 and 0.45, while the water-to-cement ratio at KPS ranges from 0.41 to 0.52. The staff is unsure how the applicant's Structures Monitoring Program is addressing the possibility of accelerated degradation in the inaccessible concrete due to freeze-thaw that may result from the higher water-to-cement ratio. By letter dated August 28, 2009, the staff issued RAI 3.5.2.2.2.2.1-1 requesting that the applicant explain what actions will be taken in the future to adequately address freeze-thaw degradation in inaccessible concrete areas during the period of extended operation.

By letter dated September 28, 2009, the applicant responded and explained that the Structures Monitoring Program has been used in the past to inspect and manage loss of material and cracking due to freeze-thaw, with no indications of degradation. The response also explained that the Structures Monitoring Program will perform opportunistic visual inspections on inaccessible concrete whenever exposed. The applicant further explained that although the concrete is outside the GALL Report water-to-cement ratio and air entrainment limits, the concrete was designed to applicable ACI standards and meets the intent of ACI 201.2R-77. In addition, the applicant explained that plant-specific OE shows that the ground tends to freeze and remain frozen throughout the winter, which reduces the number of freeze-thaw cycles experienced by the inaccessible concrete.

The staff reviewed the applicant's response and noted that the applicant did not identify any concrete degradation that was attributed to freeze-thaw. The staff's review also did not identify degradation that was attributed to freeze-thaw. The lack of identified freeze-thaw degradation in accessible regions provides assurance that freeze-thaw degradation has not occurred in inaccessible areas. In addition, the inaccessible areas will be inspected under the Structures Monitoring Program when exposed for any reason. Since the applicant is performing Structures Monitoring Program inspections for the period of extended operation, and concrete degradation has not been attributed to freeze-thaw, the staff concludes that the applicant's management approach is acceptable, even with the water-to-cement ratio above the GALL Report recommended limit.

The GALL Report recommends an air content of 3 percent to 6 percent, while the value specified at KPS ranges from 3 percent to 7 percent. The staff noted that ACI 201.2R-77 states that, "too little entrained air will not protect cement paste against freezing and thawing. Too much air will penalize the strength." This indicates that the upper limit of air-entrainment is tied to the strength, and if the necessary strength can be maintained, a higher air entrainment value is acceptable. The necessary KPS concrete strength was verified during construction with appropriate concrete batch testing; therefore, the increased air content provides increased protection against freeze-thaw without jeopardizing the concrete strength, and meets the intent of ACI 201.2R-77. In addition, as noted above in the RAI discussion, freeze-thaw degradation has not been reported at KPS and potential freeze-thaw effects on inaccessible concrete will be assessed under the Structures Monitoring Program whenever the concrete becomes accessible for inspection due to excavation. The Structures Monitoring Program will continue to inspect accessible concrete for indications of degradation due to freeze-thaw. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, including the response to RAI 3.5.2.2.2.2.1-1, the staff finds that there is assurance that the aging effect loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures will be adequately managed during the period of extended operation.

(2) Cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures.

LRA Section 3.5.2.2.2.2.2 states that aging management is not required because KPS concrete was constructed in accordance with the recommendations contained in ACI 201.2R-77. The LRA further states that the aggregates complied with ASTM C-33 and were tested per ASTM C-227, ASTM C-289, and ASTM C-295.

The staff reviewed LRA Section 3.5.2.2.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.2.2, which states that the GALL Report recommends further evaluation of inaccessible areas of these groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

GALL Report item III.A1-2 states that ASTM C-295 or ASTM C-227 can be used to demonstrate that aggregates are non-reactive. If non-reactive aggregates are used, aging management is not necessary. KPS used both GALL Report recommended ASTM standards to demonstrate that non-reactive aggregates were used in KPS concrete. Since the aggregates in the KPS concrete are non-reactive, the staff finds that cracking due to expansion and reaction with aggregate in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures is not an aging effect for inaccessible concrete.

On the basis of its review, the staff finds that the aging effect is not significant; therefore, no additional plant-specific program is required to manage the aging effect.

(3) Cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures.

LRA Section 3.5.2.2.2.2.3 states that the building structures are founded on stiff to hard silty clays. Settlement readings have been measured since plant construction and no significant variations have been observed. The LRA further states that the Structures Monitoring Program requires that settlement readings be taken every 5 years. The program is also used to inspect for visual cracks and distortion due to increased stress levels from settlement in accessible areas. The LRA also states that no porous concrete subfoundations are used below foundations, and de-watering systems are not used at KPS.

The staff reviewed LRA Section 3.5.2.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.2.3, which states that the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation, if the plant's CLB credits a de-watering system. The GALL Report recommends no further evaluation if this activity and these aging effects are included in the scope of the applicant's Structures Monitoring Program.

On the basis of its review, the staff determines that cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures are not plausible aging effects due to the absence of these aging mechanisms. KPS does not use a de-watering system, and there are no porous subfoundations on the site. In addition, the applicant elected to monitor accessible concrete for the aging effect of cracking due to settlement under the Structures Monitoring Program. The Structures Monitoring Program also requires settlement measurements to be taken every 5 years.

On the basis of its review, the staff finds that the aging effects are not significant; therefore, no additional plant-specific program is required to manage the aging effects.

(4) Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures.

LRA Section 3.5.2.2.2.2.4 states that the Structures Monitoring Program requires that below-grade concrete be examined whenever exposed, and that the program will be enhanced to include periodic monitoring of below-grade water chemistry. The LRA provides groundwater chemistry values for July 1968, June 1971, and 2006 which meet the GALL Report limits for non-aggressive groundwater chemistry. However, the LRA also included chemistry test results for groundwater samples taken in June 2007 and March 2008 with chloride values as high as 1,240 ppm, which exceed the limit of 500 ppm. The LRA attributes these high values to salt used for de-icing during the winter months.

The staff reviewed LRA Section 3.5.2.2.2.2.4 against the criteria in SRP-LR Section 3.5.2.2.2.2.4, which states that the GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas of these groups of structures if the environment is aggressive.

The GALL Report recommends periodic groundwater inspection for chlorides, sulfates, and pH to ensure non-aggressive groundwater chemistries, as well as examination of exposed portions of below-grade concrete whenever excavated. The staff noted that the applicant's Structures Monitoring Program requires examination of exposed portions of below-grade concrete, and the program will be enhanced to perform groundwater monitoring. Additionally, the Structures Monitoring Program inspects for this aging effect on accessible concrete areas. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff is unsure how the applicant's Structures Monitoring Program is addressing the possibility of accelerated degradation in the inaccessible concrete due to the high chloride values in the groundwater. By letter dated July 13, 2009, the staff issued RAI B.2.1.31-3 requesting that the applicant describe past and present groundwater monitoring activities, including results, and to explain the technical basis and acceptance criteria of the monitoring program.

By letter dated August 17, 2009, the applicant restated the results included in the LRA, as well as the average value of samples taken since June 2007, from tritium assessment wells located near plant structures. The applicant explained that the elevated chloride levels were obtained from wells located near paved plant areas that are heavily salted in the winter months. The applicant further explained that the highest average chloride level was 640 ppm, which is only marginally above the GALL Report limit of 500 ppm. The applicant explained that the 500 ppm limit was conservative and that a value of 640 ppm was acceptable. The applicant further explained that a waterproofing membrane had been installed on below-grade concrete during initial construction, which should minimize direct contact between concrete and groundwater.

The staff reviewed the response and required additional information in order to complete its review. By letter dated November 20, 2009, the staff issued follow-up RAI B.2.1.31-3a, requesting that the applicant demonstrate that the current chloride levels are not causing degradation. The applicant responded by letters dated December 28, 2009, and February 15, 2010. In its responses, the applicant explained its plans to reduce the chloride levels in the groundwater, as well as commitments to take core samples of the inaccessible concrete. The concrete core samples would verify that the aggressive groundwater environment had not caused concrete degradation. The staff found the applicant's responses acceptable because they explained how the applicant would ensure that the aggressive environment had not caused degradation prior to and during the period of extended operation. This issue is discussed in more detail in the staff's review of the Structures Monitoring Program (SER Section 3.0.3.2.18).

On the basis of its review, the staff finds that there is assurance that the aging effect increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures will be adequately managed during the period of extended operation.

(5) Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures.

LRA Section 3.5.2.2.2.2.5 states that KPS concrete was constructed in accordance with ACI and ASTM specifications and materials at the time of construction, which are in accordance with the recommendations in ACI 201.2R-77.

The staff reviewed LRA Section 3.5.2.2.2.2.5 against the criteria in SRP-LR Section 3.5.2.2.2.2.5, which states that the GALL Report recommends further evaluation of this aging effect for inaccessible areas of Groups 1-3, 5, and 7-9 structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77 for a quality concrete with low water-to-cement ratio (0.35-0.45), smaller aggregate, long curing period, adequate air entrainment (3 percent to 6 percent), and thorough consolidation. The staff finds that KPS concrete meets the intent of ACI 201.2R-77. A more detailed discussion of the staff's review of the equivalence of KPS concrete to the ACI 201.2R-77 recommendations is documented in SER Sections 3.5.2.2.2.2.1 and 3.5.2.2.2.2.2. In addition, the Structures Monitoring Program will manage this aging effect in accessible areas, as well as inaccessible areas, when exposed for any reason.

On the basis of its review, including the response to RAI 3.5.2.2.2.2.1-1, the staff finds that increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures is not a plausible AERM because the design and construction of concrete structures in accordance with ACI codes enhances resistance to leaching.

Based on the programs and analyses discussed above, including the RAI responses, the staff concludes that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.2. For those line items that apply to LRA Section 3.5.2.2.2.2, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 3, Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature. LRA Section 3.5.2.2.2.3 states that none of the concrete elements of Groups 1-5 exceeds the temperature limits of 150 °F for general areas or 200 °F for local areas.

The staff reviewed LRA Section 3.5.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.3, which states that reduction of strength and modulus of concrete due to elevated temperatures may occur in PWR and BWR concrete structures of Groups 1-5. For concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A to ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. Temperatures shall not exceed 150 °F, except for local areas allowed to have temperatures that do not exceed 200 °F.

The staff finds the applicant's evaluation acceptable since this aging effect is not applicable on the basis that KPS Groups 1-5 concrete does not experience temperatures above the limits.

Item 4, Aging Management of Inaccessible Areas for Group 6 Structures. The staff reviewed LRA Section 3.5.2.2.2.4 against the following criteria in SRP-LR Section 3.5.2.2.2.4:

(1) Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures.

LRA Section 3.5.2.2.2.4.1 states that the above aging effects for concrete in inaccessible areas are managed by the Structures Monitoring Program, which incorporates the attributes of GALL AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants." The LRA also states that the Structures Monitoring Program requires examination of below-grade concrete whenever exposed and the program will be enhanced to include periodic monitoring of below-grade water chemistry.

The staff reviewed LRA Section 3.5.2.2.2.4.1 against the criteria in SRP-LR Section 3.5.2.2.2.4.1, which states that the GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas if the environment is aggressive. The staff's review for the increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack and corrosion of embedded steel for inaccessible concrete elements is documented in SER Section 3.5.2.2.2.2.4. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, as discussed in SER Section 3.5.2.2.2.2.4, the staff finds that there is assurance that the aging effect, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in below-grade inaccessible concrete areas of Group 6 structures will be adequately managed during the period of extended operation.

(2) Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures.

LRA Section 3.5.2.2.2.4.2 states that KPS is located in a severe weathering area. The applicant stated that the concrete structures were designed in accordance with ACI 318-63, except for the TSC which was designed in accordance with ACI 318-77 (a later addition to the building was designed in accordance with ACI 318-2002). Plant documents indicate that concrete mixes were designed with water-cement ratios ranging from 0.41 to 0.52, with entrained air content between 3 percent and 7 percent. The applicant further stated that a review of OE has not revealed any freeze-thaw related degradation; however, the Structures Monitoring Program will examine exposed portions of below-grade concrete whenever excavation occurs.

The staff reviewed LRA Section 3.5.2.2.2.4.2 against the criteria in SRP-LR Section 3.5.2.2.2.4.2, which states that the GALL Report recommends further evaluation of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions (weathering index greater than 100 day-inch/year). The staff's review for the loss of material (spalling, scaling) and cracking due to freeze-thaw for inaccessible concrete elements, including the applicant's further evaluation, is documented in SER Section 3.5.2.2.2.2.1. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, including the response to RAI 3.5.2.2.2.2.1-1, the staff finds that there is assurance that the aging effect of loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Group 6 structures will be adequately managed during the period of extended operation.

(3) Cracking due to expansion and reaction with aggregates and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible reinforced concrete areas of Group 6 structures.

LRA Section 3.5.2.2.2.4.3 states that KPS concrete was constructed in accordance with the recommendations contained in ACI 201.2R-77. LRA Table 3.5.1, items 3.5.1-36 and 3.5.1-37 state that no aging management is required for inaccessible areas if the concrete was constructed in accordance with ACI 201.2R-77. The LRA further states that the aggregates complied with ASTM C-33 and were tested per ASTM C-227, ASTM C-289, and ASTM C-295.

The staff reviewed LRA Section 3.5.2.2.2.4.3 against the criteria in SRP-LR Section 3.5.2.2.2.4.3, which states that the GALL Report recommends further evaluation of inaccessible areas if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77. The staff's review for cracking due to expansion and reaction with aggregates for inaccessible concrete elements, including the review of the applicant's concrete, is documented in SER Section 3.5.2.2.2.2.2. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Since the applicant's concrete aggregate was tested in accordance with the GALL Report recommended ASTM standards, as discussed in SER Section 3.5.2.2.2.2.2, the staff finds that further evaluation is not necessary, and the criteria of SRP-LR Section 3.5.2.2.2.4.3 have been met for cracking due to expansion and reaction with aggregates.

The staff's review for an increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide for inaccessible concrete elements is documented in SER Section 3.5.2.2.2.2.5. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Since the concrete was constructed in accordance with ACI 201.2R-77, as discussed in SER Section 3.5.2.2.2.2.5, the staff finds that further evaluation is not necessary, and the criteria of SRP-LR Section 3.5.2.2.2.4.3 have been met for an increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide.

Based on the programs discussed above, including RAI responses, the staff concludes that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4. For those line items that apply to LRA Section 3.5.2.2.2.4, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 5, Cracking Due to Stress-Corrosion Cracking and Loss of Material Due to Pitting and Crevice Corrosion. In LRA Section 3.5.2.2.2.5, the applicant stated that tanks are evaluated for aging management in their respective mechanical systems.

The staff reviewed LRA Section 3.5.2.2.2.5 against the criteria in SRP-LR Section 3.5.2.2.2.5, which states that cracking due to SCC and loss of material due to pitting and crevice corrosion could occur for Groups 7 and 8 stainless steel tank liners exposed to standing water. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects.

During the review, the staff noticed that for GALL AMP XI.M29, "Aboveground Steel Tanks," the applicant stated that the AMRs did not identify the need for this AMP. The staff was unable to verify whether or not the applicant has any stainless steel tank liners exposed to standing water for Groups 7 and 8. Therefore, on August 28, 2009, the staff issued RAI 3.5.2.2.1.5-1 requesting that the applicant provide this information for the staff to review. In its response dated September 28, 2009, the applicant stated that there are no aboveground tanks with stainless steel liners exposed to standing water at KPS.

On the basis of its review, the staff finds that cracking due to SCC and loss of material due to pitting and crevice corrosion that could occur for Groups 7 and 8 stainless steel tank liners exposed to standing water are not applicable to KPS. Therefore, the staff agrees that no additional plant-specific program is required.

Based on the programs identified above, the staff concludes that the applicant's programs meet the criteria of SRP-LR Section 3.5.2.2.2.5. For those line items that apply to LRA Section 3.5.2.2.2.5, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 6, Aging of Supports Not Covered by the Structures Monitoring Program. LRA Section 3.5.2.2.2.6 states that the Structures Monitoring Program is used to manage the aging effects for Groups B1 through B5 supports and miscellaneous structural commodities, such as cabinets and panels.

The staff reviewed LRA Section 3.5.2.2.2.6 against the criteria in SRP-LR Section 3.5.2.2.2.6, which recommends further evaluation of the following support and aging effect combinations if they are not covered by the Structures Monitoring Program.

(1) Loss of Material Due to General and Pitting Corrosion for Groups B2 through B5 Supports – LRA Section 3.5.2.2.2.6 states that the Structures Monitoring Program manages the aging effects for Groups B1 through B5 supports and miscellaneous structural commodities, such as cabinets and panels. For miscellaneous structural commodities, such as junction, terminal, and pull boxes and doors, the External Surfaces Monitoring and Fire Protection programs are used.

    The staff is not clear how the above programs satisfy the criteria of the Structures Monitoring Program. Therefore, the staff issued RAI 3.5.2.2.2.6-1, dated August 28, 2009, requesting that the applicant explain how the above mentioned AMPs meet or exceed the inspection recommendations of the Structures Monitoring Program.

By response dated September 28, 2009, the applicant explained that both the External Surfaces Monitoring and Fire Protection programs require visual inspections to manage the loss of material for steel structural SC supports. The applicant stated that these visual inspections match the inspections required by the Structures Monitoring Program. The applicant further explained that the Structures Monitoring Program requires visual examinations be performed at 5-year inspection intervals, while the Fire Protection Program requires visual examinations every 18 months, and the External Surfaces Monitoring Program requires visual examinations at least once every refueling cycle, which is normally between 18 and 24 months.

The staff reviewed the applicant's response and found it acceptable because the programs credited by the applicant require similar visual inspections more frequently than the GALL Report recommended program. Therefore, since the External Surfaces Monitoring and Fire Protection programs meet or exceed the recommendations of the GALL Report recommended Structures Monitoring Program, the staff finds that the criteria of the SRP-LR Section 3.5.2.2.2.6.1 have been met, and no further evaluation is required. The staff's review of the Fire Protection and External Surfaces Monitoring programs are documented in SER Sections 3.0.3.2.8 and 3.0.3.2.7, respectively.

(2) Reduction in Concrete Anchor Capacity Due to Degradation of the Surrounding Concrete for Groups B1 through B5 Supports – LRA Table 3.5.1, item 3.5.1-40 states that reduction in concrete anchor capacity due to local concrete degradation of expansion and grouted anchors is managed by the Structures Monitoring Program. In LRA Section B2.1.31, the applicant also stated that the Structures Monitoring Program manages the aging effect of reduction in concrete anchor capacity due to local concrete degradation.

Since the aging effect is covered by the Structures Monitoring Program, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.6.2 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(3) Reduction or Loss of Isolation Function Due to Degradation of Vibration Isolation Elements for Group B4 Supports – LRA Table 3.5.1, item 3.5.1-41 states that reduction or loss of isolation function due to radiation hardening, temperature, humidity, or sustained vibratory loading for vibration isolation elements is managed by the Structures Monitoring Program. In LRA Section B2.1.31, the applicant also stated that the Structures Monitoring Program manages the aging effect of reduction or loss of isolation function for elastomers.

Since the aging effect is covered by the Structures Monitoring Program, the staff finds that the criteria of SRP-LR Section 3.5.2.2.2.6.3 have been met, and no further evaluation is required. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Based on the programs and analysis identified above, the staff concludes that the applicant's programs meet the criteria of SRP-LR Section 3.5.2.2.2.6. For those items that apply to LRA Section 3.5.2.2.2.6, the staff determines that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Item 7, Cumulative Fatigue Damage Due to Cyclic Loading. LRA Section 3.5.2.2.2.7 states that there are no fatigue analyses in the CLB applicable to component supports. Therefore, the applicant concluded that cumulative fatigue damage of component supports is not a TLAA as defined in 10 CFR 54.3.

The staff reviewed LRA Section 3.5.2.2.2.7 against the criteria in SRP-LR Section 3.5.2.2.2.7, which states that fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3, only if a CLB fatigue analysis exists. The evaluation of this TLAA is addressed separately in SRP-LR Section 4.3.

The staff reviewed the USAR and the LRA and confirmed that there are no fatigue analyses in the CLB applicable to component supports. Therefore, the staff finds that cumulative fatigue damage of component supports is not a TLAA and the applicant has appropriately addressed the criteria of SRP-LR Section 3.5.2.2.2.7.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.5.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.5.2-1 through 3.5.2-15, the staff reviewed additional details of the AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.5.2-1 through 3.5.2-15, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information about how it will manage the aging effects. Specifically, note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant 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. The staff's evaluation is documented in the following sections.

3.5.2.3.1 Concrete Reactor Containment Vessel Sumps Exposed to Raw Water, Aging Effect of Cracking, Loss of Bond, and Increase in Porosity and Permeability

According to LRA AMR Table 3.5.2-1, the applicant credited the Structures Monitoring Program for aging of the RCV sumps in a raw water environment.. The LRA also specifies the sumps as part of the pressure boundary. The GALL Report recommends ASME Section XI, Subsection IWL/IWE for containment components which are part of the pressure boundary.

By letter dated October 13, 2009, the staff issued RAI 3.5.2.3-2 requesting that the applicant justify why aging effect for RCV sumps are not managed under the ASME Section XI, Subsection IWL/IWE Program. In its response dated November 13, 2009, the applicant clarified that the pressure boundary function indicated in LRA Tables 2.4.1-1 and 3.5.2-1 for the containment sump is considered a system function for water retention and not a structural function as pressure boundary. The applicant uses the ASME Section XI, Subsection IWE Program for the RCV and its components, such as penetrations, airlocks, and hatches. For all the internal structures of the RCV, including the sumps and common basemat, the applicant credited the Structures Monitoring Program.

The staff finds the applicant's response acceptable because in the RAI response, the applicant clarified that the sump is not considered part of the RCV pressure boundary from structural consideration and, therefore, the Structures Monitoring Program is suitable for monitoring the aging effects for the sump. The staff's concern described in RAI 3.5.2.3-2 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these structures will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.2 Concrete Sumps Exposed to Raw Water, Aging Effect of Cracking, Loss of Bond, and Increase in Porosity and Permeability

In LRA Table 3.5.2-2, the applicant recognized the Structures Monitoring Program for shield building sumps and trenches of the MEA combination concrete (M); raw water (E); and cracking, loss of bond, and loss of material, and corrosion of embedded steel (AERM). Also, there is another MEA combination for concrete (M); raw water (E); and increase in porosity and permeability, cracking, loss of material (spalling, scaling), and aggressive chemical attack (AERM). Additionally, LRA Tables 3.5.2-4, 3.5.2-7, 3.5.2-9, 3.5.2-10, 3.5.2-11, and 3.5.2-12 credit the Structures Monitoring Program for the same MEA combination.

For the similar combination, the GALL Report items III.A1-4 (T-05) and II.A1-4 (T-05) recommend further evaluation if the environment is aggressive; otherwise, the Structures Monitoring Program is adequate.

By letter dated October 13, 2009, the staff issued RAI 3.5.2.3-1 requesting that the applicant:

(1) explain the past and present raw water monitoring activities and discuss the results

(2) indicate which inspection and monitoring criteria of the Structures Monitoring Program are or will be followed, and if raw water is not monitored, to ensure 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

In its response dated November 13, 2009, the applicant stated that it has not performed periodic monitoring of raw intake water from Lake Michigan presently or in the recent past. The applicant further stated that Lake Michigan is a fresh water lake and analysis of lake water samples taken in 1971, 2004, and 2006 indicated average results of 8.18 pH, 8.94 ppm chloride, and

22.63 ppm sulfate. In addition, the applicant stated that in 2004, an analysis of water samples taken from the two deep potable water wells located on site indicated average readings of 7.5 pH, 34 ppm chloride, and 640 ppm sulfate. Also, the applicant stated that it does not conduct periodic monitoring of aggressiveness of water in the drains and sumps. However, water collected in the floor drains and sumps is monitored for gamma, tritium, and suspended solids. If a high sump level is detected in the RCV, the applicant tests the sump water for boron, conductivity, and pH to help determine the leakage source. In normal situations, the water in the floor drains and sumps is either from Lake Michigan, potable wells, or treated water systems, and all three of these are considered non-aggressive to concrete and steel. Nevertheless, the applicant confirmed that identified leaks do not continue for the extensive period of time required for degradation of concrete, steel, and other material to occur. For inaccessible below-grade concrete, groundwater is periodically monitored under the Structures Monitoring Program. However, by letter dated August 17, 2009, in response to RAI B.2.1.31-3, the applicant stated that the groundwater samples taken in June 2007; March, July, August, and October 2008; and March and June 2009 indicate a chloride range from 34 ppm to 1,240 ppm, while the GALL Report limit for chlorides is 500 ppm.

The staff reviewed the responses and required additional information in order to complete its review. By letter dated November 20, 2009, the staff issued follow-up RAI B.2.1.31-3a asking the applicant to demonstrate that the current chloride levels are not causing degradation. The applicant responded by letters dated December 28, 2009, and February 15, 2010. In its responses, the applicant explained plans to reduce the chloride levels in the groundwater, as well as commitments to take core samples of the inaccessible concrete. The concrete core samples would verify that the aggressive groundwater environment had not caused concrete degradation. The staff found the applicant's responses acceptable because they explained how the applicant would ensure that the aggressive environment had not caused degradation prior to and during the period of extended operation. In addition, the staff confirmed that the Structures Monitoring Program will inspect the accessible concrete structures within the scope of license renewal that are exposed to raw water regardless of the water composition. The staff's concerns described in RAIs 3.5.2.3-1 and B.2.1.31-3 are resolved. This issue is discussed in more detail in the staff's review of the Structures Monitoring Program (SER Section 3.0.3.2.18).

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these structures will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.3 Concrete Exposed to Air-Outdoor, Aging Effect of Cracking, Loss of Bond, and Increase in Porosity and Permeability

LRA Table 3.5.2-2 credits the Structures Monitoring Program for shield building equipment of the MEA combination concrete (M); air-outdoor (E); and increase in porosity and permeability, loss of strength, and leaching of calcium hydroxide (AERM). In LRA Tables 3.5.2-3, 3.5.2-4, 3.5.2-6, 3.5.2-7, 3.5.2-8, 3.5.2-9, and 3.5.2-12, there are other items with the same combination.

The staff evaluated all of the above and found that the applicant's Structures Monitoring Program is adequate because the GALL Report recommends the Structures Monitoring Program for a similar combination in item III.A1-7 (T-02) where the environment is flowing water. The staff confirmed that if the Structures Monitoring Program can adequately manage this aging effect of concrete in flowing water, it can also manage the aging effect of concrete in air-outdoor. However, by letter dated October 13, 2009, the staff issued RAI 3.5.2.3-3 requesting that the applicant describe the structures where leaching of calcium hydroxide is occurring in the environment of air and explain the possible reason for such leaching.

In its response dated November 13, 2009, the applicant stated that minor leaching of calcium hydroxide in an air-outdoor environment has occurred for the main auxiliary transformer walls, the concrete masonry wall that forms the back bay of the reserve auxiliary transformer (RAT) and turbine building exterior wall, the shield building exterior concrete wall, and the screenhouse forebay exterior concrete wall. Furthermore, the applicant stated that in an air-outdoor environment, water from rain or melting snow passes through cracks or inadequately prepared construction joints, causing leaching of calcium compound from concrete. Efflorescence, a surface phenomenon consisting of salt deposits that have been leached from concrete, is an aesthetic issue rather than a structural problem, and KPS has conservatively included efflorescence due to leaching of calcium hydroxide in an air-outdoor environment.

The staff finds the applicant's response acceptable because the applicant explained that only minor indications have occurred and the aging effect of loss of strength due to leaching of calcium hydroxide has been included in the Structures Monitoring Program. The staff's concern described in RAI 3.5.2.3-3 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.5.2.3.4 Steel Exposed to Raw Water, Aging Effect of Cracking, Loss of Material, and Erosion

According to LRA Table 3.5.2-10, the applicant proposed the Structures Monitoring Program for discharge tunnel and pipe of the MEA combination steel (M), raw water (E), and loss of material and erosion (AERM).

The GALL Report, under item VII.C1-19 (A38) recommends using the program described in GALL AMP XI.M20, "Open-Cycle Cooling Water System," for managing loss of material and erosion in the open-cycle cooling water system or SCs.

By letter dated August 28, 2009, the staff issued RAI 3.5.2.3-4 requesting that the applicant propose a program which is consistent with the recommendation in the GALL Report and also meets the commitments relating to GL 89-13, or otherwise, justify why the proposed program is sufficient.

In its response dated September 28, 2009, the applicant stated that the discharge tunnel and pipe consist of a concrete tunnel, a steel pipe encased in concrete, and a reinforced concrete pipe section. The applicant clarified that in order to manage the aging effects of the discharge tunnel and pipe, it uses the Structures Monitoring Program which requires divers to periodically inspect all three sections, including the steel pipe encased in concrete. The applicant further stated that the Open-Cycle Cooling Water System Program uses the same preventive maintenance procedure as the Structures Monitoring Program, requiring the divers to inspect the intake pipe from the intake structure to the screenhouse. The applicant also confirmed that the loss of material, zebra mussels, and other organic macro-fouling, as discussed in GL 89-13, are part of their inspection.

The staff finds the applicant's response acceptable because the Structures Monitoring Program includes the necessary attributes of the program described in GALL AMP XI.M20, "Open-Cycle Cooling Water System," and GL 89-13. The staff's evaluation of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these structures will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.5 Concrete Exposed to Raw Water, Aging Effect of Loss of Material, and Cracking and Freeze-Thaw

According to LRA Tables 3.5.2-9 and 12, the applicant proposed the Structures Monitoring Program for managing the discharge structure and screenhouse of the MEA combination concrete (M); raw water (E); and loss of material (spalling, scaling), cracking, and freeze-thaw (AERM).

The GALL Report recommends GALL AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," for a similar combination in item III.A6-5 (T-15) where the environment is air-outdoor. The applicant is not committed to RG 1.127, Revision 1. Aging management of water-control structures has been included in the applicant's Structures Monitoring Program, which is permitted by the GALL Report. However, the GALL Report recommends that programs pertaining to water-control structures should incorporate the attributes described in GALL AMP XI.S7. To ensure the applicant's Structures Monitoring Program incorporates all the necessary attributes, the staff issued RAI B2.1.31-2 by letter dated July 13, 2009, and follow-up RAI B2.1.31-2a by letter dated November 20, 2009, requesting that the applicant include all the references for implementation in an element by element comparison of the applicant's Structures Monitoring Program and the GALL Report programs. In its responses to the RAIs, dated August 17, 2009, and December 28, 2009, respectively, the applicant included the necessary references in the program basis documents and provided the list of parameters that will be monitored for water-control structures. The staff also confirmed that those parameters can be adequately monitored by the applicant's Structures Monitoring Program. These RAIs, including the staff's review, are discussed in more detail in the review of the Structures Monitoring Program (SER Section 3.0.3.2.18).

The staff evaluated the above and found that the applicant's use of the Structures Monitoring Program is adequate because the applicant's program incorporates the recommendations of the GALL Report-recommended AMP, and the program will be enhanced to require inspection of submerged structures in raw water on a frequency of 5 years.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.5.2.3.6 Loss of Sealing Due to Deterioration of Seals, Gaskets, and Moisture Barriers from the External Surfaces of Seals Exposed to Outdoor or Uncontrolled Indoor Air

In LRA Tables 3.5.2-1, 3.5.2-4, and 3.5.2-14, the applicant stated that external surfaces of seals exposed to outdoor or uncontrolled indoor air are being managed for loss of sealing due to deterioration of seals, gaskets, and moisture barriers by the WCP Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material and component type is the external surfaces of seals exposed to outdoor or uncontrolled indoor air, and noted that there are several AMPs recommended by the GALL Report that could monitor the aging effect of loss of sealing due to deterioration of seals, gaskets, and moisture barriers, such as GALL AMP XI.M26, "Fire Protection," and GALL AMP XI.S6, "Structures Monitoring Program."

The staff reviewed the applicant's WCP Program and its evaluation is documented in SER Section 3.0.3.2.19. In its review of these items, the staff noted that the aging effect identified by the applicant is applicable for this combination of component, material, and environment. The staff also noted that the LRA AMP includes both visual inspections and physical manipulation of elastomers. The staff further noted that the combined use of visual inspections and physical manipulations are capable of detecting loss of sealing from elastomers. The staff finds the applicant's proposal acceptable because the applicant has: (1) identified an applicable aging effect, (2) selected an AMP with an appropriate scope for the component under consideration, and (3) chosen an AMP which contains appropriate inspection techniques to identify that aging effect. In addition, a staff concern related to selection and frequency of inspections is addressed in RAI B2.1.32-2 and the staff's evaluation of the RAI response is documented in SER Section 3.3.2.2.13.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.7 Changes in Material Properties and Cracking of the Exterior Surfaces of Elastomeric Materials Exposed to Uncontrolled Indoor Air

In LRA Table 3.5.2-2, the applicant stated that exterior surfaces of elastomeric materials exposed to uncontrolled indoor air are being managed for changes in material properties and cracking by the External Surfaces Monitoring Program. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material/component type is exterior surfaces of elastomeric materials exposed to uncontrolled indoor air and confirmed that there are no entries for this component/material and environment.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.7. In its review of these items, the staff noted that the proposed AMP uses visual inspection to identify aging. The staff also noted that identification of cracking in elastomers may be difficult using only visual inspection techniques. The staff further noted that changes in material properties, such as hardness and elasticity, cannot be reliably identified using only visual inspection techniques. By letter dated October 13, 2009, the staff issued RAI 3.5.2.3.2-1 requesting that the applicant propose an AMP which includes visual inspection and manual manipulation of a sufficient number or area of elastomeric material at a sufficient inspection frequency to adequately detect cracking or changes in the material properties of those materials.

The applicant responded by letter dated November 13, 2009. In that response, the applicant cited its response to RAI B2.1.10-1 (this response is dated August 17, 2009), which stated that the External Surfaces Monitoring Program includes the "scratch, sniff, and stretch" technique described in the EPRI Aging Assessment Field Guide, which entails detection of surface material degradation and hardening by scratching, odor changes possibly indicating degradation by sniffing, and elastomer hardening or cracking by stretching. The staff finds this acceptable because aging issues, such as changes in hardness and strength, may be discovered using this approach. The applicant also stated that these components were related to the fire protection system and their aging was managed under both the External Surfaces Monitoring and the Fire Protection programs. The applicant further stated that the frequency and sample size for the inspection of these components is based on the Fire Protection Program. During the on-site AMP audit, the applicant stated that it plans to examine 20 percent of the penetration seals that fulfill the 10 CFR Part 50 Appendix A function every 18 months and 100 percent of the penetration seals that fulfill the Appendix R requirements every 18 months. The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. The staff finds the applicant's approach acceptable because the AMP proposed will adequately detect the aging effects under consideration and the sampling size and frequency exceed the GALL Report Fire Protection Program recommendation of 10 percent every refueling outage interval. The staff's concern described in RAI 3.5.2.3.2-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.8 Exterior Surfaces of Non-Metallic Materials Exposed to Uncontrolled Indoor Air and Interior Surfaces of Non-Metallic Materials Exposed to Raw Water

In LRA Tables 3.5.2-4, 3.5.2-12, and 3.5.2-14, the applicant stated that the exterior surfaces of non-metallic materials exposed to uncontrolled indoor air and the interior surfaces of non-metallic materials exposed to raw water have no aging effect and that no AMP is required. The AMR line items cite generic note H, indicating that for the component, material, and environment combination listed, the aging effect being considered is not evaluated in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material type is exterior surfaces of non-metallic materials exposed to uncontrolled indoor air and the interior surfaces of non-metallic materials exposed to raw water, and confirmed that there are no entries for this component/material and environment. The staff also noted that there is not a distinct definition for non-metallic material in the GALL Report Chapter IX. The staff further noted that many polymeric materials are adversely affected by oxidizers (e.g., chlorine), UV light, and high temperatures. Based on the information provided, the staff cannot conclude that no aging effects will occur to the combination of materials and environments under consideration. By letter dated October 13, 2009, the staff issued RAI 3.5.2.3-6 requesting that the applicant identify the specific material under consideration and justify why this material is not subject to aging under the conditions being considered.

In its response dated November 13, 2009, the applicant stated that the non-metallic material in LRA Table 3.5.2-4, which has no aging effect, is wood. All surfaces of this material are exposed to uncontrolled indoor air. The applicant also stated that this material is located indoors and is not in contact with soil. The applicant conducted an OE search for this combination of material and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and environment. The staff finds the applicant's proposal that no aging effect exists for this combination of material and environment and that no aging management is required acceptable because the material environment combination under consideration is commonly employed and no evidence of aging has been detected.

The applicant stated that the non-metallic material in LRA Table 3.5.2-12, which has no aging effect, is fiberglass used in the travelling water screen covers. The external surfaces of this material are exposed to uncontrolled indoor air. The internal surfaces of this material are exposed to raw water. The applicant also stated that this material is not exposed to UV radiation, ozone, or high-voltage current, which could result in loss of strength. The applicant conducted an OE search for this combination of material and environments and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and the external environment. The staff finds the applicant's proposal that no aging effect exists for fiberglass exposed to air acceptable because this material environment combination is commonly employed and no evidence of aging has been detected. The staff's assessment of the interaction between raw water and fiberglass differs from that proposed by the applicant. The staff is aware that fiberglass may undergo significant blistering as a result of exposure to water. Blistering can become sufficiently severe to result in structural degradation of the material. By letter dated December 16, 2009, the staff issued RAI 3.5.2.3-6a requesting that the applicant propose an AMP for fiberglass exposed to water or to justify why the fiberglass component under consideration should be considered to have no aging effect.

In its response dated January 21, 2010, the applicant stated that the inside fiberglass surface is not constantly immersed in water, but rather subject to splashing. The applicant also stated that the inside surface is not subjected to continuous hydraulic pressure whereby the water penetrates the gelcoat into the underlying laminate. The applicant further stated that as such, there is no potential for blistering of the travelling screen covers. The staff finds the applicant's response acceptable because the inside surface of the screens are not exposed to constant hydraulic pressure and, thus, there is no potential for blistering. The staff's concern described in RAI 3.5.2.3-6a is resolved.

The applicant stated that one non-metallic material in LRA Table 3.5.2-14, which has no aging effect, is fiberglass fire boots. All surfaces of this material are exposed to uncontrolled indoor air. The applicant also stated that this material is not exposed to UV radiation, ozone, or high-voltage current, which could result in loss of strength. The applicant conducted an OE search for this combination of material and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of this material and environment. The staff finds the applicant's proposal that no aging effect exists for fiberglass exposed to air acceptable because this material environment combination is commonly employed and no evidence of aging has been detected.

The applicant stated that the second non-metallic material in LRA Table 3.5.2-14, which has no aging effect, is calcium silicate, expanded silicate, and fiberglass insulation. These materials are exposed to uncontrolled indoor air. The applicant also stated that these materials are not exposed to UV radiation, ozone, or high-voltage current, which could result in loss of strength. The applicant conducted an OE search for this combination of materials and environment and failed to find any instances of aging. The results of this search are consistent with the staff's knowledge of these materials and environment. The staff finds the applicant's proposal that no aging effect exists for these materials exposed to air acceptable because these material environment combinations are commonly employed and no evidence of aging has been detected.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.9 Structures and Component Supports – Discharge Structure – Aging Management Evaluation

In LRA Table 3.5.2-9, the applicant stated that steel sheet piling exposed to soil has no aging effect. The applicant also stated that no AMP is required. The AMR line items cite generic note H indicating that the component, material, and environment combination is not addressed in the GALL Report.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the environment is soil. The staff noted that the GALL Report recommends the consideration of the aging effect of loss of material due to corrosion. Based on the information provided, it is not clear to the staff why steel sheet pile exposed to soil as part of the plant's discharge structure would not experience loss of material due to corrosion. By letter dated December 16, 2009, the staff issued RAI 3.5.2.3-7 requesting that the applicant select an AMP appropriate for the management of aging in steel sheet piling exposed to soil.

In its response dated January 21, 2010, the applicant stated that the portions of the steel sheet piling that is exposed to air-outdoor and raw water environments, at the air-water and soil-water interfaces, respectively, are managed by the Structures Monitoring Program. The applicant also stated that the soil environment is applicable to the portion of the sheet steel pile that is driven into undisturbed soil where due to the oxygen-deficient environment, corrosion would be lower than at the air-water and soil-water environment interface points. The staff reviewed the applicant's Structures Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.18. The staff finds the applicant's response acceptable because the inspections conducted by the Structures Monitoring Program at the air-water and soil-water interfaces will be conservatively representative of the conditions of the steel pilings driven into the oxygen-deficient environment.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.10 Structures and Component Supports – Shield Building, Miscellaneous Structural Commodities – Aging Management Evaluation

LRA Tables 3.5.2-2 and 3.5.2-14 summarize the results of AMRs for the shield building and miscellaneous structural commodities. In LRA Table 3.5.2-2, the applicant stated that for elastomer penetration seals exposed to uncontrolled indoor air, the aging effects of change in material properties, cracking, and delamination are managed by the Fire Protection Program. In LRA Table 3.5.2-14, the applicant stated that for various fire barriers (e.g., fire doors, fire walls, radiant energy shields, fire coatings, penetration seals) constructed of elastomers and non-metallic materials, exposed to either indoor or outdoor uncontrolled air, the aging effects of change in material properties, cracking, delamination, and loss of material are managed by the Fire Protection Program. The applicant referenced generic note H for these items, indicating that the aging effect of this component, material, and environment combination is not evaluated in the GALL Report.

The staff evaluated the applicant's claim that the aging effect for this component, material, and environment combination is not evaluated in the GALL Report. The staff reviewed all AMR result lines in the GALL Report and found none where the material is elastomers or non-metallic, the environment is indoor or outdoor uncontrolled air, and the aging effect is change in material properties, cracking, delamination, or loss of material; and confirmed that the applicant's use of generic footnote H is acceptable.

The staff evaluated the use of elastomers and non-metallic materials in an indoor or outdoor uncontrolled air environment. The staff noted that these items are typically made of rubber-like polymers or other inorganic material (e.g., calcium sulfate dehydrate, silicate) and used as fire barriers to stop hot gases from traveling from fire areas to other areas or to protect steel members, pipes, and electrical raceways during a fire event. The staff also noted that these materials are designed for use in an outdoor or indoor air environment without significant degradation.

The staff reviewed the applicant's Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.8. The staff noted that the applicant's Fire Protection Program includes periodic visual inspections of fire barriers, such as fire barrier penetration seals, fire coatings, and fire wraps. The staff also noted that degradation, such as cracking, delamination, or loss of material from fire barriers, would be detectable during a visual inspection. The staff further noted that it is a common practice to examine the material condition of industrial fire barriers during periodic inspections, such that changes in material properties would be identified. The staff finds that the aging effects of change in material properties, cracking, delamination, or loss of material of fire barriers exposed to an indoor or outdoor uncontrolled air environment can, therefore, be adequately managed by periodic visual inspection in accordance with the Fire Protection Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant 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).

3.5.2.3.11 Structures and Component Supports – Miscellaneous Structural Commodities – Aging Management Evaluation

LRA Table 3.5.2-14 summarizes the results of AMRs for miscellaneous structural commodities. In LRA Table 3.5.2-14, the applicant stated that for elastomer expansion joints and flood barriers and gaskets exposed to uncontrolled indoor air, the aging effects of change in material properties and cracking are managed by the Structures Monitoring Program. The applicant referenced generic note H for these items, indicating that the aging effect of this component, material, and environment combination is not evaluated in the GALL Report.

The staff evaluated the applicant's claim that the aging effects for this component, material, and environment combination is not evaluated in the GALL Report. The staff reviewed all AMR result lines in the GALL Report and found none where the material is elastomers, the environment is indoor or outdoor uncontrolled air, and the aging effect is change in material properties, or cracking; and confirmed that the applicant's use of generic note H is acceptable.

The staff evaluated the use of elastomers in an indoor or outdoor uncontrolled air environment. The staff noted that these items are typically made of rubber-like polymers and are designed for use in an outdoor or indoor air environment without significant degradation. The staff reviewed the applicant's Structures Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.18. The staff noted that the applicant's Structures Monitoring Program includes periodic visual inspections of non-metallic structural commodities, including elastomers, sealants, and flood barriers for change in material properties, cracking, increased hardness, shrinkage and loss of strength, loss of sealing, and reduction or loss of isolation function. The staff also noted that degradation, such as cracking, delamination, or loss of material, would be detectable during a visual inspection. The staff further noted that it is a common industry practice to examine the material condition of elastomers during periodic inspections, such that changes in material properties would be identified. The staff finds that the aging effects of change in material properties, cracking, delamination, or loss of material of elastomer expansion joints and flood barriers and gaskets exposed to an indoor or outdoor uncontrolled air environment can, therefore, be adequately managed by periodic visual inspections in accordance with the Structures Monitoring Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff concludes that the applicant 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).

3.5.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the structures and component supports within the scope of license renewal and subject to an AMR will be adequately managed such 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 Aging Management of Electrical Commodity Group

The following information documents the staff's review of the applicant's AMR results for the electrical and instrumentation and control (I&C) components and component groups of:

- cables and connections
- fuse holders
- metal-enclosed bus
- switchyard bus and connections
- transmission conductors and connections

3.6.1 Summary of Technical Information in the Application

LRA Section 3.6 provides the AMR results for the electrical and I&C components and component groups. LRA Table 3.6.1, "Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the NUREG-1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the electrical and I&C components and component groups.

3.6.2 Staff Evaluation

The staff reviewed LRA Section 3.6 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for the electrical and I&C components within the scope of license renewal and subject to an AMR 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).

The staff reviewed the AMRs to confirm the applicant's claim that certain AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant has identified the appropriate GALL Report AMPs. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. Details of the staff's evaluation are documented in SER Section 3.6.2.1.

The staff also reviewed the AMRs that were consistent with the GALL Report and those for which further evaluation is recommended. The staff confirmed that the applicant's further evaluations were consistent with the SRP-LR Section 3.6.2.2 acceptance criteria. The staff's evaluations are documented in SER Section 3.6.2.2.

The staff also reviewed the remaining AMRs that were not consistent with, or not addressed in, the GALL Report. The technical review also evaluated whether all plausible aging effects have been identified and whether the aging effects listed were appropriate for the material-and-environment combinations specified. The staff's evaluations are documented in SER Section 3.6.2.3.

Table 3.6-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.6 and addressed in the GALL Report.

Table 3.6-1 Staff Evaluation for Electrical and Instrumentation and Controls in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements (3.6.1-1)	Degradation due to various aging mechanisms	Environmental Qualification of Electric Components	Yes	TLAA; EQ of Electrical Components Program	Further evaluation (See SER Section 3.6.2.2.1)
Electrical cables, connections and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements (3.6.1-2)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	No	Non-EQ Electrical Cables and Connections Program	Consistent with the GALL Report
Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (3.6.1-3)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Used In Instrumentation Circuits Not Subject to 10 CFR 50.49 EQ Requirements	No	Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program	Consistent with the GALL Report
Conductor insulation for inaccessible medium-voltage (2 kV to 35 kV) cables (e.g., installed in conduit or directly buried) not subject to 10 CFR 50.49 EQ requirements (3.6.1-4)	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion, water, and trees	Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	No	Non-EQ Inaccessible Medium-Voltage Cables Program	Consistent with the GALL Report
Connector contacts for electrical connectors exposed to borated water leakage (3.6.1-5)	Corrosion of connector contact surfaces due to intrusion of borated water	Boric Acid Corrosion	No	Boric Acid Corrosion Program	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Fuse holders (not part of a larger assembly): Fuse holders – metallic clamp (3.6.1-6)	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	No	No	Not consistent with the GALL Report (See SER Section 3.6.2.3)
Metal-enclosed bus: bus, connections (3.6.1-7)	Loosening of bolted connections due to thermal cycling and ohmic heating	Metal-Enclosed Bus	No	Metal-Enclosed Bus Program	Consistent with the GALL Report
Metal-enclosed bus: insulation, insulators (3.6.1-8)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Metal-Enclosed Bus	No	Metal-Enclosed Bus Program	Consistent with the GALL Report
Metal-enclosed bus: enclosure assemblies (3.6.1-9)	Loss of material due to general corrosion	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with the GALL Report
Metal-enclosed bus: enclosure assemblies (3.6.1-10)	Hardening and loss of strength due to elastomer degradation	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with the GALL Report
High-voltage insulators (3.6.1-11)	Degradation of insulation quality due to presence of any salt deposits and surface contamination; loss of material caused by mechanical wear due to wind blowing on transmission conductors	A plant-specific AMP is to be evaluated.	Yes	None	Further evaluation (See SER Section 3.6.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Transmission conductors and connections; switchyard bus and connections (3.6.1-12)	Loss of material due to wind induced abrasion and fatigue; loss of conductor strength due to corrosion; increased resistance of connection due to oxidation or loss of preload	A plant-specific AMP is to be evaluated.	Yes	None	Further evaluation (See SER Section 3.6.2.2.3)
Cable connections: metallic parts (3.6.1-13)	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	No	Non-EQ Electrical Cable Connections Program	Consistent with the GALL Report
Fuse holders (not part of a larger assembly): insulation material (3.6.1-14)	None	None	No	None	Consistent with the GALL Report

The staff's review of the electrical and I&C component groups followed any one of several approaches. One approach, documented in SER Section 3.6.2.1, reviewed the AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.6.2.2, reviewed the AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.6.2.3, reviewed the AMR results for components that the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the electrical and I&C components is documented in SER Section 3.0.3.

3.6.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.6.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the electrical and I&C components:

- Boric Acid Corrosion Program
- Metal-Enclosed Bus Program

- Non-EQ Electrical Cable Connections Program
- Non-EQ Inaccessible Medium-Voltage Cable Program
- Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program
- Non-EQ Electrical Cables and Connections Program

In LRA Table 3.6.2-1, the applicant summarized the AMRs for the electrical and I&C components and claimed that these AMRs are consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the report and for which the GALL Report does not recommend further evaluation, the staff's review determined whether the plant-specific components of these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant noted for each AMR line item how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through D, indicating how the AMR is consistent with the GALL Report.

The staff reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMPs.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the electrical and I&C components that are subject to an AMR. On the basis of its review, the staff determines that, for those AMRs not requiring further evaluation, as identified in LRA Table 3.6.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Electrical EQ is a TLAA. The staff's evaluation is documented in SER Section 4.4.

3.6.2.2.2 Degradation of Insulator Quality Due to Salt Deposits or Surface Contamination, and Loss of Material Due to Mechanical Wear

Summary of Technical Information in the Application. In LRA Section 3.6.2.2.2, the applicant stated that KPS is located in a rural environment with no major industry in close proximity;

therefore, contamination from industrial effluents is not significant. Lake Michigan is a fresh water lake used for cooling, and salt spray is not a concern for the insulators. The applicant also stated that seasonal rainwater or snow prevent any accumulation of surface contamination buildup. The applicant further stated that its review of OE has identified no concerns related to the occurrence of degradation of insulator quality due to the presence of salt deposits or surface contamination in the switchyard high-voltage insulators. Therefore, the applicant concluded that degradation of insulator quality due to the presence of salt deposits or surface contamination is not a credible aging mechanism requiring management.

The applicant also stated that the switchyard bus is rigid aluminum tube material or aluminum angle supported by post type insulators mounted on steel structures with concrete foundations. The bus runs are short lengths, rigidly supported and, therefore, the post insulators are not subject to vibration or wind abrasion and do not require management of loss of material due to mechanical wear. The applicant also stated that the overhead line from the switchyard to the RAT has suspension type insulators and the span lengths between towers are short which minimize wind effect. The applicant further stated that its experience has shown that the transmission conductors do not normally swing, and that when they do, due to a substantial wind, they do not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line and insulators to vibrate or sway, is considered in the design and installation. No high-voltage insulator failures have been experienced. Therefore, the applicant concluded that these suspension insulators do not require aging management for loss of material due to mechanical wear. The applicant also stated that its review of OE has identified no concerns related to the occurrence of loss of material due to mechanical wear as a result of wind blowing on transmission conductors in the switchyard high-voltage insulators.

Staff Evaluation. The staff reviewed LRA Section 3.6.2.2.2 against SRP-LR Section 3.6.2.2.2, which states that degradation of insulator quality due to salt deposits or surface contamination may occur in high-voltage insulators. The GALL Report recommends further evaluation of plant-specific AMPs for plants at locations with potential salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Loss of material due to mechanical wear caused by wind on transmission conductors may occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff determined that since KPS is not located near facilities that discharge soot or near the sea coast, and since the applicant's plant-specific OE did not identify any issues associated with contamination buildup, degradation of insulators due to salt deposit or surface contamination is not an applicable AERM for high-voltage insulators at KPS.

The staff noted that mechanical wear is an aging effect for both strain and suspension insulators, in that they are subject to movement. Movement of the insulators can be caused by wind blowing the supported transmission conductor, causing it to swing from side to side. If this motion were severe enough, it could cause wear in the metal contact point of the insulator string and between an insulator and its support hardware. Although loss of material of insulators due to mechanical wear is possible, transmission conductors do not normally swing and when they do, due to a substantial wind, they do not continue to swing very long once the wind has subsided. Wind loading that can cause transmission lines and insulators to vibrate or sway is considered in the design and installation. In addition, the applicant has not experienced any insulator failures due to wear. Furthermore, transmission conductors, within the scope of license renewal, are short spans (i.e., connecting the switchyard to the RAT), and the surface areas exposed to wind loads are not significant. Based on its review, the staff finds that mechanical wear aging effect of high-voltage insulators is not an AERM at KPS.

Conclusion. Based on the programs identified above, the staff concludes that the applicant's programs meet the SRP-LR Section 3.6.2.2.2 criteria. For those items that apply to LRA Section 3.6.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2.3 Loss of Material Due to Wind-Induced Abrasion and Fatigue, Loss of Conductor Strength Due to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of Preload

Summary of Technical Information in the Application. In LRA Section 3.6.2.2.3, the applicant stated that the switchyard bus material consists of continuous runs of aluminum angle or tubular bus connected to rigid post insulator supports, and no aging effects for the ambient air environment have been identified that could cause a loss of intended function for the period of extended operation. The switchyard buses have terminations that are part of the active components (i.e., breakers, disconnect switches, etc.), or are evaluated as part of the cable and connections component types. Therefore, the applicant concluded that no aging management is required for the bus or connections. The applicant further stated that a review of OE has identified no concerns related to the occurrence of loss of material or loss of conductor strength due to wind-induced abrasion and fatigue, or corrosion of the switchyard bus and connections due to aging.

The applicant stated that transmission conductors within the scope of license renewal are 138 kV, 795 thousands of circular mils (MCM) aluminum conductor steel reinforced (ACSR) conductors connecting the 138-kV switchyard to the RAT. The most prevalent mechanism contributing to loss of conductor strength of an ACSR transmission conductor is corrosion, which includes corrosion of the steel core and aluminum strand pitting. The applicant also stated that for ACSR conductors, degradation begins as a loss of Zn from the galvanized steel core wires. Corrosion rates depend largely on air quality, which includes suspended particles chemistry, sulfur dioxide concentrations in air, precipitation, fog chemistry, and meteorological conditions. The applicant further stated that the plant is located in a rural area and does not experience urban or industrial air pollutants. The corrosion of aluminum in air is very slow, particularly in the rural, non-industrial location of the plant. Additionally, the ACSR steel core is the primary strength component of the conductor. The applicant also stated that loss of conductor strength through corrosion of the steel core is not considered a credible aging effect based on the Ontario Hydro testing of an 80-year old 4/0 ACSR conductor that retained a 37 percent safety margin of the heavy load tensile strength when compared to the ultimate strength. The National Electric Safety Code (NESC) requires that the maximum tension a conductor be designed to withstand be not more than 60 percent of the ultimate conductor strength. Also, the NESC sets the maximum tension a conductor can be designed to withstand under heavy load requirements, which includes consideration of ice, wind, and temperature. In addition, the applicant stated that the installed (795 MCM-45/7 strands) conductor has an ultimate conductor strength of 22,100 pounds and was installed with 5,000 pound tension for NESC heavy loading. The installed margin of this conductor is 77.3 percent of the ultimate strength which is well above the 67 percent installed margin of the Ontario Hydro conductor that was tested. The applicant concluded that loss of conductor strength through corrosion is not a credible aging mechanism requiring management.

The applicant also stated that NESC design of these conductors included the effects of wind loading and sways through span lengths (which are short), and the sag and tension criteria of the lines. Also, the applicant stated that experience has shown that when substantial wind causes a line to sway, the line does not continue to sway or vibrate once the wind subsides. Therefore, the applicant concluded that loss of material due to wind-induced abrasion and fatigue is not a credible aging mechanism requiring management.

The applicant stated that increased resistance of aluminum conductor connections due to oxidation or loss of preload is minimized through the use of compatible aluminum hardware, the use of lock washers in bolted connections, and no-oxide compounds at connection surfaces in all termination types. Therefore, the applicant concluded that increased resistance of aluminum conductor connections due to oxidation or loss of preload is not a credible aging mechanism requiring management. The applicant further stated that its review of OE has identified no concerns related to the occurrence of loss of material, loss of strength, or increased resistance of connections in the high-voltage transmission conductors due to aging.

Staff Evaluation. The staff reviewed LRA Section 3.6.2.2.3 against the criteria in SRP-LR Section 3.6.2.2.3 which states that loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed.

The staff noted that the sections of transmission conductor in the scope of license renewal are short spans connecting the switchyard to the RAT, and the surface areas exposed to wind loads are not significant. Furthermore, the applicant confirmed that plant-specific OE did not identify any aging effects of mechanical wear of transmission. Based on this information, the staff determined that loss of material of transmission conductors due to vibration is not an AERM.

The staff reviewed the aging effect due to corrosion of specific conductors installed at KPS against NESC requirements. The installed (795 MCM-45/7 strands) conductors have the conductor strength of 22,100 pounds and were installed with 5,000 pound tension for NESC heavy loading. The Ontario study showed about 30 percent of conductor strength loss due to corrosion. For plant-specific conductors at KPS, the tension on installed conductors is about 32 percent of the ultimate conductor strength after 80 years in service (5,000 lb/22,100 lb x 0.7). The NESC requires that tension installed on conductors be a maximum of 60 percent of ultimate conductor strength. The ratio of maximum heavy load and the ultimate conductor strength of installed conductors is below the 60 percent NESC requirements. Furthermore, the staff noted that the length of transmission conductors in scope of license renewal is generally in short span. These transmission conductors connect the switchyard to the RAT, providing restoration of offsite power after an SBO event. The loading of these transmission conductors is much less than the calculated heavy loading of a long span transmission line. The staff determined that with a 30 percent loss of conductor strength, there is still ample margin between the NESC requirements and the actual conductor strength. Based on this information, the staff determined that loss of conductor strength due to corrosion of transmission conductor is not a significant AERM for the period of extended operation.

In LRA Section 3.6.2.2.3, the applicant stated that switchyard buses have terminations that are evaluated as part of the cable and connections component types. The staff noted that the scope of the Non-EQ Electrical Cables and Connections Program does not include high-voltage connections. The scope of this program only includes medium- and low-voltage levels. In a letter dated November 20, 2009, the staff issued RAI 3.6.2.2.3-1 requesting that the applicant explain how switchyard bus terminations are evaluated as part of the cable and connection component types. In response to the staff's request, in a letter dated December 28, 2009, the applicant stated that switchyard bus terminations were evaluated as part of the AMR for cables and connections component types and the results of the evaluation are provided in LRA Table 3.6.2-1 for the commodity group and component type "Transmission Conductors and Connections." The applicant also stated that the AMR concluded that there are no AERMs for the switchyard bus terminations and no AMP is required. The applicant further stated that the basis for this conclusion, as described in LRA Section 3.6.2.2.3, is that: (1) oxidation and loss of preload for these connections are minimized through the use of compatible aluminum bolting hardware, (2) lock washers are used in bolted connections, and (3) no-oxide compounds are used at connection surfaces in all termination types, such that increased resistance of aluminum conductor connections due to oxidation or loss of preload is not a credible aging mechanism. The staff finds the applicant's response acceptable because the applicant clarified that switchyard bus terminations are evaluated as part of cable and connection component types and not in the Non-EQ Electrical Cables and Connections Program, which is only applicable to medium- and low-voltage connections (below 35 kV) and not the high-voltage connections (above 35 kV). The staff noted that increased temperature of electrical bolted joints is due to high circuit rating or an increase in current duration. The different coefficient thermal expansion of different material of electrical bolted joints will rise, and stress will increase with increasing current duration. If this temperature increase is not taken into consideration, loose joints or joint failures will occur. The design of the transmission conductor bolted connections at KPS precludes torque relaxation due to different coefficient thermal expansion and the plant-specific OE has not identified any failures of switchyard connections due to aging. The staff also noted that the use of compatible aluminum hardware and lock washers in bolted connections in all termination types will preclude torque relaxation. This method of assembly is consistent with the good bolting practices recommended by industry guidelines (EPRI TR-104213, "Bolted Joint Maintenance & Application Guide"). The bolted connections and washers are coated with an anti-oxidant compound (i.e., a grease-type sealant) prior to tightening the connection to prevent the formation of oxides on the metal surface and to prevent moisture from entering the connection, thus reducing the chances of corrosion. This method of installation has been shown to provide a corrosion-resistant, low-electrical-resistance connection. Based on this information, the staff determined that increased resistance of switchyard bus and transmission conductor connections due to torque relaxation or corrosion is not a significant AERM at KPS. The staff's concern described in RAI 3.6.2.2.3-1 is resolved.

However, the staff noted that failures of locked washers (i.e., Belleville washers causing loose connections) were noted from industry OE, whereby hydrogen entrapment with plated steel washers causing embrittlement and stress cracking of the plated washer can lead to loose connections. In addition, EPRI document TR-104213 also identifies this problem with galvanized and electroplated Belleville washers. In a letter dated November 20, 2009, the staff issued RAI 3.6.2.2.3-2 requesting that the applicant explain if electroplated and galvanized Belleville washers are currently used at KPS. If they are, the staff requested that the applicant explain why hydrogen embrittlement is not a problem at KPS. The staff also requested that the applicant describe the switchyard maintenance activity used to confirm the effectiveness of bolted connections in the switchyard. In a letter dated December 28, 2009, the applicant responded that stainless steel Belleville washers are installed in switchyard bus aluminum conductor connections. Therefore, embrittlement and stress cracking due to the use of plated washers is not applicable. The applicant also stated that thermography of switchyard bolted connections is performed at least annually to identify any increased resistance condition in switchyard bus connections. The applicant further stated that after any switchyard maintenance that could create a high-resistance condition, all re-worked connections have micro-ohm resistance measurements taken to ensure that no high-resistance conditions have been created during the maintenance activities. The staff finds the applicant's response acceptable because Belleville washers used at KPS are stainless steel; thus the concern with hydrogen entrapment with plated steel washers is not applicable to KPS. The staff also finds the applicant's use of thermography to check for switchyard connections acceptable to confirm the effectiveness of bolted connections in the switchyard. The staff's concern described in RAI 3.6.2.2.3-2 is resolved.

Conclusion. Based on the programs identified above, the staff concludes that the applicant's programs meet the SRP-LR Section 3.6.2.2.3 criteria. For those items that apply to LRA Section 3.6.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

GALL Report, Volume 2, Revision 1, item VI.A-8, "Fuse Holders (Not Part of a Larger Assembly; Metallic Clamp)," identifies the aging/effect mechanism as fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation. The associated GALL AMP XI.E5, "Fuse Holders," states that fuse holders within the scope of license renewal should be tested to provide an indication of the condition of the metallic clamps of fuse holders. In LRA Section 3.6.2.1.2, "Fuse Holders," the applicant stated that there are no AMPs required for fuse holders based on a review of the environment of the fuse holders. LRA Table 3.6.1, item 3.6.1-06 concludes that only fuse holders located in two enclosed cabinets in the relay room required evaluation, and concludes that these fuse holders are in a controlled environment, and are not subject to the aging effect/mechanisms identified in the GALL Report, Volume 2, Revision 1, item VI.A-8. Although the applicant concluded in LRA Section 3.6.2.1.2 that the aging effects/mechanisms identified by the GALL Report are not applicable to the fuse holders at KPS, the applicant did not provide an evaluation to substantiate the conclusion. LRA Table 3.6.1, item 3.6.1-06 provides the same conclusion.

In a letter dated November 20, 2009, the staff issued RAI 3.6.2.1.2-1 requesting that the applicant provide an evaluation that addresses the aging effect/mechanisms (environmental and mechanical) identified in the GALL Report, Volume 2, Revision 1, item VI.A-8 that supports the conclusions made in LRA Section 3.6.2.1.2 and Table 3.6.1, item 3.6.1-06. In a letter dated December 28, 2009, the applicant responded that the fuse holders subject to an AMR are those located in enclosed cabinets in the relay room. The relay room is a temperature and humidity controlled environment. The applicant provided the following as a basis for the conclusion that the fuse holders are not subject to the aging effects/mechanisms:

Fatigue. The applicant stated that NUREG-1760, "Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Application in Nuclear Power Plants," states that fatigue of fuse holders can typically occur due to elevated temperature, mechanical stress, and repeated insertion and removal of fuses. NUREG-1760 further states that fuse failures resulting from thermal cycling are associated with the fuse element, and not the fuse holder. The applicant also stated that the fuse holders subject to an AMR are located indoors and in a controlled air environment. There is no significant source of heat in close proximity to the fuse holders such that elevated temperatures are not expected. Therefore, the applicant concluded that fatigue due to elevated temperature is not an applicable aging effect. The applicant stated that fatigue related to mechanical stress and/or repeated insertion and removal is evaluated under Mechanical Stress below.

Mechanical Stress. The applicant stated that the fuse holders subject to an AMR are located in enclosed cabinets and the fuses are not routinely removed and reinserted into the metallic clamps. The fuses are only removed during fuse replacement with circuit isolation performed by other devices in the circuit (circuit breaker). Therefore, the applicant concluded that the fuse holder metallic clamps are not subject to repeated manipulation, which could lead to mechanical fatigue. The applicant also stated that mechanical stress resulting from electrical faults and transients is not considered a credible aging mechanism since they are infrequent and random in nature. In addition, the applicant stated that stresses resulting from electrical faults are mitigated by fast acting circuit protective devices.

Vibration. The applicant stated that two fuse panels are wall mounted, not mounted on rotating equipment, and are not in close proximity to rotating equipment such that they could be affected by vibration. Therefore, the applicant concluded that vibration is not an applicable aging mechanism for the fuse holders in these panels.

Chemical Contamination and Corrosion. The applicant stated that these fuse holders are located in enclosed cabinets that are located indoors, in a controlled air environment, and are not subject to exposure to fluid system leakage. The fuse holders are not subject to moisture or chemicals inside the panel enclosures and do not experience a corrosive environment. Therefore, the applicant concluded that chemical contamination and corrosion do not require management for the fuse holders.

Ohmic heating and Thermal Cycling. The applicant stated that these fuses are used in a low-voltage and low current application such that there is no significant ohmic heating. The applicant also stated that the power is continuous such that thermal cycling does not occur. Therefore, the applicant concluded that ohmic heating and thermal cycling is not an applicable aging mechanism for these fuse holders.

Oxidation. The applicant stated that the relay room is a controlled air environment. The room is served by the control room air conditioning system. The environment is maintained at approximately 80 °F and 35 percent relative humidity. The applicant also stated that oxidation in this environment is not considered an applicable mechanism. In addition, the applicant stated that a review of industry and plant-specific OE has indicated there are no aging concerns for copper alloy fuse holders in this environment.

The staff finds the applicant's response acceptable. The staff determined that the applicant has provided an adequate evaluation to support the conclusion that aging effect/mechanism as identified in the GALL Report, Volume 2, Revision 1, item VI.A-8 are not applicable to the fuse holders at KPS. Fatigue due to elevated temperatures and mechanical stress is not applicable to KPS because the fuse holders subject to an AMR are located in a controlled air environment. There is no significant source of heat in close proximity to the fuse holders such that elevated temperature is not a concern for these fuse holders. Mechanical stress resulting from electrical faults and transient is not considered a credible aging mechanism since they are infrequent and random in nature. Furthermore, stresses resulting from electrical faults are mitigated by fast acting circuit protective devices (e.g., circuit breakers, fuses). The fuses are not routinely removed and reinserted to the metallic clamps. The fuses are only removed during fuse replacement with circuit isolation performed by circuit breakers in the circuit; therefore, fatigue is not an applicable aging effect. The fuse panels are mounted on the wall and not on rotating equipment or in close proximity to rotating equipment; therefore, vibration is not an applicable aging effect. The fuse holders are located in a controlled air environment and are not exposed to fluid system leakage; therefore, chemical contamination and corrosion is not an aging effect. These fuses are used in low-voltage/low-current applications such that there is no significant ohmic heating. Ohmic heating and thermal cycling is not an applicable aging effect. The relay room is a controlled air environment and oxidation is not expected in this environment. In addition, there is no oxidation concern for copper alloy in a controlled air environment. Furthermore, the applicant did review industry and plant-specific OE and indicated that there is no aging concern for copper alloy fuse holders in a controlled air environment. Therefore, the staff determined that aging affects and mechanisms identified in the GALL Report are not applicable to KPS. The staff's concern described in RAI 3.6.2.1.2-1 is resolved.

In LRA Table 3.6.2-1, "Electrical Components-Cables and Connections-Aging Management Evaluation," the applicant indicated that fuse holder insulations are not in an adverse localized environment and denoted note H. Note H means that the aging effect is not in the GALL Report for this component, material, and environment combination. The staff noted that the GALL Report, Volume 2, Revision 1, item VI.A-6 identifies embrittlement, cracking, melting, or loss of dielectric strength leading to reduced insulation resistance for insulation materials of fuse holders in an adverse localized environment due to heat, radiation, or moisture in the presence of oxygen or greater than 60-year service limiting temperature. In a letter dated November 20, 2009, the staff issued RAI 3.6.2.3-1, requesting that the applicant explain why the aging effect identified in the GALL Report or in an adverse localized environment is not applicable to the insulation materials of fuse holders. In a letter dated December 28, 2009, the applicant stated that as indicated in LRA Table 3.6.2-1, for Commodity Group and Component Type "Fuse Holders insulation," note 1 states that the fuse holders are not located in an adverse localized environment (e.g., high heat, high radiation). The fuse holders subject to an AMR are located in enclosed cabinets in the relay room, which has a temperature and humidity controlled environment. The applicant stated that since the fuse holders are not located in an adverse localized environment, the aging effects identified in the GALL Report, item VI.A-6 for fuse holder insulation materials are not applicable. The staff finds the applicant's response acceptable because fuse holder insulation materials are not in an adverse localized environment. The fuse holders are located in two cabinets inside a relay room which have temperature and humidity controlled environments. These fuse holders are not in an adverse localized environment. The staff determined that there is no aging effect for fuse holder insulation material in a controlled environment. The staff's concern described in RAI 3.6.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environments, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant 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).

3.6.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the electrical and I&C components within the scope of license renewal and subject to an AMR 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).

3.7 Conclusion for Aging Management Review Results

The staff reviewed the information in LRA Section 3, "Aging Management Review Results," and Appendix B, "Aging Management Programs." On the basis of its review of the AMR results and AMPs, the staff concludes that the applicant has demonstrated that the aging effects 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). The staff also reviewed the applicable USAR supplement program summaries and concludes that the USAR supplement adequately describes the AMPs credited for managing aging as required by 10 CFR 54.21(d).

With regard to these matters, the staff concludes that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and that any changes made to the CLB, in order to comply with 10 CFR 54.21(a)(3), are in accordance with the Atomic Energy Act of 1954 and NRC regulations.

SECTION 4

TIME-LIMITED AGING ANALYSES

4.1 Identification of Time-Limited Aging Analyses

This section of the safety evaluation report (SER) addresses the identification of time-limited aging analyses (TLAAs). In Sections 4.2 through 4.8 of the license renewal application (LRA), Dominion Energy Kewaunee, Inc. (Dominion, DEK, or the applicant) addressed the TLAAs for Kewaunee Power Station (KPS). SER Sections 4.2 through 4.8 document the review of the TLAAs conducted by the staff of the U.S. Nuclear Regulatory Commission (NRC or the staff).

TLAAs are certain plant-specific safety analyses that involve time-limited assumptions defined by the current operating term. Pursuant to Title 10, Section 54.21(c)(1), of the *Code of Federal Regulations* (10 CFR 54.21(c)(1)), applicants must list TLAAs as defined in 10 CFR 54.3, "Definitions."

In addition, pursuant to 10 CFR 54.21(c)(2), applicants must list existing plant-specific exemptions granted under 10 CFR 50.12, "Specific Exemptions," based on TLAAs. For any such exemptions, the applicant must evaluate and justify the continuation of the exemptions for the period of extended operation.

4.1.1 Summary of Technical Information in the Application

LRA Section 4.1.1, "Identification Process of Time-Limited Aging Analyses," states that the applicant used a process consistent with Nuclear Energy Institute (NEI) 95-10, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54-The License Renewal Rule." LRA Section 4.1.1 also states that the applicant identified TLAAs by evaluating calculations for KPS against the six criteria specified in 10 CFR 54.3. The applicant indicated that it identified the calculations that met the six criteria by searching the current licensing basis (CLB), which included the updated safety analysis report (USAR), engineering calculations, technical reports, licensing correspondence, and applicable vendor reports. In LRA Table 4.1-1, "Time Limited Aging Analysis Applicable to KPS," the applicant listed the following applicable TLAA categories:

- reactor vessel neutron embrittlement
- metal fatigue
- environmental qualification (EQ) of electrical equipment
- containment liner plate, metal containments, and penetrations
- other unit-specific TLAAs:
  - crane load cycle limits
  - reactor coolant pump flywheel
  - leak-before-break (LBB)
  - reactor vessel underclad cracking
  - reactor coolant loop piping flaw tolerance evaluation

Pursuant to 10 CFR 54.21(c)(2), the applicant stated that it had identified one exemption granted under 10 CFR 50.12 that is in effect, and based upon a TLAA as defined in 10 CFR 54.3. This concerns an exemption from the requirements of 10 CFR 50.61 and 10 CFR Part 50, Appendices G and H. This exemption request, granted in a letter dated May 2001 (Agencywide Document Access and Management System (ADAMS) Accession No. ML011210180), provided the following for KPS:

- established the use of a new methodology to meet the requirements of Appendix G to 10 CFR Part 50
- established the use of a new methodology to meet the requirements of 10 CFR 50.61
- modified the basis for the KPS reactor pressure vessel (RPV) surveillance program (required by Appendix H of 10 CFR Part 50) to incorporate the acquisition of fracture toughness data

The applicant stated:

> The new methodology for assessing the [reactor pressure vessel] RPV circumferential beltline weld is based on the use of the 1997 Edition of [American Society for Testing and Materials] ASTM Standard Test Method E-1921 and [American Society of Mechanical Engineers] ASME Code Case N-629. The exemption was necessary for the reactor vessel beltline weld to meet the pressurized thermal shock criterion of 10 CFR 50.61.

The applicant evaluated pressurized thermal shock (PTS) as a TLAA as part of LRA Section 4.2.

4.1.2 Staff Evaluation

LRA Table 4.1-1 lists the TLAAs the applicant identified as being applicable to KPS. The staff reviewed the information to determine whether the applicant had provided sufficient information pursuant to 10 CFR 54.21(c)(1) and (c)(2).

As defined in 10 CFR 54.3, TLAAs meet the following six criteria:

(1) involve systems, structures, and components within the scope of license renewal, pursuant to 10 CFR 54.4(a)

(2) consider the effects of aging

(3) involve time-limited assumptions defined by the current operating term (40 years)

(4) are determined to be relevant by the applicant in making a safety determination

(5) involve conclusions, or provide the basis for conclusions, related to the capability of the system, structure, and component to perform its intended functions, pursuant to 10 CFR 54.4(b)

(6) are contained or incorporated by reference in the CLB

The applicant reviewed the list of potential TLAAs from NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," (SRP-LR) dated September 2005. The applicant listed those potential TLAAs applicable to KPS in LRA Table 4.1-2, "Review of Generic Analyses Listed on Tables 4.1-2 and 4.1-3 of NUREG-1800," and indicated whether the TLAA was applicable to KPS or not.

The staff confirmed that the applicant's LRA includes the TLAAs that are normally applicable to pressurized water reactor (PWR) applications, including TLAAs on the following:

- reactor vessel neutron embrittlement for neutron fluence, upper-shelf energy, pressurized thermal shock limits, and pressure-temperature limits

- metal fatigue of ASME Class 1 components and of non-Class 1 components

- environmental qualification of electrical equipment

- fatigue of the reactor containment vessel, liner plate, and containment penetrations

The staff noted that a concrete containment tendon prestress TLAA does not apply to KPS since the containment vessel is not a concrete, prestressed, tensioned containment. The staff finds the applicant's identification of these TLAAs acceptable because they are consistent with the TLAAs identified in SRP-LR Sections 4.2, 4.3, 4.4, and 4.6 as being applicable to PWR LRAs.

The staff also verified that the LRA included the following plant-specific TLAA evaluations:

- crane load cycle limits
- reactor coolant pump motor flywheel fatigue crack growth analysis
- leak-before-break
- reactor vessel underclad cracking
- reactor coolant loop piping flaw tolerance evaluation

The staff confirmed that the applicant's identification of these additional TLAAs satisfies the recommendation in SRP-LR Section 4.7 that the applicant identify any additional analyses for the facilities that meet the definition of a TLAA in 10 CFR 54.3.

During the review of the applicant's TLAA identification process, the staff concluded that it was consistent with that identified in NEI 95-10, Revision 6. The staff did not identify any omissions of TLAAs that should have been addressed for this LRA.

Based on its review, the staff concludes that the applicant has satisfied the requirement of 10 CFR 54.21(c)(1) to identify the TLAAs that are applicable to the LRA because the applicant has satisfied the TLAA identification guidance and recommendations in SRP-LR Sections 4.2, 4.3, 4.4, 4.6, and 4.7.

As required by 10 CFR 54.21(c)(2), the applicant must list all exemptions granted in accordance with 10 CFR 50.12, based on TLAAs, and evaluate and justify them for continuation through the period of extended operation. The LRA states that each active exemption was reviewed to determine whether it was based on a TLAA. The applicant identified one TLAA-based exemption. Based on the information provided by the applicant regarding the process and results of the applicant's search of the CLB to identify these exemptions, the staff has determined, in accordance with 10 CFR 54.21(c)(2), that there is one TLAA-based exemption granted under 10 CFR 50.12 which the applicant has identified for continuation through the period of extended operation. This exemption applies to the applicant's methodology for assessing an RPV circumferential beltline weld to meet the PTS criterion of 10 CFR 50.61. The staff's review of the reactor vessel neutron embrittlement TLAA is described in SER Section 4.2.

4.1.3 Conclusion

On the basis of its review, the staff concludes that the applicant has provided an acceptable list of TLAAs, as required by 10 CFR 54.21(c)(1). The staff also confirmed, as required by 10 CFR 54.21(c)(2), that the applicant has provided an evaluation, as discussed in LRA Sections 4.1.2 and 4.2, that justifies the continuation of one exemption pursuant to 10 CFR 50.12 for the period of extended operation.

4.2 Reactor Vessel Neutron Embrittlement

"Neutron embrittlement" is the term for changes in mechanical properties of RPV materials caused by exposure to fast neutron flux (E > 1.0 million electron volts (MeV)) within the vicinity of the reactor core, called the beltline region. The most pronounced material change is a reduction in fracture toughness. As fracture toughness decreases with cumulative fast neutron exposure, the material's resistance to cleavage and ductile fracture decreases. Fracture toughness also depends on temperature. The reference nil ductility transition temperature (RT_{NDT}), above which the material behaves in a ductile manner and below which the material behaves in a brittle manner, increases as fluence increases and requires higher temperatures for continued ductility. As required by 10 CFR 50.60, all light-water reactors must meet the fracture toughness, pressure-temperature (P-T) limits, and material surveillance program requirements for the reactor coolant pressure boundary (RCPB) in Appendices G and H to 10 CFR Part 50. Section 50.61 of 10 CFR provides the fracture toughness requirements protecting the RPV of a PWR against the consequences due to a PTS event: a severe overcooling concurrent with or followed by significant pressure in the RPV. Neutron fluence, upper-shelf energy (USE), PTS, and P-T limits are time-dependent items that must be investigated to evaluate RPV embrittlement or reduction of fracture toughness. The CLB analyses evaluating reduction of fracture toughness of the RPV for 40 years are TLAAs. The following sections address neutron fluence, USE, PTS, and P-T limits for RPV beltline materials for the period of extended operation.

4.2.1 Neutron Fluence

4.2.1.1 Summary of Technical Information in the Application

The WCAP-16641 report, "Analysis of Capsule T from Dominion Energy Kewaunee Power Station Reactor Vessel Radiation Surveillance Program," provides the calculation of the KPS RPV neutron fluence projections to the end of the period of extended operation based on 52.1 effective full-power years (EFPYs), or a 60-year plant lifetime. Neutron exposure up to Cycle 27 was based upon actual plant operating history, including power uprate from 1,650 megawatt-thermal (MWt) to 1,772 MWt that occurred during Cycle 26. Neutron exposure projections beyond the end of Cycle 27 were based upon a series of 18-month operating cycles at full power having operating characteristics similar to Cycle 27 of 1,772 MWt followed by a 25-day refueling outage. Based on this scenario, the calculated capacity factor for the KPS RPV is 95.6 percent with 33.0 EFPYs at the end of license and 52.1 EFPYs at the end of the period of extended operation. The neutron exposure projections were based on continued use of low neutron leakage fuel management.

All of the calculations and dosimetry evaluations for the specimens documented in the WCAP-16641 report were based on the latest available nuclear cross section data derived from Evaluated Nuclear Data File (ENDF/B-VI) and made use of the latest available calculational tools. Furthermore, the neutron transport and dosimetry evaluation methodologies follow the guidance of Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," version 2001. The power distributions used in the plant-specific transport analysis were based on the individual core designs for each of the first 27 fuel cycles at KPS.

The transport calculations supporting the analysis were carried out using the DORT discrete ordinates code Version 3.1 and the BUGLE-96 cross-section library. The fluence calculations concluded that capsule T surveillance specimens received a fluence of 5.62E+19 neutrons per square centimeter (n/cm^2) (E > 1.0 MeV) after irradiation to 24.6 EFPYs and the peak RPV clad/base metal interface fluence after 24.6 EFPYs of plant operation was 2.60E+19 n/cm^2 (E > 1.0 MeV). LRA Table 4.2-1 provides fast neutron fluence (E > 1.0 MeV) projections for 60 calendar years of operation (52.1 EFPYs) at the clad/base metal interface for all materials comprising the beltline and the extended beltline region of the KPS RPV.

4.2.1.2 Staff Evaluation

RG 1.190 recommends a neutron fluence evaluation to satisfy the following:

- a fluence calculation performed using an acceptable methodology
- analytic uncertainty analysis identifying possible sources of uncertainty
- benchmark comparison to approved results of a test facility
- plant-specific qualification by comparison to measured fluence values

The fast neutron exposure parameters were determined for DEK by Westinghouse, using the methodologies discussed in WCAP-14040-NP-A, "Methodology Used to Develop Cold Overpressure Mitigating Systems Setpoints and RCS Heatup and Cooldown Limit Curves," and WCAP-16083-NP-A, "Benchmark Testing of the FERRET Code for Least Squares Evaluation of Light Water Reactor Dosimetry, May 2006." As noted by safety evaluations dated February 27, 2004, and January 10, 2006, these reports describe a methodology that the staff found acceptable.

The WCAP-16641 report, which was provided to the staff as Attachment 1 to a letter dated November 14, 2006, regarding the KPS RPV Capsule T test results, indicated that DEK is using the two-dimensional discrete ordinates code, DORT, with the BUGLE-96 cross-section library derived from the ENDF/B-VI. Approximations include a P5 Legendre expansion for anisotropic scattering and an S16 order of angular quadrature. These approximations are of a higher order than the P3 expansion and S8 quadrature suggested in RG 1.190. Space and energy dependent core power (neutron source) distributions and associated core parameters are treated on a fuel cycle specific basis. Three dimensional flux solutions are constructed using a synthesis of azimuthal, axial, and radial flux. Source distributions include cycle-dependent fuel assembly initial enrichments, burnups, and axial power distributions, which are used to develop spatial and energy dependent core source distributions that are averaged over each fuel cycle. This method accounts for source energy spectral effects by using an appropriate fission split for uranium and plutonium isotopes based on the initial enrichment and burnup history of each fuel assembly. The neutron transport calculations, as described above, are performed consistent with RG 1.190.

As described in the WCAP-16641 report, DEK performed an analytic uncertainty analysis by combining the uncertainties associated with the individual components of the transport calculations in quadrature. The calculations were compared with the benchmark measurements from the Poolside Critical Assembly simulator at the Oak Ridge National Laboratory, and with surveillance capsule and reactor cavity measurements from the H.B. Robinson power reactor benchmark experiment. These constitute acceptable test facilities.

Finally, the WCAP-16641 report provided a direct comparison against the measured sensor reaction rates from Capsule T. For all reactions, the measured-to-calculated (M/C) ratios were very close to unity; the average ratio was 0.99 with 5.2-percent standard deviation. The distribution of M/C ratios ranged from 0.93 to 1.07. Therefore, all reaction rates were calculated within 20 percent of measured values, as suggested in RG 1.190.

In addition, LRA Section 4.2.1 stated that WCAP-16641 provides the calculation of KPS RPV neutron fluence projections to the end of the period of extended operation (60 years of plant lifetime or 52.1 EFPYs of exposure). The fluence estimate to the end of Cycle 27 included actual plant operating history, considering power uprate. Neutron exposure projections beyond Cycle 27 assumed an 18-month fuel cycle followed by a 25-day refueling outage. This assumption resulted in a 95.6-percent capacity factor. Based on the operating history at KPS, the average capacity factor for the period of time from 2001 through 2006 was 80.25 percent, as noted in NUREG-1350, "2007-2008 Information Digest." This makes the assumption of a 95.6-percent capacity factor reasonably conservative. Based on these considerations, the staff concludes that the fluence calculations are in accordance with RG 1.190 and the 52.1 EFPY fluence values, which adequately account for the period of extended operation, and are acceptable.

4.2.1.3 USAR Supplement

The applicant did not provide a USAR supplement summary description of its evaluation of neutron fluence in LRA Appendix A, "USAR Supplement." Therefore, the staff issued request for additional information (RAI) 4.2.1-1.

> RAI 4.2.1-1:
>
> The Evaluation of neutron fluence is provided in LRA Section 4.2.1, "Neutron Fluence." The LRA does not provide a USAR Supplement summary description of LRA Section 4.2.1 in LRA Appendix A, "Updated Safety Analysis Report Supplement." Please provide a USAR supplement summary description of the evaluation of neutron fluence for 52.1 effective full power years.

In its response dated November 13, 2009, the applicant provided a USAR supplement summary description of its evaluation of neutron fluence, which will be added to LRA Section A.3.1. Hence, RAI 4.2.1-1 is resolved. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address neutron fluence is adequate.

4.2.1.4 Conclusion

In summary, the applicant has provided fluence calculations performed using an acceptable methodology, supported by analytic uncertainty analysis and comparison to approved test facilities, along with a plant-specific comparison of measured fluence values from Surveillance Capsule T. Based on these considerations, the staff concludes that the applicant has followed the guidance in RG 1.190, and the neutron exposures reported in the applicant's submittal are, therefore, acceptable. The staff also concludes that, because the applicant has assumed actual past operating history in its fluence calculations, accounted for a power uprate, and assumed a reasonably conservative capacity factor, the fluence projections adequately account for the period of extended operation.

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that its reactor vessel neutron fluence analyses have been projected to the end of the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.2.2 Upper-Shelf Energy Evaluation

4.2.2.1 Summary of Technical Information in the Application

LRA Section 4.2.2 summarizes the evaluation of USE values for the period of extended operation.

Appendix G to 10 CFR Part 50 contains screening criteria that establish limits on how far the USE values for an RPV material may be allowed to decrease due to neutron irradiation exposure. The regulation requires the initial USE value be greater than 75 foot-pounds (ft-lb) in the unirradiated condition and that the value be greater than 50 ft-lb in the fully irradiated condition throughout the licensed life of the plant. USE values of less than 50 ft-lb may be acceptable to the staff if it can be demonstrated that these lower values will provide margins of safety against brittle fracture equivalent to those required by ASME Code Section XI, Appendix G. RG 1.99, Revision 2 provides guidance for the USE evaluation of the RPV materials. In this application, Charpy USE for the beltline forgings and weld were determined using surveillance data (Position 2.2 of RG 1.99, Revision 2), and the Charpy USE for the extended beltline materials was determined without the use of surveillance data (Position 1.2 of RG 1.99, Revision 2). LRA Table 4.2-2 summarized the predicted Charpy USE values at the end of the period of extended operation (52.1 EFPYs) using the fluence projection at one quarter of the RPV wall thickness (1/4 T), the copper (Cu) content of the beltline and the extended beltline materials, and the results of the capsule specimens tested to date using Figure 2 in RG 1.99, Revision 2. The USE values for the beltline and extended beltline materials remain above the 50 ft-lb requirement for the period of extended operation.

4.2.2.2 Staff Evaluation

The staff reviewed LRA Section 4.2.2, to verify pursuant to 10 CFR 54.21(c)(1)(ii), that the analyses have been projected to the end of the period of extended operation.

According to RG 1.99, Revision 2, the predicted decrease in USE values due to neutron embrittlement during plant operation is dependent upon the amount of Cu in the material and the predicted neutron fluence for the material. As indicated in SER Section 4.2.2.1 above, the applicant used Position 2.2 to determine the Charpy USE values at the end of the period of extended operation for the RPV beltline forgings and weld because five sets of surveillance data are available for each of these materials. For the extended beltline materials, however, the applicant used Position 1.2, in accordance with the RG, to determine its Charpy USE values because the values for extended beltline materials are not represented by capsule specimens.

The staff performed an independent evaluation considering the KPS RPV information in the NRC's Reactor Vessel Integrity Database (RVID) and the recent capsule T surveillance data in the WCAP-16641 report. The staff found that Cu contents and unirradiated USEs for all beltline materials in LRA Table 4.2-2 are identical to those in the RVID. Based on this information and the complete surveillance data information in the RVID and the WCAP-16641 report, the staff plotted a line in Figure 2 of RG 1.99, Revision 2, bounding all surveillance data for each RPV beltline material. These bounding lines indicate that the applicant's projected USE values at the end of the period of extended operation are valid for all KPS RPV beltline materials. The projected USE value at 52.1 EFPYs for the limiting material (the intermediate shell-to-lower shell circumferential weld) is 60 ft-lb.

Because of the relatively high fluence for 52.1 EFPYs for the beltline material, the applicant prudently performed a USE evaluation for "extended beltline materials," using Position 1.2 of RG 1.99, Revision 2 (i.e., without surveillance data). However, because RVID does not contain information for the extended beltline materials, the staff issued RAI 4.2.2-1.

> RAI 4.2.2-1:
>
> The U.S. Nuclear Regulatory Commission's (NRC) Reactor Vessel Integrity Database (RVID) does not contain information for the extended beltline materials reported in the LRA. Please discuss the procedures used to determine the chemistry data, initial reference temperature (RT_{NDT}), and margins for the extended beltline materials to demonstrate that there are consistent approaches for both beltline and extended beltline materials.

The applicant's response dated November 13, 2009, provided additional information regarding the chemistry data, initial RT_{NDT}, and margins for the extended beltline materials. This response stated that: (1) between the Certified Material Test Reports and the guidance from RG 1.99, Revision 2, best-estimate Cu and nickel (Ni) weight percentages were determined for the extended beltline materials; (2) the initial RT_{NDT} values of the RPV materials were determined in accordance with Subsection NB-2331 of Section III of the ASME Code and Branch Technical Position MTEB 5-2, "Fracture Toughness Requirements," of the NRC Standard Review Plan (NUREG-0800); and (3) the margins are determined in accordance with RG 1.99, Revision 2. Therefore, the staff agrees with the applicant's conclusion that, "the procedures that were applied to determine the properties for the extended beltline materials are consistent with those applied for determination of properties for the traditional beltline forgings," and RAI 4.2.2-1 is resolved. This information also supplements LRA Section 4.2.3 on PTS.

The staff used Position 1.2 of RG 1.99, Revision 2 and verified that the upper shell forging is the limiting extended beltline material with a projected 52.1 EFPY USE of 71 ft-lb. Thus, pursuant to 10 CFR 54.21(c)(1)(ii), the KPS RPV beltline and extended beltline materials, which have 52.1 EFPY USE values at 1/4 T greater than 50 ft-lb, meet the 10 CFR Part 50, Appendix G USE requirement to the end of the period of extended operation.

4.2.2.3 USAR Supplement

The applicant provided a USAR supplement summary description of its TLAA evaluation of the USE values for RPV materials in LRA Section A.3.1.1. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address USE is adequate.

4.2.2.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that for USE, the analyses have been projected to the end of the period of extended operation and meet 10 CFR Part 50, Appendix G requirements. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d) and is, therefore, acceptable.

4.2.3 Pressurized Thermal Shock Limits for Reactor Vessel Materials Due to Neutron Embrittlement

4.2.3.1 Summary of Technical Information in the Application

LRA Section 4.2.3 summarizes the PTS evaluation of the KPS RPV beltline and extended beltline materials for the period of extended operation against the screening criteria established in accordance with 10 CFR 50.61. The screening criteria are 270 °F for plates, forgings, and axial weld materials, and 300 °F for circumferential weld materials.

The KPS RPV beltline region is composed of three different materials: two ring forgings and a circumferential weld, which were included in the Reactor Vessel Surveillance Program. The WCAP-16642 report, "Evaluation of Pressurized Thermal Shock for Kewaunee Power Station," defined reference temperatures for PTS (RT_{PTS}) for the forgings in accordance with 10 CFR 50.61 for materials that have surveillance data. Since the data scatter requirements are exceeded, the surveillance data for the forgings are considered to be not credible and higher chemistry factors based on the measured Cu and Ni contents are used with a 2σ margin. RT_{PTS} values for RPV extended beltline materials have also been evaluated in accordance with 10 CFR 50.61 and determined to be not controlling.

For the circumferential weld (heat 1P3571), an exemption to 10 CFR 50.61 was granted for KPS in an NRC safety evaluation dated May 1, 2001, regarding use of the Master Curve method as defined in ASME Code Case N-629, "Use of Fracture Toughness Test Data to Establish Reference Temperature for Pressure Retaining Materials," coupled with measured fracture toughness data from pre-cracked Charpy specimens. The WCAP-16609 report, "Master Curve Assessment of Kewaunee Power Station Reactor Vessel Weld Metal," re-evaluated RT_{PTS} for this weld using the same methodology defined in the May 1, 2001, NRC safety evaluation based on fracture toughness data determined from Capsule T specimens to obtain a Master Curve-based irradiated reference temperature (RT_{To}) for use in place of the adjusted RT_{PTS} value for this weld. The PTS evaluation results from the WCAP-16642 report for the reactor vessel beltline and extended beltline materials in LRA Table 4.2-3 meet the screening criteria of 10 CFR 50.61(b)(2). Therefore, acceptable RT_{PTS} values have been calculated in accordance with 10 CFR 50.61 and the approved exemption to 10 CFR 50.61 requirements, to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

4.2.3.2 Staff Evaluation

The staff reviewed LRA Section 4.2.3 to verify, pursuant to 10 CFR 54.21(c)(1)(ii), that the analyses have been projected to the end of the period of extended operation.

Section 50.61 of 10 CFR provides the fracture toughness requirements protecting the RPVs of PWRs against the consequences of PTS. Licensees are required to perform an assessment of the RPV materials' projected RT_{PTS} values through the end of their operating license. Here, RT_{PTS} values defined in 10 CFR 50.61 are identical to RT_{NDT} values defined in RG 1.99, Revision 2. The rule requires each licensee to calculate the end-of-license RT_{PTS} value for each RPV beltline material. The RT_{PTS} value for each beltline material is the sum of the unirradiated RT_{NDT}, a shift in the RT_{NDT} value caused by neutron irradiation of the material (ΔRT_{NDT}), and a margin value to account for uncertainties (M). Section 50.61 of 10 CFR also provides screening criteria against which the calculated values are to be evaluated.

As stated in LRA Section 4.2.3.1, the screening criteria are 270 °F for plates, forging, and axial weld materials, and 300 °F for circumferential weld materials. RG 1.99, Revision 2 provides a discussion regarding the calculations of ΔRT_{NDT} and the M value. In this RG, ΔRT_{NDT} is the product of a chemistry factor and a fluence factor, where the fluence factor is dependent upon the neutron fluence at the clad-to-base metal interface and the chemistry factor is dependent upon information from either the surveillance material or from the tables in the RG. If the RPV beltline material is not represented by surveillance material, its chemistry factor may be determined using the tables and the methodology documented in Position 1.1 in this RG.

The chemistry factor determined from the tables in the RG depends upon the amount of Cu and Ni in the material. If the RPV beltline material is represented by surveillance material, its chemistry factor may be determined from the surveillance data using the methodology documented in Position 2.1 of the RG.

The applicant summarized its PTS evaluation results for the KPS RPV beltline and extended beltline materials in LRA Table 4.2-3. For beltline intermediate forging and lower shell forging, LRA Table 4.2-3 presents 52.1 EFPY RT_{PTS} values based on Position 1.1 and Position 2.1 of RG 1.99, Revision 2. The staff verified that the Cu and Ni contents and the initial RT_{PTS} values for these two beltline forgings are identical to those in the RVID. Using this material information and the 52.1 EFPY fluence, the staff calculated the RT_{PTS} values for these forgings based on Position 1.1 and found them almost identical to the applicant's values. For the PTS evaluation of the two forgings based on surveillance data or Position 2.1, the staff validated the chemistry factors reported in LRA Tables 4.2-3, which are also consistent with those in the WCAP-16641 report. Using the 52.1 EFPY fluence and the calculated chemistry factors, the staff verified the applicant's 52.1 EFPY RT_{PTS} values based on surveillance data. Since the applicant's limiting 52.1 EFPY RT_{PTS} value is significantly below the PTS screening criteria, the staff determined that the KPS RPV beltline forgings meet the PTS requirements at the end of the period of extended operation.

For the circumferential weld, the applicant performed its PTS evaluation using the Master Curve methodology defined in the May 1, 2001, NRC safety evaluation, which supported granting an exemption from the requirements of 10 CFR Part 50, Appendices G and H, and 10 CFR 50.61. The details for this recent PTS evaluation based on the Master Curve methodology are contained in the WCAP-16609 report, which was submitted as Attachment 2 to the applicant's November 14, 2006, letter. The staff confirmed that the fundamental material information regarding two of the three surveillance weld data used in the WCAP-16609 report is identical to those in Appendix A of the May 1, 2001, NRC safety evaluation, except for a minor modification to the neutron fluence for Capsule S. This modification is appropriate because neutron fluence values for capsules are updated based on the latest information whenever a new capsule is withdrawn and tested. The WCAP-16609 report evaluated the KPS weld RT_{PTS} value in accordance with the procedures designated as "Calculation #1" and "Calculation #2" in Appendix A of the May 1, 2001, NRC safety evaluation for the two surveillance weld data. Similar calculations were performed via the Calculation #2 procedure for the new Capsule T weld data. This is acceptable because the Calculation #2 procedure is for plant-specific surveillance weld data (i.e., data from KPS capsules). The staff's calculations verified the RT_{PTS} values reported in Table 8-1 of the WCAP-16609 report. The staff first adjusted these RT_{PTS} values considering the difference in the neutron fluence between LRA Table 4.2-3 (5.37E+19 n/cm^2) and Table 8-1 of the WCAP-16609 report (4.7E+19 n/cm^2), and then used the three surveillance weld data, including the most recent Capsule T data, to determine the best-estimate value for the KPS RPV circumferential weld. This exercise verified the applicant's RT_{PTS} value of 297.5 °F for the circumferential weld at the end of the period of extended operation. This RT_{PTS} value is below the PTS screening criteria and, thus, is acceptable to the staff.

LRA Table 4.2-3 shows that, for extended beltline materials, the upper shell forging and upper shell-to-intermediate shell circumferential weld have about the same magnitude of 52.1 EFPY RT_{PTS} values as the beltline intermediate shell forging; others have values significantly below the PTS screen criteria. Thus, the staff concludes that the applicant is prudent by including the extended beltline materials in its PTS evaluation, and that the extended beltline materials meet the PTS screening criteria.

Based on the above discussion, the staff concludes that all KPS RPV beltline and extended beltline materials satisfy the PTS requirements of 10 CFR 50.61 through the period of extended operation. Thus, the applicant's TLAA for calculating the RT_{PTS} values of the KPS RPV beltline materials at the end of the period of extended operation is acceptable because it meets the requirements of 10 CFR 54.21(c)(1)(ii) and will ensure that the RPV materials will have adequate RT_{PTS} values and fracture toughness through the period of extended operation for KPS.

4.2.3.3 USAR Supplement

The applicant provided a USAR supplement summary description of its TLAA evaluation of PTS in LRA Section A.3.1.2. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address PTS is adequate.

4.2.3.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has satisfactorily demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that for PTS, the analyses, including the Master Curve methodology for the circumferential weld in the approved Exemption, have been projected to the end of the period of extended operation. However, an Exemption request for the period of extended operation must be submitted at the same time when the applicant requests an amendment to use the P-T limits valid for the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.2.4 Pressure-Temperature Limits

4.2.4.1 Summary of Technical Information in the Application

LRA Section 4.2.4 summarizes the evaluation of P-T limits for the period of extended operation. Appendix G to 10 CFR Part 50 requires that heatup and cooldown of the RPV be accomplished within established P-T limits, which considers reduced fracture toughness of the RPV materials due to neutron irradiation embrittlement. Heatup and cooldown limit curves have been calculated using the adjusted RT_{NDT} value corresponding to the limiting beltline material of the RPV for the current period of licensed operation. In accordance with 10 CFR 50, Appendix G, updated P-T limits for the period of extended operation have been developed in WCAP-16643, "Kewaunee Power Station Heatup and Cooldown Limit Curves for Normal Operation," and will be implemented prior to the period of extended operation. The low-temperature overpressure protection (LTOP) enables temperature requirements to be updated concurrently with the P-T limits in order to ensure that these limits are not exceeded for postulated plant transients during the period of extended operation.

4.2.4.2 Staff Evaluation

The staff reviewed LRA Section 4.2.4 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended function will be adequately managed by the KPS Reactor Vessel Surveillance Program for the period of extended operation. The Reactor Vessel Surveillance Program is responsible for development of P-T limits and LTOP set points for the RPV protection.

The current P-T limits were approved by the NRC on April 1, 1999. These P-T limits were developed by the applicant for 33 EFPYs, but were limited to 28 EFPYs due to the staff's concern with the initial RT_{NDT} value and the standard deviation for the initial RT_{NDT} value for the circumferential weld. This is an area that the staff will pay attention to when the updated P-T limits are submitted for the NRC review in a license amendment request. LRA Section 4.2.4 states that updated P-T limits for the period of extended operation have been developed in accordance with 10 CFR Part 50, Appendix G and documented in WCAP-16643, which will be implemented prior to the period of extended operation. The applicant did not include the updated P-T limits in the LRA for the staff's review.

The staff does not require the updated P-T limit curves for the period of extended operation to be submitted as part of the applicant's LRA for this TLAA. However, the applicant is required to submit revised P-T limits (not necessarily the 52.1 EFPY P-T limits) in accordance with 10 CFR Part 50, Appendix G prior to the expiration of the facility's current P-T limit curves, considering adequate time for staff review and approval. Hence, the staff finds that the applicant's plan to manage the P-T limits in accordance with 10 CFR 54.21(c)(1)(iii) is acceptable because changes to the P-T limit curves will be implemented by the license amendment process (i.e., through revision of the plant technical specifications (TSs)) and meet the requirements of 10 CFR 50.60 and 10 CFR Part 50, Appendix G.

4.2.4.3 USAR Supplement

The applicant provided a USAR supplement summary description of its TLAA evaluation of P-T limits in LRA Section A.3.1.3. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address P-T limits is adequate.

4.2.4.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that for P-T limits, the effects of aging on the intended function will be adequately managed for the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3 Metal Fatigue

Summary of Technical Information in the Application. LRA Section 4.3 states that its design basis addresses the effects of metal fatigue. The section also states that ASME Class 1 vessels and the pressurizer surge line piping have been explicitly analyzed in accordance with ASME Boiler and Pressure Vessel (B&PV) Code requirements using assumptions for thermal and mechanical loading cycles over the component life. The applicant further stated that other plant piping systems were designed and constructed to United States of America Standards (USAS) B31.1.0 Power Piping Code requirements, and have been evaluated for the effects of thermal fatigue using stress range reduction factor methodology based on expected full thermal cycles. Furthermore, if the cyclic behavior of the plant systems and components were evaluated for a 40-year plant life, the associated analyses are considered TLAAs according to 10 CFR 54.3(a)(3), and the fatigue-related analysis must be evaluated for the period of extended operation. The applicant stated if a component has a fatigue TLAA that remains valid to the end of the period of extended operation (demonstration in accordance with 10 CFR 54.21(c)(1)(i)), or is projected to the end of the period of extended operation (demonstration in accordance with 10 CFR 54.21(c)(1)(ii)), then cracking due to metal fatigue is not an aging effect requiring management for that component. If the fatigue TLAA cannot be demonstrated to remain valid by either of these methods, then an aging management program (AMP) is needed to manage the effects of fatigue on the intended function of the affected component(s) (demonstration in accordance with 10 CFR 54.21(c)(1)(iii)).

The applicant stated the following sections provide the results of the evaluation of metal fatigue-related TLAAs:

- Section 4.3.1, "Fatigue of ASME Class 1 Components"
- Section 4.3.2, "Fatigue of Non-ASME Class 1 Components"

Staff Evaluation. The staff noted that in LRA Section 4.3, the applicant stated that if a component whose fatigue TLAA remains valid to the end of the period of extended operation or is projected to the end of the period of extended operation, then cracking due to metal fatigue is not an aging effect requiring management for that component. The staff noted that cracking is a major safety issue for any operating structural component and must be addressed immediately, and that the applicant's statement implies that cracking could be ignored as long as the fatigue TLAA remains valid or can be projected to the end of the period of extended operation. By letter dated July 13, 2009, the staff issued RAI 4.3-1 requesting that the applicant provide the basis to justify this statement in LRA Section 4.3 and discuss how it would address cracks for components dispositioned in accordance with 10 CFR 54.21(c)(1)(i) or 10 CFR 54.21(c)(1)(ii).

In its response dated August 17, 2009, the applicant stated that this statement was not intended to imply that identified cracking in pressure boundary components could be ignored if the fatigue TLAAs are shown to remain valid for the period of extended operation. The applicant asserted that all required inspections will continue to be performed for components within the scope of metal fatigue TLAAs, and any identified nonconforming conditions, including cracking, will be evaluated in accordance with the corrective action program, as appropriate.

Based on its review, the staff finds the applicant's response to RAI 4.3-1 acceptable because the applicant clarified that all required inspections will continue to be performed and that any cracking that is identified will be evaluated in accordance with the corrective action program. The staff's concern described in RAI 4.3-1 is resolved.

4.3.1 Fatigue of ASME Class 1 Components

LRA Section 4.3.1 stated its design incorporates the requirements of the ASME B&PV Code, Section III, for Class 1 pressure vessels, which requires a discrete analysis of the thermal, mechanical, and dynamic stress cycles for portions of components that make up the RCPB. The applicant stated that although original design specifications commonly state that the transient conditions are for a 40-year design life, the fatigue analyses are based on the specified number of occurrences of each transient rather than on this lifetime. Furthermore, the number of occurrences of each design transient was selected based on operating experience and on assumptions for future plant operation during the 40-year design life.

The applicant stated that in addition to the original design transients, fatigue loading transients related to insurges or outsurges from the pressurizer and associated thermal stratification transients that are not part of the original fatigue analyses were subsequently identified. As a result, the applicant stated it performed an ASME Code fatigue analysis for the pressurizer surge line, in response to NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification," that was incorporated into its design basis. The applicant also stated the ASME Code Class 1 reactor coolant loop piping was designed and constructed to the requirements of USAS B31.1.0-1967 and, with the exception of the pressurizer surge line piping, there are no design-basis fatigue analyses. The reactor coolant loop piping and branch connections are subject to the stress range reduction factor thermal cycle limits of the design code (i.e., 7,000 cycles without stress range reduction).

The applicant further stated the additional consideration of the reactor coolant environmental effects on the fatigue usage factor, in accordance with the resolution of Generic Safety Issue (GSI) 190, must be considered for the period of extended operation, and these effects have been evaluated for the required ASME Code Class 1 locations.

The results of the applicant's TLAA evaluations for ASME Code Class 1 components are presented in the following sections:

- Section 4.3.1.1, "Component Design Transient Cycles"
- Section 4.3.1.2, "ASME Code Class 1 Vessels and Surge Line Piping"
- Section 4.3.1.3, "Reactor Coolant Loop Piping"
- Section 4.3.1.4, "Pressurizer Lower Head and Surge Line"
- Section 4.3.1.5, "Effects of Reactor Coolant Environment on Fatigue Life of ASME Code Class 1 Piping and Components"

4.3.1.1 Component Design Transient Cycles

4.3.1.1.1 Summary of Technical Information in the Application

The applicant stated that operating experience at its site and other Westinghouse nuclear steam supply system (NSSS) units has demonstrated that the analyzed numbers of design-basis transients are generally conservative for a 40-year life. LRA Table 4.3-1, "Reactor Coolant System Operating Transients," provides a listing of these transients and indicates those that are monitored by the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The applicant stated the program monitors transients and components to assure that actual plant operation remains bounded by the assumptions used in the design analyses and this program tracks cycles of design-basis transient events and evaluates the number of occurrences against the design basis. Furthermore, for transients that are not monitored, LRA Table 4.3-1 provides the basis for not being monitored.

The applicant stated a projection of the number of occurrences of transient cycles monitored by the Metal Fatigue of Reactor Coolant Pressure Boundary Program to the end of the period of extended operation has been provided in LRA Table 4.3-1. The applicant stated the projection is based on doubling the number of transient occurrences as of July 2006 (representing more than 32 years of operation) and provides a conservative estimate of transient occurrences for a 60-year plant lifetime. The applicant stated that these transients will continue to be tracked in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program for the remaining plant life.

4.3.1.1.2 Staff Evaluation

The applicant stated that the 60-year cycle projection was based on the cycles accrued over the plant life (from plant startup through July 10, 2006) multiplied by a factor of 2. The staff finds that this projection is conservative and acceptable because: (1) the applicant's baseline period through July 10, 2006, is 32 years, which is 2 years beyond the mid-term of a 60-year plant life; (2) the transient occurrence rate for the first few years of operation are higher than that for the later years of operation when plant operational experience was better; and (3) these transients will continue to be tracked in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program for the remaining plant life.

The staff noted that the applicant relies on transient cycle monitoring and tracking to manage the aging due to fatigue effects. The staff noted that for a valid cycle-based fatigue (CBF) management program, it is essential that all thermal and pressure activities (transients) are bounded by the design specifications (including P-T excursion ranges and temperature rates). By letter dated July 13, 2009, the staff issued RAI B3.2-1 requesting that the applicant: (a) describe the procedures that it uses for tracking thermal transients, (b) confirm that all monitored transient events were bounded by the design specifications, (c) confirm that transient events were continuously monitored since the plant startup, and (d) provide a histogram of cycles accrued for plant heatup and plant cooldown transients.

The applicant responded to RAI B3.2-1 by letter dated August 17, 2009. For parts (a) and (b), the applicant stated that the thermal and pressure transients listed in LRA Table 4.3-1 and USAR Table 4.1-8 are tracked by its program and that the requirements of the program are implemented by a plant surveillance procedure, which includes a summary description of critical parameters associated with the transient definition and requires tracking the occurrence of transients listed in LRA Table 4.3-1. The applicant also stated that transient conditions were defined for fatigue evaluation based on a conservative estimate of the magnitude and frequency of the temperature and pressure cycles resulting from normal operation, normal and abnormal load transients, and accident conditions. The applicant further stated that if a thermal or pressure transient occurs that is not bounded by the transient parameters described in the procedure, the event will be documented in the corrective action program and an engineering evaluation will be performed to determine the impact on applicable components and analyses. In its response to part (c), the applicant stated that thermal and pressure transients listed in LRA Table 4.3-1 have been monitored and tracked since initial plant operation in 1973. In its response to part (d), the applicant provided histograms of cycles accrued for plant heatup and plant cooldown transients.

The staff reviewed these histograms (see applicant's response, Attachment 1, pages 113 and 114) and found that the transient occurrence rates (both heatup and cooldown) are quite constant since 1980. This means that for the past 26 years (through 2006), the plant operation has been quite steady. The applicant made its cycle projections by doubling the actual number of cycles accrued as of July 10, 2006. The staff noted that cycle projection can be graphically represented (e.g., as shown in the histograms), by drawing a straight line from the intersection of the x and y axes to the 2004 data point, boosted to the July 10, 2006, cycle value. It is evident from the two histograms that the slope used by the applicant for making cycle projections is significantly greater than that of the average of the past 26 years. This means that the basis of projections that the applicant used is conservative and, therefore, the staff finds it acceptable. As expected, the slopes of event occurrence (i.e., the rates) during the first few years (5 to 7 years) are significantly higher than the averages for both heatups and cooldowns.

Based on its review, the staff finds the applicant's response to RAI B3.2-1 acceptable because: (1) for parts (a) and (b), the applicant has demonstrated effectiveness of its program on transient cycle capturing and counting, as well as keeping all transients being bounded within the design specifications; (2) for part (c), the applicant confirmed that transient events have been continuously monitored since the plant startup; and (3) for part (d), the applicant provided the transient cycle histograms for the plant heatup and cooldown transients, covering the plant operating history thus far. Based on the applicant's response, the staff confirmed that: (a) all transients are bounded within the design specifications, and (b) all transient cycles that had occurred were captured and counted since the startup of the plant. The staff noted that these two criteria are the essence and technical bases of the CBF management methodology. The staff's concern described in RAI B3.2-1 is resolved.

4.3.1.1.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of component design transient cycles in LRA Section A.3.2.1.1. Based on its review of the USAR supplement, the staff concludes that the applicant has provided an adequate summary description of its actions to address component design transient cycles.

4.3.1.1.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the component design transient cycles will be adequately managed during the period of extended operation pursuant to 10 CFR 54.21(c)(1)(iii). The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d), and, therefore, is acceptable.

4.3.1.2 ASME Class 1 Vessels and Surge Line Piping

4.3.1.2.1 Summary of Technical Information in the Application

LRA Section 4.3.1.2 states the reactor vessel (including the control rod drive mechanism pressure housings), steam generators, pressurizer, reactor coolant pumps, and the pressurizer surge line have been analyzed for fatigue usage in accordance with ASME Code Section III requirements for Class 1 components. Furthermore, the applicant stated that as an input to the fatigue analysis, design-basis operational transients were defined. To provide assurance of the necessary high degree of integrity for the components in the reactor coolant system (RCS), transient conditions were selected for fatigue evaluation based on a conservative estimate of the magnitude and frequency of the temperature and pressure transients resulting from normal operation, normal and abnormal load transients, and accident conditions. The applicant also stated that those transients were chosen which are representative of transients to be expected during plant operation and which are sufficiently severe or frequent to be of possible significance to component cyclic behavior. Furthermore, an assumed number of occurrences of each of the design transients during the plant lifetime were used as input to the design-basis fatigue calculations.

The applicant stated that based on the transient cycle projections, which will be confirmed by continued monitoring through the Metal Fatigue of Reactor Coolant Pressure Boundary Program, the design fatigue analyses remain valid for 60 years, and the ASME Code Class 1 vessels and surge line piping fatigue TLAA has been demonstrated to be acceptable for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i) and (iii).

4.3.1.2.2 Staff Evaluation

The staff reviewed LRA Section 4.3.1.2 to verify, pursuant to 10 CFR 54.21(c)(1)(i), that the TLAA remains valid during the period of extended operation, and pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions will be adequately managed for the period of extended operation.

The staff noted that the applicant has dispositioned its ASME Code Class 1 vessels and surge line piping fatigue in accordance with 10 CFR 54.21(c)(1)(i) and 10 CFR 54.21(c)(1)(iii). The staff noted that the 60-year cycle projection was based on the cycles accrued over the plant life (from plant startup through July 10, 2006) multiplied by a factor of 2. The staff finds that this projection is conservative and acceptable because: (1) the applicant's baseline period through July 10, 2006, is 32 years, which is 2 years beyond the mid-term of a 60-year plant life; (2) the transient occurrence rate for the first few years of operation is higher than that for the later years of operation when plant operational experience was better; and (3) these transients will continue to be tracked in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program for the remaining plant life. The staff noted that the applicant dispositioned its TLAA in accordance with 10 CFR 54.21(c)(1)(i) because its conservative projections for 60 years did not exceed the design cycles for 40 years of operation. However, the staff also noted that the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program will continue to track and confirm, by continued monitoring, to ensure that these transients will not exceed the design cycles for the remaining plant life, in accordance with 10 CFR 54.21(c)(1)(iii), and that the effects of aging on the intended functions will be adequately managed for the period of extended operation. The staff noted that the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program includes corrective actions, such as repair or replacement of the component or a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded during the period of extended operation, consistent with the recommendations of NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." The staff reviewed the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program and its evaluation is documented in SER Section 3.0.3.2.20.

The staff finds the applicant's disposition of the ASME Class 1 vessels and surge line piping TLAA pursuant to 10 CFR 54.21(c)(1)(i) and 10 CFR 54.21(c)(1)(iii) acceptable because the applicant's cycle projection of design basis transients is conservative as described above and the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program will continue to monitor the number of transient occurrences to ensure the limits used in the analyses are not exceeded, such that analyses remains valid.

Further discussion of the staff's review of the pressurizer surge line is documented in SER Sections 4.3.1.4.2 and 4.3.1.5.2.

4.3.1.2.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of the ASME Code Class 1 vessels and surge line piping in LRA Section A.3.2.1.2. The staff noted that the applicant's USAR supplement is consistent with the recommendations in SRP-LR Section 4.3.3.3. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the ASME Code Class 1 vessels and surge line piping.

4.3.1.2.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that the ASME Code Class 1 vessels and surge line piping remains valid during the period of extended operation, and pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions of the ASME Code Class 1 vessels and surge line piping will be adequately managed for the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d), and, therefore, is acceptable.

4.3.1.3 Reactor Coolant Loop Piping

4.3.1.3.1 Summary of Technical Information in the Application

LRA Section 4.3.1.3 states the reactor coolant loop piping was designed in accordance with the requirements of USAS B31.1.0-1967 and there is no general requirement in this code for an explicit fatigue analysis; however, piping systems are required to be evaluated for thermal expansion cycles, and a thermal expansion stress range reduction factor is to be applied if cycling is excessive. The applicant stated the code allows 7,000 full temperature thermal expansion cycles without penalty.

The applicant stated the design transients defined for RCS ASME Code Class 1 vessels are also applicable to the reactor coolant loop piping. An evaluation of these transients, and the 60-year cycle projections discussed in LRA Section 4.3.1.1, concluded that thermal cycling of the reactor coolant loop piping will remain well below the 7,000 thermal expansion cycles allowed by USAS B31.1.0, and as a result, the design-basis stress analysis for the reactor coolant loop piping remains valid for 60 years of plant operation.

The applicant stated the expected number of thermal transients affecting the reactor coolant loop piping is significantly below the design-basis limit of 7,000 cycles and, therefore, the piping stress analysis remains acceptable, and the TLAA remains valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

4.3.1.3.2 Staff Evaluation

The staff reviewed LRA Section 4.3.1.3 to verify, pursuant to 10 CFR 54.21(c)(1)(i), that the TLAA remains valid during the period of extended operation.

The staff noted that since the piping systems are connected to the vessel, they are generally cycled in parallel with reactor operations. The staff noted that the 60-year transient cycles for the reactor vessel components in LRA Table 4.3-1 can be used to estimate the cycles for the piping systems. The staff reviewed the 60-year transient cycles for the reactor vessel components in LRA Table 4.3-1 and finds that the total number of projected transients for 60 years is significantly lower than the 7,000 cycles permitted by the requirements of USAS B31.1.0-1967.

The staff finds the applicant's disposition of the reactor coolant loop piping fatigue TLAA pursuant to 10 CFR 54.21 (c)(1)(i) acceptable because as shown in LRA Table 4.3-1, the 60-year projected cycles are well below the cycles used in the original design analysis by a significant margin.

4.3.1.3.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of reactor coolant loop piping in LRA Section A.3.2.1.3. The staff noted that the applicant's USAR supplement is consistent with the recommendations in SRP-LR Section 4.3.3.3. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the reactor coolant loop piping.

4.3.1.3.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that the analyses of reactor coolant loop piping will remain valid during the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d), and, therefore, is acceptable.

4.3.1.4 Pressurizer Lower Head and Surge Line

4.3.1.4.1 Summary of Technical Information in the Application

LRA Section 4.3.1.4 states that insurge and outsurge fatigue effects on the pressurizer lower head and the surge line must be evaluated for license renewal. The applicant stated that these effects were evaluated using stress-based fatigue (SBF) monitoring software (Electric Power Research Institute (EPRI) FatiguePro™) as part of the Metal Fatigue of Reactor Coolant Pressure Boundary Program. The applicant further stated that for license renewal, SBF monitoring software modules have been developed for critical locations in the pressurizer lower head and in the surge line, including the pressurizer and hot leg nozzles. The applicant stated the fatigue monitoring software calculates the cumulative usage factor (CUF) for these locations based on actual plant conditions such as temperature, pressure, and other parameters affecting component material stresses and fatigue usage and accounts for loading due to pressurizer insurges and outsurges, and any thermal stratification conditions present. The applicant stated the software also provides a fatigue CUF projection based on analysis of several years of collected plant data. Furthermore, the applicant has always operated with a "Modified Steam Bubble" method of startup and shutdown, such that recent operating data is representative of past operations, and in order to further reduce thermal fatigue in the pressurizer lower head and surge line, operating procedures were changed at the end of Cycle 28 (March 2008) to incorporate the "Water Solid" method of startup and shutdown. The applicant also stated the fatigue CUF projection currently does not take into account these improved startup and shutdown operating methods as a conservative measure, and the highest projected 60-year CUF for these locations is 0.318 at a pressurizer heater penetration, which is less than the design limit of 1.0.

Therefore, the applicant stated the design limits are not challenged due to pressurizer insurge and outsurge fatigue effects for a 60-year plant life, and the pressurizer lower head and surge line fatigue will be managed using SBF monitoring under the Metal Fatigue of Reactor Coolant Pressure Boundary Program. As such, the TLAA has been demonstrated to be acceptable for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.1.4.2 Staff Evaluation

The staff reviewed LRA Section 4.3.1.4 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions will be adequately managed for the period of extended operation.

Based on its review, the staff noted that the applicant's fatigue evaluation for the pressurizer lower head and surge line used FatiguePro™, which is relied upon for making SBF usage calculations for this location and several other locations. The staff noted that NRC Regulatory Issue Summary (RIS) 2008-30, "Fatigue Analysis of Nuclear Power Plant Components," dated December 16, 2008, identifies issues with the use of a simplified methodology associated with

FatiguePro™. By letter dated July 13, 2009, the staff issued RAI B3.2-2 requesting that the applicant: (1) identify the items whose CUF values were calculated using FatiguePro™ or simplified methodology, including the results shown in LRA Table 4.3-2 and the results embedded in the text (not tabulated), and the items that are identified must be re-evaluated in accordance with the guidelines described in the ASME Code Section III NB-3200, taking all six components of stress into consideration; and (2) make appropriate adjustments and corrections regarding the use of the "stress-based monitoring" and "SBF" terminologies, and reliance on the SBF methodology for fatigue usage calculations. This action applies to the entire body of the LRA, including Commitment No. 28.

In its response dated August 19, 2009, the applicant stated that the reanalysis of locations subject to evaluation of the environmental effects on fatigue usage in accordance with NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," that were initially evaluated using SBF monitoring methods, is currently in progress. The applicant further stated that the response to RAI B3.2-2 will be provided following completion of the reanalysis.

In its response dated February 2, 2010, the applicant stated that the reanalysis of the surge line hot leg nozzle and charging line nozzle in accordance with the guidance in ASME B&PV Code Section III, Subsection NB-3200 is still in progress and is not yet complete. The staff noted that these two locations were the only NUREG/CR-6260 locations that the applicant evaluated with SBF monitoring methods. The applicant committed (Commitment No. 41) to perform a fatigue analysis of the surge line hot leg nozzle and the charging line nozzle in accordance with ASME B&PV Code Section III, Subsection NB-3200 guidance and determine the CUF, considering the effects of the reactor coolant environment and confirm that the CUF is less than 1.0 at the end of 60 years of plant operation. The staff noted that a summary of results for the reanalysis of the surge line hot leg nozzle and charging line nozzle in accordance with the guidance in ASME B&PV Code Section III, Subsection NB-3200 will be provided to the staff. The staff identified this as **Open Item 3.0.3.2.20-1**.

The staff's evaluation and resolution of Open Item 3.0.3.2.20-1 is documented in SER Section 3.0.3.2.20. Open Item OI 3.0.3.2.20-1 is closed.

The staff noted that LRA Section 4.3.1.4 states that the SBF monitoring software module of FatiguePro™ has been used for critical locations in the pressurizer lower head and in the surge line, including the pressurizer and hot leg nozzles. The LRA section states that the highest projected 60-year CUF for these locations is 0.318 at a pressurizer heater penetration.

On September 30, 2010, the staff conducted a telephone conference call with the applicant to discuss its concerns. The staff was concerned with whether the analysis submitted for the surge line hot leg nozzle, which is part of the applicant's submittal to satisfy its Commitment No. 41, with its environmentally-adjusted CUF of 0.0166 was bounding for all of the locations for which an SBF analysis was calculated using FatiguePro™, including the two components discussed in LRA Section 4.3.1.4 (i.e., the pressurizer lower head and surge line).

By letter dated October 20, 2010, the applicant supplemented its response to RAI B3.2-2a and committed (Commitment No. 51) to the following:

> DEK will perform a fatigue evaluation of the pressurizer lower head and surge line that is consistent with the requirements of ASME B&PV Code, Section III,

NB-3200 and will determine the cumulative fatigue usage through the period of extended operation.

The applicant also stated that this additional evaluation will be performed through its Metal Fatigue of Reactor Coolant Pressure Boundary Program to manage metal fatigue associated with pressurizer lower head and surge line fatigue in accordance with 10 CFR 54.21 (c)(1)(iii). The applicant also stated that the EPRI FatiguePro™ SBF monitoring module described in LRA Section 4.3.1.4 will not be used to monitor fatigue usage for the pressurizer lower head and surge line.

Based on its review, the staff finds the applicant's Commitment No. 51 and the disposition of the evaluation for the pressurizer lower head and surge line, pursuant to 10 CFR 54.21(c)(1)(iii), acceptable because: (1) the applicant committed to calculate the CUF for the pressurizer lower head and surge line, consistent with the requirements of the ASME Code Section III, NB-3200; (2) the applicant will manage the effects of aging for the pressurizer lower head and surge line, without the use of SBF; and (3) the applicant will use its Metal Fatigue of Reactor Coolant Pressure Boundary Program to monitor the number of transient occurrences to ensure the limits used in the analysis are not exceeded and the analysis remains valid.

4.3.1.4.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of pressurizer lower head and surge line in LRA Section A.3.2.1.4. The staff noted that the applicant's USAR supplement is consistent with the recommendations in SRP-LR Section 4.3.3.3. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the pressurizer lower head and surge line.

4.3.1.4.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging due to fatigue on the intended functions of the pressurizer lower head and surge line will be adequately managed during the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.1.5 Effects of Reactor Coolant Environment on Fatigue Life of ASME Code Class 1 Piping and Components

4.3.1.5.1 Summary of Technical Information in the Application

LRA Section 4.3.1.5 summarizes the closure of GSI-190 in 1999, along with stating the staff conclusion that licensees should address the effects of the reactor coolant environment on the fatigue life of selected components in support of applicants' license renewal submittals. The section also states that the applicant's plant design did not include requirements for fatigue analysis for piping locations and that, therefore, the four piping locations' evaluations were based upon guidance from the ASME B&PV Code Section III, 1989 Edition with 1989 Addenda.

In LRA Section 4.3.1.5, the applicant stated that it performed environmentally-assisted fatigue (EAF) analyses for the plant-specific locations identified in NUREG/CR-6260 for older vintage Westinghouse plants as listed below:

- reactor vessel shell and lower head
- reactor vessel outlet nozzle
- reactor vessel inlet nozzle
- surge line hot leg nozzle
- safety injection (SI) cold leg nozzle
- charging line nozzle
- residual heat removal (RHR) system tee at SI accumulator line

The applicant stated that it calculated the environmental fatigue life correction factor, F_{en}, in accordance with NUREG/CR-5704 for stainless steel components and in accordance with NUREG/CR-6583 for carbon and low-alloy steel components.

The applicant also stated that since there are no design-basis fatigue analyses for the SI cold leg nozzle and the RHR system tee at SI accumulator line, fatigue usage for these two locations were now calculated for the LRA as a response to GSI-190 to evaluate the effects of reactor water environment on fatigue life of components. The applicant presented the results of the EAF usage in LRA Table 4.3-2. The applicant used a separate subsection to discuss the results and disposition for each NUREG/CR-6260 location listed above.

The applicant dispositioned the following locations pursuant to 10 CFR 54.21(c)(1)(ii):

- reactor vessel shell and lower head
- reactor vessel inlet nozzle and outlet nozzle
- SI cold leg nozzle
- RHR system tee at SI accumulator line

The applicant stated that the fatigue usages for the reactor vessel shell and lower head, and reactor vessel inlet nozzle and outlet nozzle were calculated based on the design transients and cycles shown in LRA Table 4.3-1, whereas the fatigue usages for the SI nozzle and RHR system tee at SI accumulator line were analyzed using the ASME B&PV Code Section III, Subsection NB-3600 rules using the limiting numbers and severity of transients typically defined for these locations. The applicant concluded that since the environmentally-assisted CUF for the locations listed above are less than the limit of 1.0, the evaluations for these locations are acceptable, in accordance with 10 CFR 54.21(c)(1)(ii).

The applicant dispositioned the following locations pursuant to 10 CFR 54.21(c)(1)(iii):

- surge line hot leg nozzle
- charging line nozzle

The applicant stated that the fatigue usages for the surge line hot leg nozzle and charging nozzle were calculated using the SBF monitoring methodology based on the actual plant operating data collected over several years. The applicant concluded that since the surge line hot leg nozzle and charging nozzle are monitored as part of the Metal Fatigue of Reactor

Coolant Pressure Boundary Program, the fatigue usage at these two locations will be managed for the period of extended operation by the Metal Fatigue of Reactor Coolant Pressure Boundary Program, in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.1.5.2 Staff Evaluation

The staff noted that the applicant conservatively addressed the effects of the reactor coolant environment on component fatigue life consistent with the guidance in the SRP-LR and the staff's recommendations for resolving GSI-190, dated December 26, 1999. The staff also noted that, consistent with Commission Order No. CLI-10-17, dated July 8, 2010, the evaluations associated with the effects of the reactor coolant environment on component fatigue life do not fall within the definition of a TLAA in 10 CFR 54.3(a) because these evaluations are not in the applicant's CLB. Based on Commission Order No. CLI-10-17, the staff finds the applicant's evaluation of the effects of the reactor coolant environment on component fatigue life is conservative and an acceptable practice consistent with the staff's recommendations in the SRP-LR and the closure of GSI-190.

The staff reviewed LRA Section 4.3.1.5 to verify, pursuant to 10 CFR 54.21(c)(1)(ii), that the applicant's evaluation is projected to the end of the period of extended operation for the reactor vessel shell and lower head, reactor vessel outlet nozzle, reactor vessel inlet nozzle, SI cold leg nozzle, and RHR system tee at SI accumulator line. The staff also verified, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions will be adequately managed for the period of extended operation for the surge line hot leg nozzle and the charging line nozzle.

Based on its review, the staff noted that the applicant's fatigue evaluations for the pressurizer surge line hot leg nozzle and the charging line nozzle use FatiguePro™, which is relied upon for making SBF usage calculations for these locations. The staff noted that NRC RIS 2008-30, "Fatigue Analysis of Nuclear Power Plant Components," dated December 16, 2008, identifies issues with the use of a simplified methodology associated with FatiguePro™. By letter dated July 13, 2009, the staff issued RAI B3.2-2 requesting that the applicant: (1) identify the items whose CUF values were calculated using FatiguePro™ or simplified methodology, including the results shown in LRA Table 4.3-2 and the results embedded in the text (i.e., not tabulated), and the items that are identified must be re-evaluated in accordance with the guidelines described in ASME B&PV Code Section III, Subsection NB-3200, taking all six components of stress into consideration; and (2) make appropriate adjustments and corrections regarding the use of the "stress based monitoring" and "SBF" terminologies, and reliance on the SBF methodology for fatigue usage calculations. This action applies to the entire body of the LRA, including Commitment No. 28.

In its response dated August 19, 2009, the applicant stated that the reanalysis of locations subject to evaluation of the environmental effects on fatigue usage in accordance with NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," that were initially evaluated using SBF monitoring methods, is currently in progress. The applicant further stated that the response to RAI B3.2-2 will be provided following completion of the reanalysis.

The staff noted that the results of the applicant's re-evaluation will be provided upon its completion. The staff further noted that the surge line hot leg nozzle and the charging line nozzle are the two locations in which FatiguePro™ was used for determining the CUFs.

In its response dated February 2, 2010, the applicant stated that the reanalysis of the surge line hot leg nozzle and charging line nozzle in accordance with the guidance in ASME B&PV Code Section III, Subsection NB-3200 is still in progress and is not yet complete. The staff noted that these two locations were the NUREG/CR-6260 locations that the applicant evaluated with SBF monitoring methods. The applicant committed (Commitment No. 41) to perform a fatigue analysis of the surge line hot leg nozzle and the charging line nozzle in accordance with ASME B&PV Code Section III, Subsection NB-3200 guidance and determine the CUF, considering the effects of the reactor coolant environment and confirm that the CUF is less than 1.0 at the end of 60 years of plant operation. The staff noted that a summary of results for the reanalysis of the surge line hot leg nozzle and charging line nozzle in accordance with the guidance in ASME B&PV Code Section III, Subsection NB-3200 will be provided to the staff. The staff identified this as **Open Item 3.0.3.2.20-1**.

The staff's evaluation and resolution of Open Item 3.0.3.2.20-1 is documented in SER Section 3.0.3.2.20. Open Item OI 3.0.3.2.20-1 is closed.

In its review of the fatigue analysis results shown in LRA Table 4.3-2, the staff noted that three F_{en} values are used for the components considered as part of NUREG/CR-6260. Specifically, a F_{en} value of 2.455 is used for low-alloy steel locations and a F_{en} value of 15.35 is used for stainless steel locations, except for the RHR tee at SI accumulator line location, in which a F_{en} value of 2.55 is used. The staff noted that the F_{en} factor is dependent upon the type of material, strain rates, temperature of the component considered, and the dissolved oxygen (DO) concentration of the reactor water. The staff noted that for the stainless steel locations, except for the RHR tee at SI accumulator line location, the applicant used the maximum and bounding F_{en} factor of 15.35, as described in NUREG/CR-5704. The staff finds the applicant's use of a F_{en} factor of 15.35 acceptable because it is conservative and is the bounding and maximum value for stainless steel components. The staff noted that for the RHR tee at SI accumulator line location, a design-basis fatigue analysis did not exist; therefore, the applicant performed its evaluation for the 60-year CUF using the ASME B&PV Code Section III, Subsection NB-3600. The staff noted that the applicant used a F_{en} factor of 2.55 because this location is subjected to temperatures less than 200 °C (392 °F), as described in NUREG/CR-5704. The staff further noted and confirmed in USAR Table 9.3-2 that the RHR system operates to remove residual heat from the RCS from 350 °F to 140 °F, therefore, the applicant's use of a "low-temperature" (less than 200 °C) is reasonable. The staff noted that the RHR system tee at SI accumulator line is downstream of the RHR heat exchanger and the staff confirmed in USAR Table 9.3-2 that the temperature of the outlet side of the RHR heat exchanger is less than 200 °C. The staff finds that the applicant appropriately analyzed the 60-year CUF for the RHR tee at SI accumulator line location and the applicant used the appropriate F_{en} factor of 2.55 because: (1) the applicant used the requirements of the ASME B&PV Code Section III, Subsection NB-3600 to calculate the 60-year CUF; and (2) the applicant appropriately calculated the F_{en} factor, based on NUREG/CR-5704, for the operating temperatures for the RHR system.

However, the staff noted that for the low-alloy steel locations, the applicant used a F_{en} value of 2.455, based on the equations from NUREG/CR-6583, which assumes that the DO is not greater than 0.05 parts per million (ppm). The staff noted that the applicant may have operated at DO levels greater than 0.05 ppm during the early years of operation, such that this F_{en} value of 2.455 may not be bounding. By letter dated July 13, 2009, the staff issued RAI 4.3-2 requesting that the applicant: (1) summarize its experience in controlling the DO level in the reactor water since initial plant startup, including describing all water chemistry programs it has used, as well as procedures and requirements used for managing DO concentration including the inception date of each water chemistry program; (2) provide a historic summary of the DO level since the plant startup, including estimating the fraction of time of its operating history, thus far, that the DO level exceeded 0.05 ppm; and (3) describe how reactor water samples were taken, including the sampling locations. If samples were taken from a single location, justify that the DO data discussed in part (2) above are applicable to all NUREG/CR-6260 components for the F_{en} calculations.

In its response dated August 17, 2009, to part (1), the applicant stated that its TSs provide a limit of 100 parts per billion (ppb) for DO with the reactor coolant temperature greater than 250 °F. The applicant stated that reactor coolant DO has been controlled since initial plant operation and is currently controlled in accordance with the latest industry guidelines provided in EPRI 1002884, "Pressurized Water Reactor Primary Water Chemistry Guidelines." The applicant also stated that reactor coolant chemistry control requires monitoring of water chemistry parameters including DO concentration, and these are achieved through routine sampling and analysis of the samples for contaminants, as well as through maintaining an elevated hydrogen concentration (hydrogen overpressure) in the volume control tank of the chemical and volume control system.

In its response dated August 17, 2009, to part (2), the applicant stated that the reactor coolant elevated hydrogen concentration is effective in mitigating oxidizing conditions due to radiolysis or oxygen ingress. The applicant stated that historically, DO concentrations are significantly less than the limit provided in the TS or in the EPRI guidelines. The applicant also stated that based on a review of reactor coolant chemistry data from 1984 to 2009, the typical reactor coolant DO level during normal operation has been less than 5 ppb (0.005 ppm). The applicant also stated that based on the review of chemistry data, there have been no significant periods where the RCS operated at a temperature greater than 250 °F and DO level was greater than 50 ppb (0.05 ppm). The applicant further stated that based on the DO level control method used, the sampling frequency and DO level limits specified in the chemistry control program, and the historical DO level, it is reasonable to assume that reactor coolant DO level will continue to be maintained below 50 ppb (0.05 ppm) at temperatures above 250 °F.

In its response dated August 17, 2009, to part (3), the applicant stated that reactor coolant samples are taken on a routine basis either directly from the sample point at the reactor coolant "B" hot leg connection during normal operation or indirectly via the RHR system sample point during startup and shutdown. The applicant also stated that based on flow rates through the RCS that promote mixing within the system, the samples obtained are representative of the bulk reactor coolant water chemistry. The applicant further stated that the low-alloy steel locations that are required to be evaluated for the effects of the reactor coolant environment on fatigue usage are the reactor vessel nozzles and reactor vessel shell to lower head transition. At these locations, the applicant stated there are no stagnant fluid conditions (i.e., potentially caused by dead-leg or creviced geometries). As such, the applicant concluded that the local water chemistry at these locations is expected to be consistent with the bulk reactor coolant water chemistry conditions and so the DO data discussed are representative of the DO level at these locations.

The staff noted that the applicant did not provide the historical DO data for the first 10 years of plant operating history. By letter dated December 3, 2009, the staff issued follow-up RAI 4.3-2a requesting that the applicant provide justification for the first 10 years of operation that the DO level in the RCS was maintained at or below 0.05 ppm.

In its response dated January 21, 2010, the applicant stated it maintains an elevated hydrogen concentration in the reactor coolant during normal operation to ensure a low concentration of

DO. The applicant further stated that reactor coolant chemistry data recorded since 1984 was reviewed and showed that DO is typically less than 0.005 ppm. The staff noted that the applicant has operated its plant since initial startup in 1973 with an elevated hydrogen concentration.

The staff finds it reasonable that the applicant stated that the operating period of 1973 to 1984 is expected to be consistent with the DO data recorded since 1984 because the applicant has operated and maintained elevated hydrogen concentration since initial plant start up and the applicant's review showed the DO level one order of magnitude lower than the threshold in NUREG/CR-6583.

Based on its review, the staff finds the applicant's responses to RAI 4.3-2 and RAI 4.3-2a acceptable because the applicant: (1) provided its operating experience with DO and the limits it controls the DO level in the reactor; (2) confirmed in its reactor coolant chemistry data that since initial plant startup (i.e., 1973–2009), it is reasonable to state that the DO level was maintained one order of magnitude below the threshold the applicant used to calculate the F_{en} factors for low-alloy steel; and (3) confirmed that for the reactor vessel shell and lower head and reactor vessel inlet and outlet nozzles, there are no stagnant fluid conditions such that the local water chemistry at these locations is consistent with the bulk reactor coolant water chemistry conditions and the DO level is representative of the DO concentration at these locations.

Based on its review, the staff found disposition of the applicant's evaluation for the reactor vessel shell and lower head, reactor vessel outlet nozzle, reactor vessel inlet nozzle, SI cold leg nozzle, and RHR system tee at SI accumulator line, pursuant to 10 CFR 54.21(c)(1)(ii), acceptable because: (1) the 60-year environmentally-assisted CUF results are within the limit of 1.0, as shown in LRA Table 4.3-2; and (2) the F_{en} factors for the reactor vessel shell and lower head, reactor vessel outlet nozzle, reactor vessel inlet nozzle, SI cold leg nozzle, and RHR system tee at SI accumulator line calculated by the applicant are either bounding or appropriate as discussed above.

Based on its review, the staff found disposition of the applicant's evaluation for the surge line hot leg nozzle and charging line nozzle, pursuant to 10 CFR 54.21(c)(1)(iii), acceptable because: (1) the fatigue usage factor analysis was performed in accordance with ASME Code Section III, Subsection NB-3200, which utilized six components of a transient stress tensor that addressed the staff's concern expressed in RIS-2008-30; (2) the CUFs and the EAF usage factors for both the surge line hot leg nozzle and the charging line nozzle are below the ASME B&PV Code Section III allowable limit of 1.0; (3) the applicant will manage the effects of aging for the surge line hot-leg nozzle and the charging line nozzle, without the use of FatiguePro's™ SBF; and (4) the applicant will use its Metal Fatigue of Reactor Coolant Pressure Boundary Program to monitor the number of transient occurrences to ensure the limits used in the analysis are not exceeded and the analysis remains valid.

On September 30, 2010, the staff conducted a telephone conference call with the applicant to discuss some concerns. The staff was concerned whether the applicant had considered environmental effects on fatigue for those locations with a CUF higher than those for the NUREG/CR-6260 locations, consistent with SRP-LR Sections 4.3.2.2 and 4.3.3.2 and GALL AMP X.M1 to consider environmental effects for the NUREG/CR-6260 locations "at a minimum."

By letter dated October 20, 2010, the applicant supplemented its response to RAI B3.2-2a and committed (Commitment No. 52) to the following:

> *DEK will perform a review of design basis ASME Class 1 component fatigue evaluations to determine whether the NUREG/CR-6260-based components that have been evaluated for the effects of the reactor coolant environment on fatigue usage are the limiting components for the Kewaunee plant configuration. If more limiting components are identified, the most limiting component will be evaluated for the effects of the reactor coolant environment on fatigue usage.*

The applicant also stated that this additional evaluation will be performed through its Metal Fatigue of Reactor Coolant Pressure Boundary Program to manage metal fatigue associated with the environmental effects on fatigue usage in accordance with 10 CFR 54.21(c)(1)(iii).

Based on its review, the staff finds the applicant's Commitment No. 52 acceptable because: (1) the applicant commited to determine whether the NUREG/CR-6260-based locations, evaluated for environmental fatigue, are the limiting locations; (2) if more limiting locations are identified, they will be evaluated and managed in accordance with 10 CFR 54.21(c)(1)(iii), with its Metal Fatigue of Reactor Coolant Pressure Boundary Program; and (3) Commitment No. 52 is consistent with SRP-LR Sections 4.3.2.2 and 4.3.3.2 and with GALL AMP X.M1 to consider environmental effects for the NUREG/CR-6260 locations at a minimum.

4.3.1.5.3 USAR Supplement

The applicant provided the USAR supplement summarizing its evaluation of the NUREG/CR-6260 components in LRA Section A.3.2.1.5. The staff noted that the applicant's USAR supplement is consistent with the recommendations in SRP-LR Section 4.3.3.3 and SRP-LR Table 4.3-2. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the NUREG/CR-6260 components.

4.3.1.5.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the applicant's evaluations of the reactor vessel shell and lower head, reactor vessel outlet nozzle, reactor vessel inlet nozzle, SI cold leg nozzle, and RHR system tee at SI accumulator line are projected to the end of the period of extended operation. The staff also concludes that the applicant has acceptably accounted for the effects of the reactor coolant environment on fatigue life of ASME Code Class 1 piping and components and has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging due to fatigue on the intended functions of the surge line hot leg nozzle and charging nozzle will be adequately managed during the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the applicant's evaluation, as required by 10 CFR 54.21(d).

The staff concludes that the applicant's evaluations on the effects of the reactor coolant environment on component fatigue life is not a TLAA as defined by 10 CFR 54.3(a) and is consistent with Commission Order No. CLI-10-17 (Entergy Nuclear Vermont Yankee, LLC (Vermont Nuclear Power Station) CLI-10-17), dated July 8, 2010 (ADAMS Accession No. ML101890775). The staff also concludes that the applicant's evaluation on the effects of the reactor coolant environment on component fatigue life is conservative and consistent with the recommendations of the SRP-LR and the closure of GSI-190.

4.3.2 Fatigue of Non-ASME Code Class 1 Components

The applicant stated that its results of TLAA evaluations for non-ASME Code Class 1 components are presented in the following sections:

- Section 4.3.2.1, "Non-Class 1 Piping"
- Section 4.3.2.2, "Auxiliary Heat Exchangers"

4.3.2.1 Non-Class 1 Piping

4.3.2.1.1 Summary of Technical Information in the Application

LRA Section 4.3.2.1 states that non-ASME Code Class 1 piping systems were designed and constructed to the requirements of USAS B31.1.0-1967 and there are no general requirements in this code for an explicit fatigue analysis. The applicant further stated that these piping systems are required to be evaluated for thermal expansion cycles, and a thermal expansion stress range reduction factor is to be applied if cycling is excessive. Furthermore, the applicant stated that the code allows 7,000 full temperature thermal expansion cycles without penalty. The applicant also stated that since a limit is placed on thermal cycles and these cycles can be related to time in service for the piping systems, its design in accordance with USAS B31.1 rules is, therefore, considered a TLAA.

The applicant stated that a review of non-ASME Code Class 1 piping systems was performed to determine whether any systems or components would exceed the number of thermal expansion stress cycles assumed in the design. Its review concluded that, with the exception of the reactor coolant hot leg sample line, all non-Class 1 piping systems remained within the design cycle limit for 60 years of operation. The applicant further stated the reactor coolant hot leg sample line was reanalyzed and was found to be acceptable for 60 years with the application of the appropriate stress range reduction factor to account for the increased number of thermal expansion cycles.

Therefore, the applicant stated its non-ASME Code Class 1 (except for the reactor coolant hot leg sample line) piping systems TLAA is acceptable for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i), and the reactor coolant hot leg sample line TLAA is acceptable for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(ii).

4.3.2.1.2 Staff Evaluation

The staff reviewed LRA Section 4.3.2.1 to verify, pursuant to 10 CFR 54.21(c)(1)(i), that the TLAA remains valid during the period of extended operation, and also to verify, pursuant to 10 CFR 54.21(c)(1)(ii), that the TLAA is projected to the end of the period of extended operation.

The staff noted that USAS B31.1.0-1967 Code imposes reduction factors to the allowable thermal stress-range according to rules defined in the Code when the total number of thermal cycles is larger than 7,000 cycles. The required stress-range reduction factor for a given number of full temperature cycles is listed in SRP-LR Table 4.3-1.

The staff finds the applicant's disposition of the non-ASME Code Class 1 piping, except for the reactor coolant hot leg sample line, fatigue TLAA pursuant to 10 CFR 54.21 (c)(1)(i) acceptable because as shown in LRA Table 4.3-1, the 60-year projected cycles are well below the cycles used in the original design analysis by a significant margin.

However, for the reactor coolant hot leg sample line, LRA Section 4.3.2.1 states the re-evaluation was performed to account for the increased number of thermal expansion cycles. The staff noted that the applicant did not provide information regarding the details of the re-evaluation to disposition this TLAA in accordance with 10 CFR 54.21(c)(1)(ii). By letter dated July 13, 2009, the staff issued RAI 4.3-3 requesting that the applicant: (1) describe the sampling practice, including number of times sampling activity takes place each day or each week and estimate the total number of thermal cycles projected for 60 years, including those due to the sampling operations and those due to other means; (2) provide the maximum stress intensity range induced by those thermal cycles; and (3) specify the allowable stress range, and the stress-range reduction factor used in the re-evaluation described in LRA Section 4.3.2.1.

In its response by letter dated August, 17, 2009, the applicant stated that reactor coolant hot leg samples are taken seven times per week (i.e., one sample per day during normal operation). The applicant stated that this equates to 21,840 samples in a 60-year period but the analysis of the reactor coolant hot leg sample line conservatively assumed 43,680 full temperature cycles to account for non-routine sampling. The applicant further stated that the maximum stress range was 20,104 pounds per square inch (psi), which was determined based on the USAS B31.1 Code (1967 Edition). The applicant further stated that the allowable stress range is 26,683 psi, which reflected a stress range reduction factor, f = 0.7, corresponding to 22,000 to 45,000 full temperature cycles.

Based on its review, the staff finds the applicant's response to RAI 4.3-3 acceptable because: (1) the applicant provided the details of its re-evaluation, (2) the applicant's analysis assumed a conservative number of full temperature cycles (double the once-a-day sample practice for 60 years of operation) in its evaluation, (3) the applicant applied the appropriate stress-range reduction factor that corresponds to 22,000 to 45,000 full temperature cycles, and (4) the maximum stress range induced by the thermal cycles is less than the allowable stress range. The staff's concern described in RAI 4.3-3 is resolved.

4.3.2.1.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of non-Class 1 piping in LRA Section A.3.2.2.1. The staff noted that the applicant's USAR supplement is consistent with the recommendations in SRP-LR Section 4.3.3.3. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the non-Class 1 piping.

4.3.2.1.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that the analyses of non-Class 1 piping, except for the reactor coolant hot leg sample line, will remain valid during the period of extended operation. The staff also concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the analyses of the reactor coolant hot leg sample line is projected to the end of the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.2.2 Auxiliary Heat Exchangers

4.3.2.2.1 Summary of Technical Information in the Application

LRA Section 4.3.2.2 states that heat exchangers in auxiliary systems were designed in accordance with ASME Code Section III Class C and/or Section VIII rules, which do not require an explicit fatigue analysis. However, the applicant stated that the equipment specification for the RHR, letdown, regenerative, excess letdown, and primary sample heat exchangers included thermal and pressure transient conditions as an input to the component design, therefore, the specified transient occurrences are considered a TLAA and have been evaluated for the period of extended operation.

The applicant stated the transient occurrences specified for the design of these auxiliary heat exchangers are either conservatively large when compared to actual operating conditions, or are bounded by the transient occurrences monitored by the Metal Fatigue of Reactor Coolant Pressure Boundary Program, with the exception of the primary sample heat exchanger in the reactor coolant hot leg sample stream. The applicant further stated that based on current sampling practice, it is anticipated that the number of specified transient occurrences for the reactor coolant hot leg primary sample heat exchanger will be exceeded prior to the end of the period of extended operation.

The applicant stated that, therefore, the auxiliary heat exchangers TLAA, with the exception of the primary sample heat exchanger, will remain valid during the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i). The applicant further stated the primary sample heat exchanger transient cycles will be tracked in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program and corrective actions (including reanalysis, replacement, or repair) will be initiated prior to exceeding the specified number of transient occurrences; therefore, the effects of transient cycles on the function of the sample heat exchanger will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.2.2.2 Staff Evaluation

The staff reviewed LRA Section 4.3.2.2 to verify, pursuant to 10 CFR 54.21(c)(1)(i), that the TLAA remains valid during the period of extended operation and to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions will be adequately managed for the period of extended operation.

Based on its review, the staff finds that the applicant's disposition of the auxiliary heat exchangers, except for the primary sample heat exchanger, pursuant to 10 CFR 54.21(c)(1)(i), is acceptable because: (1) as shown in LRA Table 4.3-1, the 60-year projected cycles are well below the cycles used in the original design analysis by a significant margin and the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program will continue to track and confirm by continued monitoring to ensure that these transients will not exceed the design cycles for the remaining plant life; and (2) corrective actions will be taken consistent with its Metal Fatigue of Reactor Coolant Pressure Boundary Program.

For the primary sample heat exchanger, since the thermal cycles may not be bounded by the design cycles, the applicant stated that it will manage this component in accordance with 10 CFR 54.21(c)(1)(iii). Based on its review, the staff finds that the applicant's disposition of the primary sample heat exchanger, pursuant to 10 CFR 54.21(c)(1)(iii), is acceptable because the applicant's Metal Fatigue of Reactor Coolant Pressure Boundary Program will continue to track and confirm by continued monitoring to ensure that these transients will not exceed the design cycles for the remaining plant life, and corrective actions (including reanalysis, replacement, or repair) will be initiated prior to exceeding the specified number of transient occurrences.

4.3.2.2.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of auxiliary heat exchangers in LRA Section A.3.2.2.2. Based on its review of the USAR supplement, the staff concludes that the applicant provided an adequate summary description of its actions to address the fatigue evaluation of the auxiliary heat exchangers.

4.3.2.2.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that the analyses of auxiliary heat exchangers, except for the primary sample heat exchanger, will remain valid during the period of extended operation. The staff also concludes that for the primary sample heat exchanger, the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging due to fatigue on the intended functions will be adequately managed during the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.4 Environmental Qualification of Electrical Equipment

The EQ requirements established by 10 CFR Part 50, Appendix A, Criterion 4 and 10 CFR 50.49 specifically require each applicant to establish a program to qualify electrical equipment so that such equipment, in its end of life, will meet its performance specifications during and following design-basis accidents. The 10 CFR 50.49 EQ Program is a TLAA for purposes of license renewal. Electrical equipment with a qualified life equal to or greater than the duration of the current operating term is covered by TLAAs. The TLAA of the EQ of electrical components includes all long-lived, passive, and active electrical and instrumentation and control (I&C) components that are important to safety and are located in a harsh environment. The harsh environment includes those areas subject to environmental effects caused by loss of coolant accidents (LOCAs), high-energy line breaks (HELBs), and post-LOCA radiation.

As required by 10 CFR 54.21(c)(1), the applicant must provide a list of TLAAs. In addition, 10 CFR 54.21(c)(1) requires that the applicant demonstrate one of the following for each TLAA: (1) the analyses remain valid for the period of extended operation, (2) the analyses have been projected to the end of the period of extended operation, or (3) the effects of aging on the intended functions will be adequately managed for the period of extended operation.

4.4.1 Summary of Technical Information in the Application

LRA Section 4.4 summarizes the applicant's evaluation of EQ of electric equipment for the period of extended operation and states that the KPS Environmental Qualification (EQ) of Electric Components Program is an existing program established to meet KPS commitments for 10 CFR 50.49. The applicant stated that the KPS EQ Program manages component thermal, radiation, and cyclic aging, as applicable, through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. The applicant also stated that, as required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished, replaced, or have their qualification extended prior to reaching the age limits established in the evaluation. The applicant further stated that equipment qualification evaluation for EQ components that specify qualification of at least 40 years, but less than 60 years, are considered a TLAA for license renewal. The applicant, therefore, concluded that in accordance with 10 CFR 54.21(c)(1)(iii), implementation of the EQ Program provides reasonable assurance that the effects of aging on components associated with the EQ TLAA will be adequately managed such that the intended functions can be maintained for the period of extended operation.

4.4.2 Staff Evaluation

The staff reviewed LRA Section 4.4 and program basis documents to determine if the applicant's EQ Program meets the requirements of 10 CFR 54.21(c)(1). The staff reviewed the applicant's EQ Program to determine whether it is implemented in accordance with the requirements of 10 CFR 54.21(c)(1)(iii), and whether it shows that components evaluated under the applicant's TLAA evaluation are adequately managed during the period of extended operation. The staff reviewed the applicant's EQ Program conformance to the requirements of 10 CFR 50.49, including the management of aging effects, to confirm that electric equipment requiring EQ will continue to operate consistent with the CLB during the period of extended operation.

The staff also conducted a review of the information provided in LRA Section B3.1 and the program basis documents provided to the staff during the audit. The staff's evaluation of this AMP is contained in SER Section 3.0.3.1.13. Based on its review of LRA Section B3.1, including audit results, the staff concludes that the applicant's Environmental Qualification (EQ) of Electric Components Program elements are consistent with GALL AMP X.E1, "Environmental Qualification (EQ) of Electric Components." Therefore, the staff finds that the EQ Program is capable of managing the qualified life of components within the scope of the program for license renewal and that the continued implementation of the EQ Program provides assurance that the aging effects will be managed and that electric equipment will continue to perform its intended functions for the period of extended operation.

4.4.3 USAR Supplement

In LRA Appendix A, Section A4.1, the applicant provided the USAR supplement for the EQ of electric components TLAA. GALL AMP X.E1 states that reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism incorporated in the prior evaluation. Important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). The applicant's USAR supplement includes aging evaluation reanalysis as a routine part of the EQ Program that addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions consistent with GALL AMP X.E1 and SRP-LR Table 4.4-2.

The staff determines that the information in the USAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

4.4.4 Conclusion

On the basis of its review of the applicant's Environmental Qualification (EQ) of Electric Components Program, the staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained pursuant to 10 CFR 54.21(c)(1)(iii) for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed LRA Section A4.1, the USAR supplement referenced for LRA Section 4.4, and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d), and, therefore, is acceptable.

4.5 Concrete Containment Tendon Prestress

4.5.1 Summary of Technical Information in the Application

LRA Section 4.5 summarizes the evaluation of concrete containment tendon prestress for the period of extended operation. The LRA states that the KPS reactor containment vessel (RCV) is a metal containment designed without the use of prestressed concrete containment tendons.

4.5.2 Staff Evaluation

The KPS containment has no prestressed tendons; therefore, the staff finds that this TLAA is not required.

4.5.3 USAR Supplement

The staff concludes that no USAR supplement is required because KPS does not have any prestressed tendons in its containment building.

4.5.4 Conclusion

On the basis of its review, as discussed above, the staff concludes this TLAA is not required.

4.6 Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis

4.6.1 Reactor Containment Vessel Fatigue

4.6.1.1 Summary of Technical Information in the Application

LRA Section 4.6 summarizes the evaluation of the primary containment for the KPS reactor, which consists of a cylindrical steel pressure vessel and is referred to as the RCV. The function of the RCV is to confine radioactive materials that could be released by accidental loss of integrity of the RCPB. The LRA further states that the RCV is completely enclosed within the concrete shield building. A 5-foot annular space is provided between the RCV and the shield building.

LRA Section 4.6 states that the RCV design included an analysis which determined that a cyclical fatigue analysis was not required, per ASME Code Section III, Subsection B, Paragraph N-415.1. The original design assumed 40 cycles of vessel pressurization from atmospheric to design pressure. The LRA further states that this condition will only occur during integrated leak rate tests, which are performed on a 10-year basis, or during an accident. Therefore, the applicant concluded that the 40-cycle limit is conservative and will remain valid during the period of extended operation. The original design also specified the number of temperature variations from 50 °F to 120 °F as 200 cycles. LRA Table 4.3-1 projects 110 heatup and 108 cooldown occurrences for a 60-year span; therefore, the applicant stated the assumption will remain valid during the period of extended operation. The applicant further stated that these results demonstrate that the exemption from fatigue analysis will remain valid for the period of extended operation. Therefore, the applicant dispositioned the RCV fatigue TLAA in accordance with 10 CFR 54.21(c)(1)(i).

4.6.1.2 Staff Evaluation

The staff reviewed LRA Section 4.6.1, pursuant to 10 CFR 54.21(c)(1)(i), to verify that the analyses will remain valid for the period of extended operation. The staff reviewed USAR Table 4.1-8 and verified that the original plant design was for 200 heatup/cooldown cycles. The staff found that the projected thermal cycles of 110 will remain below the original design value. The staff also found that the projected number of pressurizations is less than the design value of 40 cycles. Since the number of projected cycles remains below the original design assumptions, the staff finds the existing exemption from fatigue analysis for the RCV will remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

4.6.1.3 USAR Supplement

The applicant also provided a USAR supplement summary description of its TLAA evaluation of the RCV fatigue in LRA Section A3.4. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address the RCV fatigue is adequate because the applicant has provided information equivalent to that in Table 4.6-1 of SRP-LR Section 4.6.

4.6.1.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that for the RCV fatigue TLAA, the analysis of the unit's RCVs remains valid through the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.6.2 Containment Penetration Fatigue

4.6.2.1 Summary of Technical Information in the Application

LRA Section 4.6 summarizes the evaluation of containment penetration fatigue analysis for the period of extended operation. The LRA states that hot piping penetration assemblies were designed in accordance with USAS B31.1.0, which begins to decrease code allowable stresses when thermal cycles become greater than 7,000. This section also states that, for penetration assemblies, no fatigue analyses or specified cyclic loading limits were identified. The LRA states the evaluation of loading for the associated piping (in LRA Section 4.3.2.1) indicates that 7,000 thermal cycles will not be exceeded during the period of extended operation for any of the penetrations. Therefore, the applicant concluded that this TLAA will remain valid through the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

4.6.2.2 Staff Evaluation

The staff reviewed LRA Section 4.6, pursuant to 10 CFR 54.21(c)(1)(i), to verify that the analyses will remain valid for the period of extended operation. During its review, the staff verified that the hot piping penetration thermal cycles correlate to the RCS thermal cycles, including reactor trips. Per USAR Table 4.1-8, the original design thermal cycles for the RCS are 200, and the original design number of reactor trips is 400. The 60-year projected cycles by the applicant in LRA Table 4.3-1 are 110 for heatup, 108 for cooldown, and 114 for reactor trips. These values bound the number of thermal cycles for the containment penetrations and are not at all expected to exceed the 7,000 limit during the period of extended operation. Since the number of applicable design transients and the number of predicted transients remain below the code allowable limit of 7,000, the staff finds that the TLAA will remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

4.6.2.3 USAR Supplement

The applicant provided a USAR supplement summary description of the TLAA evaluation of the containment penetration fatigue in LRA Section A3.4. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address the containment penetration fatigue is adequate because the applicant has provided information equivalent to that in Table 4.6-1 of SRP-LR Section 4.6.

4.6.2.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that for the containment penetration fatigue TLAA, the analyses remain valid through the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d), and, therefore, is acceptable.

4.7 Other Plant-Specific Time-Limited Aging Analyses

4.7.1 Crane Load Cycle Limit

4.7.1.1 Summary of Technical Information in the Application

In LRA Section 4.7.1, the applicant stated that overhead cranes were originally designed to Specification 61 of the Electric Overhead Crane Institute (EOCI). EOCI-61 did not require a specific fatigue or load-cycle analysis. However, the applicant stated that the cranes subject to the requirements of NUREG-0612 were subsequently evaluated according to the guidelines of Specification 70 of the Crane Manufacturers Association of America (CMAA-70), which includes an evaluation of load cycles. The applicant also stated that the containment building polar crane, turbine building crane, and auxiliary building crane are considered to be within the scope of NUREG-0612 and were evaluated for load cycles in accordance with CMAA-70. These three cranes are considered Class A service cranes for CMAA-70 and are designed for 20,000 to 100,000 cycles. The applicant further stated that the 125-ton auxiliary building crane was upgraded, and incorporated CMAA-70 and ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)," in the new design and noted that the ASME Code does not require any reduction in allowable stresses due to fatigue for less than 20,000 cycles over the life of the crane.

The applicant stated that it has determined a conservative estimate of the crane usage to be less than 800 significant lifts (i.e., lifts greater than 25 percent of the capacity) for the containment building polar crane, turbine building crane, and auxiliary building crane over the 40-year period of operations. This is considerably less than 20,000 full load cycles. Therefore, the applicant concluded that the crane load cycle TLAA remains acceptable, in accordance with the requirements of 10 CFR 54.21(c)(1)(i).

4.7.1.2 Staff Evaluation

The staff reviewed LRA Section 4.7.1, pursuant to 10 CFR 54.21(c)(1)(i), to verify that the analyses remain valid for the period of the extended operation. According to LRA Section 4.7.1, the 230-ton polar crane, 125-ton turbine building crane, and 125-ton auxiliary building crane are all within the scope of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," and have been evaluated according to CMAA. The applicant further stated in LRA Section 4.7.1 that these cranes will be used to lift significant heavy loads (greater than 25 percent of the rated capacity) less than 800 times during the current licensing period of 40 years, and the expected number of lifts at the end of the period of extended operation (60 years) is not likely to exceed 1,200. The staff noted that this is considerably less than the lower bound of the crane design life of 20,000 cycles. Therefore, the crane load cycle TLAA remains acceptable, in accordance with the requirements of 10 CFR 54.21(c)(1)(i).

4.7.1.3 USAR Supplement

The applicant provided a USAR supplement summary description of its TLAA evaluation for the crane load cycle limit in LRA Section A.3.5.1. On the basis of its review of the USAR supplement, the staff concludes that the summary description of the applicant's actions to address the crane load cycles is adequate because the number of significant lifts over the 60-year period of operation will not exceed the original design limit of 20,000 cycles.

4.7.1.4 Conclusion

Based on its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that the crane load cycle analyses remain valid for the 60-year period of operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.7.2 Reactor Coolant Pump Flywheel

4.7.2.1 Summary of Technical Information in the Application

LRA Section 4.7.2 states the potential for crack propagation in the reactor coolant pump motor flywheel was evaluated due to the potential for flywheel failure that could inhibit pump coast down or result in missile generation. The applicant stated that WCAP-14535 updated the original flywheel crack growth analysis to credit the LBB analysis that results in a limited postulated break size and lower reactor coolant pump overspeed conditions, and to account for a 60-year operating life of the motor flywheel. The applicant further stated the evaluation established a basis for the elimination of the 40-month inservice inspection (ISI) requirements for the flywheel.

The applicant stated that WCAP-14535 was reviewed and approved by the staff and reissued as WCAP-14535-A, which includes the NRC SER and response to NRC RAIs. The applicant further stated that in the safety evaluation, the staff continued to require a flywheel inspection to be performed on a reduced frequency of 10 years. Subsequently, WCAP-15666 was developed to provide a technical basis and risk assessment for extending the flywheel inspection interval to 20 years in order to coincide with the typical 10- to 15-year reactor coolant pump motor refurbishment schedule and this evaluation was reviewed and approved by the NRC and reissued as WCAP-15666-1A.

The applicant stated the reactor coolant pump motor flywheels are inspected on a 20-year frequency through its ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program. The applicant further stated the potential aging effect of cracking will be managed with the application of an AMP for the period of extended operation such that the reactor coolant pump motor flywheel crack growth TLAA is resolved, in accordance with 10 CFR 54.21(c)(1)(iii).

4.7.2.2 Staff Evaluation

The staff reviewed LRA Section 4.7.2 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended functions of the reactor coolant pump flywheel will be adequately managed for the period of extended operation.

The staff noted that Topical Report WCAP-15666-1A provides analyses of the fatigue crack initiation and growth in the flywheel bore keyway from stresses due to starting the motor. The staff further noted that based on the results of the analyses, the fatigue crack growth in the flywheel after 6,000 starts of the reactor coolant pump (60-year plant life) was determined using the approved methodology of the ASME Code Section XI is negligible (0.08 inch) even when assuming a conservative initial crack length of 10 percent through the flywheel.

In its safety evaluation, dated May 5, 2003, "Safety Evaluation of Topical Report WCAP-15666, 'Extension of Reactor Coolant Pump Motor Flywheel Examination' (TAC NO. MB2819)," the staff determined the reactor coolant pump flywheel conditional failure probability analysis in the report to be conservative in its assumptions of input parameters (e.g., pump motor revolutions per minute, number of cycles per year, initial crack length) required to predict critical crack sizes through the period of extended operation, and that this probabilistic approach supported the negligible fatigue crack growth analysis previously mentioned. The staff finds the fatigue crack growth TLAA for the applicant's reactor coolant pump flywheels to be in accordance with 10 CFR 54.21(c)(1)(iii), and that the effects of aging on the intended functions of the reactor coolant pump flywheel will be adequately managed for the period of extended operation by the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program, and finds it to be acceptable on the basis of the staff's acceptance of the WCAP-15666 analyses.

4.7.2.3 USAR Supplement

The applicant provided the USAR supplement summarizing its TLAA evaluation of reactor coolant pump motor flywheel fatigue crack growth analysis in LRA Section A.3.5.2. Based on its review of the USAR supplement, the staff concludes that the applicant has provided an adequate summary description of its actions to address the fatigue evaluation of the reactor coolant pump motor flywheel fatigue crack growth analysis.

4.7.2.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the reactor coolant pump motor flywheel fatigue crack growth analysis will be adequately managed during the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.7.3 Leak-Before-Break

4.7.3.1 Summary of Technical Information in the Application

In LRA Section 4.7.3, the applicant stated that Criterion 4 of 10 CFR Part 50, Appendix A allows for the use of the LBB methodology for excluding the dynamic effects of postulated ruptures in RCS piping. The applicant stated that it referred to LBB guidance methodology contained in NUREG-1061, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee," Volume 3, and NUREG-0800, "Standard Review Plan," (SRP) Section 3.6.3. The applicant also stated that, based upon the fundamental premise of LBB methodology that the materials used in nuclear power plant piping are sufficiently tough enough to withstand a large through-wall crack, remaining stable without progressing to a double-ended pipe rupture, it limited application of the LBB methodology "to those high-energy fluid systems not considered to be susceptible to failure from such mechanisms as corrosion, water hammer, fatigue, thermal aging; or indirectly from such causes as missile damage or the failure of nearby components."

The applicant stated that it applied LBB methodology to the following piping systems: reactor coolant loop piping, pressurizer surge line piping, and reactor coolant loop branch piping, including portions of the SI and RHR systems.

Finally, the applicant stated that since there are time-based inputs to its LBB analyses (consisting of both thermal aging effects of cast austenitic stainless steel (CASS) materials and thermal and mechanical cycling assumptions of fatigue crack growth predictions) and the factors typically reflect a 40-year lifetime, it concluded it would treat its LBB analyses as TLAAs and evaluate them for the period of extended operation.

4.7.3.2 Staff Evaluation

Pursuant to 10 CFR 54.21(c)(1)(i), the staff reviewed LRA Section 4.7.3 to verify that the applicant's TLAA of LBB analyses for the reactor coolant loop piping, pressurizer surge line piping, and reactor coolant loop branch piping remain valid for the period of extended operation. Pursuant to 10 CFR 54.21(c)(1)(iii), the staff verified that the effects of aging on the intended function of the subject piping will be adequately managed for the period of extended operation. The TLAA of the LBB piping and associated analyses are fatigue crack growth analyses of the subject piping and thermal aging of the CASS material of the RCS components because these two issues are time-dependent. In addition, the staff also reviewed the impact of primary water stress-corrosion cracking (PWSCC) and power uprate on the subject piping. As part of its review, the staff asked the applicant to address the current status of the LBB piping structural integrity, the inspection history and results of the LBB piping, and future inspection schedules for each of the LBB pipes. By letter dated August 6, 2009, the applicant responded that the piping in the scope of the LBB analyses at KPS has been inspected in accordance with the requirements of the approved ASME Code Section XI ISI program since initial plant operation. This piping is subject to the inspection requirements of the Inservice Inspection Program through the period of extended operation. There are currently no identified unresolved reportable indications or flaws existing in this LBB piping. The staff finds that the LBB piping has maintained structural integrity because there are no reportable indications in the subject LBB piping. The applicant will follow the ASME Code Section XI ISI program to perform necessary inspection during the period of extended operation. Therefore, the staff finds that the structural integrity of LBB piping has been, and will be, maintained satisfactorily.

LRA Section 4.7.3.1, "LBB-Reactor Coolant Loop Piping," states that the LBB evaluations have been updated to support the power uprate program and steam generator replacement. In a letter dated July 7, 2009, the staff issued RAI 4.7.3.1-1 requesting that the applicant address the impact of the power uprate and steam generator replacement on all the LBB piping (including branch lines and surge line) and fatigue flaw growth analysis at the end of 60 years.

The applicant responded to the RAI by letter dated August 6, 2009, stating that the KPS power uprate and steam generator replacement projects were completed in 2004 and 2001, respectively. The applicant further stated that the impact of power uprate and steam generator replacement on the plant, including the LBB analyses, were evaluated and incorporated into the CLB at the time these projects were completed. The applicant submitted proprietary and non-proprietary versions of a Westinghouse report, WCAP-16738-P and WCAP-16738-NP, respectively, "Technical Bases for Eliminating Large Primary Loop Pipe Rupture as the Structural Design Basis for the Kewaunee Power Station for the License Renewal Program"

(ADAMS Accession No. ML092230619). The report evaluated the impact that an additional 20 years of plant operation would have on the reactor coolant loop and pressurizer surge line LBB analyses, with consideration of power uprate and steam generator replacement.

The staff finds that the WCAP-16738 report includes the operating conditions of power uprate in analyzing reactor coolant loop piping, including the branch piping, during the period of extended operation. The report showed that the subject LBB piping maintains the safety margin of SRP Section 3.6.3 and is, therefore, acceptable.

LRA Section 4.7.3.1 states that Westinghouse has updated the LBB analysis to support the steam generator replacement project in WCAP-15311 and the power uprate program in WCAP-16040-P. LRA Section 4.7.3.1 states that a review of the above documents identified that the fracture toughness values for the CASS loop piping were based on a 40-year plant service life. LRA Section 4.7.3.1 further states that the fracture toughness for the fully-aged condition was used and that mechanical properties were determined at operating temperatures. By letter dated July 7, 2009, the staff issued RAI 4.7.3.1-2 requesting that the applicant discuss whether the fracture toughness values used in the LBB evaluations were the values at the end of the 60-year plant life. The staff also questioned why the mechanical properties were determined at operating temperatures and not at the temperature at faulted conditions.

By letter dated August 6, 2009, the applicant responded to RAI 4.7.3.1-2 and stated that, as indicated in LRA Section 4.7.3.1, fully-aged fracture toughness values were used in the updated LBB analysis. "Fully-aged" refers to the cast stainless steel fracture toughness properties corresponding to the maximum thermal aging condition, whcih is determined based on the methodology presented in NUREG/CR-4513, Revision 1, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems." Accordingly, the fully-aged material fracture toughness values used in the LBB evaluation are conservative and envelop the material condition at the end of the 60-year plant life. The applicant stated that there is no CASS material in the pressurizer surge line piping or the reactor coolant loop branch line piping.

The fracture toughness of cast stainless steel is adversely affected by long-term exposure to a high temperature environment, resulting in thermal embrittlement. Since faulted conditions are short-lived, the long-term high temperature environment that the reactor coolant loop piping is exposed to is the normal reactor coolant operating temperature. For this reason, the short-lived faulted conditions are not expected to contribute significantly to thermal embrittlement of the piping. Therefore, the mechanical properties were determined using the normal operating temperatures.

The staff finds that the applicant used, in the LBB analyses, the fully-aged fracture toughness values of the CASS corresponding to the worst thermal aging condition, which bounds the thermal aging from 60-year operation. This is conservative and is acceptable. The staff also finds that the mechanical properties taken at normal operating temperature are reasonable values to use in the LBB evaluation because it is the normal operating conditions that contribute significantly to thermal embrittlement of the CASS.

LRA Section 4.7.3.1 states that the LBB analysis for the period of extended operation is discussed in Westinghouse report WCAP-16738. The applicant stated that the report documents the plant-specific geometry, operating parameters, loading, and material properties used in the fracture mechanics evaluation. However, it was not clear to the staff as to the impact of 60-year operation on the above parameters in the original LBB analysis. Also, the staff questioned whether WCAP-16738 considered the effects of power uprate and steam generator replacement. By letter dated July 7, 2009, the staff issued RAI 4.7.3.1-3 to request this information.

By letter dated August 6, 2009, the applicant clarified that the impact of 60-year operation is potentially significant to CASS piping material properties (i.e., fracture toughness) due to the prolonged exposure to a high temperature environment resulting in thermal aging of the material. The reactor coolant loop piping includes CASS material and has been evaluated for the effects of thermal aging. As indicated in LRA Section 4.7.3.1, thermal aging resulting from 60-year operation was considered in the LBB analysis for the reactor coolant loop piping and the results of the analysis were found to remain acceptable.

During the period of extended operation, there are no anticipated changes to operating parameters or loading on the reactor coolant loop piping, surge line piping, or reactor coolant loop branch line piping for which there are LBB analyses. Therefore, there is no impact due to 60-year operation on operating parameters and loadings for this piping.

The staff finds that the applicant has clarified that there are no anticipated changes to operating parameters or loading on the subject LBB piping until the end of the period of extended operation. Therefore, this issue is closed.

LRA Section 4.7.3.2, "LBB–Pressurizer Surge Line Piping," discusses the applicant's evaluation of the pressurizer surge line. Operating experience in PWRs has shown that thermal stratification in the surge line has occurred, which can affect the structural integrity of the surge line piping. By letter dated July 7, 2009, the staff issued RAI 4.7.3.2-1 requesting that the applicant discuss operating procedures implemented to prevent or mitigate thermal stratification events. By letter dated August 6, 2009, the applicant responded that as discussed in LRA Section 4.7.3.2, the pressurizer surge line crack growth predictions were based on the design-basis operational transients for the NSSS, including the effects of thermal stratification. KPS operating procedures have historically limited the temperature difference between the reactor coolant loop and the pressurizer during plant startup and shutdown to minimize the effects of pressurizer insurge and outsurge and thermal stratification in the surge line. LRA Section 4.3.1.4, "Pressurizer Lower Head and Surge Line," states that operating procedures were changed at the end of Cycle 28 (March 2008). These changes were implemented to further limit differential temperature between the reactor coolant loop and the pressurizer, and reduce the occurrence of pressurizer insurge and outsurge and surge line thermal stratification.

The staff finds that the applicant has implemented the necessary procedures to minimize thermal stratification in the surge line and has analyzed the surge line including thermal stratification loadings. Therefore, the issue regarding the impact of thermal stratification is closed.

LRA Section 4.7.3.3, "LBB–Reactor Coolant Loop Branch Piping," states that the fatigue growth evaluation for the 8-inch RHR lines and the 12-inch SI accumulator lines show that only a limited number of RHR initiation transients could be tolerated. The applicant stated further that growth of a postulated crack would remain well within critical crack size limits for a period of 10 years. By letter dated July 13, 2009, the staff issued RAI 4.7.3.3-1 requesting that the applicant clarify why the 8-inch and 12-inch branch piping can tolerate only a limited number of RHR initiation transients, but the analysis still concludes that growth of a postulated crack would remain well within the critical crack size.

By letter dated August 6, 2009, the applicant responded that the growth of postulated surface cracks by fatigue was evaluated in the reactor coolant branch lines LBB analysis, entitled, "Leak-Before-Break Evaluation 6-inch to 12-inch Safety Injection and Residual Heat Removal Piping Attached to the RCS (Kewaunee Nuclear Power Plant)," SIR-00-045, which is consistent with the guidance provided in NUREG-1061, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee," Volume 3, Section 5.6, "Crack Growth Analysis."

The applicant stated that since the branch line piping was designed to the requirements of American National Standards Institute (ANSI) B31.1, 1967 Code (code of record), no specific fatigue evaluation or transient definitions exist in the design basis for the branch piping. Transient information specific to the LBB analysis was developed to perform the crack growth evaluation. The transients used in the crack growth evaluation consist of those specified for the ASME Code Class 1 vessel analyses as described in LRA Section 4.3.1.1, "Component Design Transient Cycles," and three additional thermal cycles specific to the operational conditions for this piping: RHR operation, refueling flood-up, and high head SI initiation. The RHR operation thermal cycle was assumed to occur coincident with each heatup or cooldown cycle.

For the 12-inch SI accumulator line, when initial flaw sizes meeting the ASME Code Section XI acceptance standards are postulated (i.e., 11 percent through-wall), the crack growth evaluation concluded that the ASME Code allowable flaw size limit could be reached after 38 heatup and cooldown cycles at the worst-case location. For the 8-inch RHR line, the crack growth evaluation concluded that the ASME Code allowable flaw size limit could be reached after 123 heatup or cooldown cycles at the worst-case location. These total allowable cycle occurrences are less than the design number of heatup and cooldown cycles specified for the 40-year life of the plant. Therefore, the LBB analysis for the reactor coolant loop branch lines concluded that a postulated 11 percent through-wall flaw could potentially grow to greater than the ASME Code allowable flaw size within a 40-year period. However, these heatup and cooldown cycle occurrences are greater than the number expected for a 10-year period (13 for the 10 years preceding the development of the LBB analysis). Therefore, the analysis concluded that the postulated flaw would not exceed the ASME Code allowable flaw size limit within a 10-year period and that the 10-year inspection intervals of the ASME Code Section XI ISI program would effectively manage the potential for flaw growth.

The SI and RHR piping remain within their design bases since all of the design requirements continue to be met in accordance with the code of record. The LBB analysis limitation with regard to heatup or cooldown cycles results from the conservative fatigue crack growth evaluation which postulates a pre-existing large flaw. There have been no reportable indications identified during the inspections performed to date.

The applicant stated that based on the assessment included in the LBB analysis for this piping, the time required for a postulated large flaw to reach the Code-allowable flaw size would be approximately 30 years (i.e., 38 allowable heatups and cooldowns per 13 cycles per 10 years). Revision 1 of the applicant's Calculation SIR-00-045 (reviewed by the NRC and approved in a letter dated September 5, 2002) included the fatigue crack growth evaluation of the 8-inch RHR and 12-inch SI piping. Revision 2 of SIR-00-045 documents that the KPS power uprate was evaluated and that the conclusions of the LBB analysis are not affected.

The staff finds that the crack growth analysis for the 8-inch and 12-inch piping shows that it would take about 30 years for the postulated flaw to reach the allowable flaw size. During that time, the piping will be inspected every 10 years in accordance with the ASME Code Section XI

ISI program. The staff finds that the inspections will be able to monitor the structural integrity of the piping and, therefore, this issue is closed.

LRA Section 4.7.3.3 states that, "Since the time-based input for the crack growth analysis for these lines is less than 40 years, the crack growth analysis associated with these branch lines does not constitute a TLAA according to 10 CFR 54.3(a)(3)." The staff had reservations with the applicant's position that the crack growth analysis for the branch piping is not a TLAA. In general, a crack growth analysis assumes an initial flaw size. The flaw is assumed to grow to the end of the plant life based on a certain growth rate to determine whether the final flaw size at the end of plant life will still be within the allowable flaw size. In LRA Section 4.7.3.3, the crack growth is based on the fatigue mechanism. For the fatigue mechanism, transient cycles for 40 years (60 years for the LRA) should be used in combination with the fatigue crack growth rate to derive the final flaw size. The staff questioned why a crack growth analysis was performed for the time-based input that is less than 40 years, but not 60 years.

In 10 CFR 54.3(a)(3), it states that a TLAA is applicable if it "Involve[s] time-limited assumptions defined by the current operating term, for example 40 years." The applicant contends that the crack growth analysis of the subject 8-inch and 12-inch piping did not use a time-based input for 40 years; therefore, the crack growth analysis would not be considered a TLAA. The staff believes that time-limited assumptions, not time-based inputs (that are less than 40 years), should be the criterion to satisfy the criterion in 10 CFR 54.3(a)(3) that the crack growth analysis is not a TLAA. It appears that the original crack growth analysis used transient cycles less than 40 years so that the final flaw size could satisfy the allowable flaw size. The "less than 40-year transient cycles" is not an assumption but an input to the analysis. Therefore, the staff did not agree with the applicant that the crack growth analysis of the subject LBB piping is not a TLAA. By letter dated July 13, 2009, the staff issued RAI 4.7.3.3-2 to ask the applicant for clarification.

By letter dated August 6, 2009, the applicant responded that the purpose of the review of TLAAs in the LRA is to ensure that the results of plant-specific analyses that are based on an explicitly assumed 40-year plant life remain valid for the additional 20 years of plant operation to be authorized by the renewed license. The fatigue crack growth evaluation for the 12-inch SI and 8-inch RHR lines was performed as part of the reactor coolant branch lines LBB analysis. Based on the ASME Code Section XI ISIs performed during the 10-year interval, only a 10-year time period was ultimately considered for the fatigue crack growth evaluation of these lines. Since the fatigue crack growth evaluation considered a time period less than the current operating term (i.e., 40 years), it was initially concluded that the evaluation did not meet the criteria in 10 CFR 54.3(a)(3) and, therefore, was not a TLAA.

However, based on staff concerns, the applicant amended the LRA to include the fatigue crack growth evaluation for the 12-inch SI and 8-inch RHR lines as a TLAA. As described in LRA Section 4.7.3.3, the 12-inch SI and 8-inch RHR lines are inspected in accordance with the ASME Code Section XI ISI program, as described in LRA Appendix B, Section B2.1.2, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD."

Therefore, fatigue crack growth is managed by the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program and the LBB analysis crack growth evaluation TLAA for the 12-inch SI and 8-inch RHR lines and is acceptable for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

The staff finds that the applicant has amended the LRA by including the fatigue crack growth evaluation for the 8-inch RHR lines and 12-inch SI lines as a TLAA. In addition, the applicant will follow the inspection requirements of ASME Code Section XI to monitor the condition of the subject piping. Therefore, this issue is closed.

LRA Section 4.7.3.3 states that, "The fatigue crack growth conclusions are not affected by the extended plant service life since the original design-basis transient has been shown to be bounding for the period of extended operation in Section 4.3.1.1, Component Design Transient Cycles." By letter dated July 13, 2009, the staff issued RAI 4.7.3.3-3 requesting that the applicant discuss how the actual transient cycles are monitored to verify that the design transient cycles used in the LBB evaluations bound the actual operating transients at the end of 60 years.

By letter dated August 6, 2009, the applicant responded that as indicated in LRA Sections 4.7.3.1, 4.7.3.2, and 4.7.3.3, the fatigue crack growth evaluations of the LBB analyses were based on the design-basis operational transients for the NSSS. The branch line LBB analysis also included additional transients defined specifically for these lines. The design-basis operational transients have been shown to be bounding for the period of extended operation as shown in LRA Section 4.3.1.1, "Component Design Transient Cycles."

LRA Section 4.3.1.1 provides the approach to monitoring design-basis operational transients using the Metal Fatigue of Reactor Coolant Pressure Boundary Program. As described in LRA Appendix B3.2, the program monitors actual transients and components. Specifically, the design-basis operational transients are tracked and the number of occurrences is evaluated against the design basis to assure that actual plant operation remains bounded by the assumptions used in the design analyses.

The staff finds that the applicant has implemented specific AMPs to monitor the actual transients to ensure that the design-basis transients are bounding in the LBB evaluations. This issue is closed.

LRA Section 4.7.3.3 states that the inspection of the 8-inch RHR lines and the 12-inch SI accumulator lines every 10 years, in accordance with the ASME Code Section XI, would effectively manage cracking in this piping such that a crack greater in size than that postulated in the fatigue growth analysis would not be present at the start of the 10-year interval. It appears that the 10-year ISI is a part of the applicant's technical basis for not considering the crack growth analysis as a TLAA. By letter dated July 13, 2009, the staff issued RAI 4.7.3.3-4 requesting that the applicant clarify how these two piping systems will be inspected during the period of extended operation to ensure their structural integrity to the end of 60 years.

By letter dated August 6, 2009, the applicant stated that there are two 12-inch SI lines and two 8-inch RHR lines that were evaluated for fatigue crack growth in the LBB analyses and that are subject to inspection in accordance with the ASME Code Section XI ISI program. There are a total of 6 welds in the two 12-inch SI lines and a total of 17 welds in the two 8-inch RHR lines. Weld selection for inspection is performed in accordance with the ASME Code Section XI requirements for sample size and selection and does not depend upon calculated stress levels or fatigue crack growth evaluation results. The examination method is currently ultrasonic testing.

The applicant stated that inspections of the subject piping in accordance with the ASME Code Section XI is a CLB commitment that will continue to apply through the period of extended operation, thus, there is no new commitment established specifically for license renewal. Each of the welds in these lines was ultrasonically examined in accordance with the ASME Code

Section XI preservice inspection requirements. Additionally, each of these weld locations, with the exception of one inaccessible weld (i.e., RHR W-7) in an 8-inch RHR line have either been inspected in the first three intervals or are scheduled for inspection in the fourth inspection interval. Each accessible weld location will have been inspected twice, ensuring that degradation, if present, would have been detected. The examination inaccessibility of weld RHR W-7 was caused by an integrally welded rigid pipe restraint. The examination of weld RHR W-7 was managed under the risk-informed ISI program. There were no reportable indications identified during the inspections that have been performed.

Since the fifth and sixth 10-year ISI program plans are to be developed and approved in the future, it is not currently known which RHR or SI accumulator pipe welds will be inspected during the period of extended operation. However, the ISI program is in place and will continue to remain in place during the period of extended operation.

The staff finds that the applicant will inspect the subject 8-inch and 12-inch piping in accordance with the requirements of the ASME Code Section XI, to maintain the structural integrity of the subject LBB piping. Therefore, the staff finds that the applicant's inspection of the subject piping is acceptable.

PWR plants have experienced PWSCC in Alloy 82/182 dissimilar metal welds in ASME Code Class 1 piping. PWSCC has an aggressive crack growth rate and is an active degradation mechanism in Alloy 82/182 dissimilar metal welds. NUREG-1061, Volume 3 and SRP Section 3.6.3 prohibit the LBB application on piping having active degradation mechanisms. By letter dated July 13, 2009, the staff issued RAI 4.7.3-2 requesting that the applicant address potential PWSCC in Alloy 82/182 dissimilar metal welds in the LBB piping.

By letter dated August 6, 2009, the applicant responded that the only Alloy 82/182 dissimilar metal welds in the LBB piping at KPS are the steam generator primary nozzle-to-reactor coolant loop piping welds. These welds are clad in the inside diameter surface of the pipe with Alloy 52/152 weld material such that the Alloy 82/182 material is not exposed to the reactor coolant environment. Therefore, the Alloy 82/182 weld material should not experience PWSCC in this application and no mitigative actions are required to ensure that PWSCC will not affect the structural integrity of the LBB piping. The staff notes that Alloy 52/152 weld material provides improved resistance to PWSCC than that of Alloy 82/182 weld material. At present, the industry uses Alloy 52/152 as the repair weld material to mitigate PWSCC in piping. As such, the Alloy 52/152 weld material will isolate Alloy 82/182 from primary water to mitigate the potential for PWSCC. The staff finds that the applicant has minimized the potential for PWSCC in Alloy 82/182 dissimilar metal welds in the steam generator primary nozzle-to-reactor coolant loop piping by Alloy 52/152 cladding. This issue is closed.

The staff identified two discrepancies in LRA Section 4.7.3. By letter dated August 6, 2009, the applicant responded that the citation of NUREG-1031, Volume 3 in LRA Section 4.7.3 is the result of a typographical error. The correct reference is NUREG-1061, Volume 3. In addition, the applicant responded that the citation of WCAP-14111 (LRA Reference 4.8-15) is the result of a typographical error. The correct document number is WCAP-11411.

The staff concludes that the TLAA of the LBB analyses is acceptable and that the LBB analyses are valid for the period of extended operation because: (1) the applicant used worst case fracture toughness values to analyze CASS reactor coolant loop piping in the LBB analysis, (2) the applicant will monitor the transient cycles to ensure that they are within the design transient cycles used in the LBB analyses, and (3) the subject LBB piping continues to satisfy the SRP Section 3.6.3 margins using power uprate and post-steam generator replacement conditions. The applicant also has addressed the potential for PWSCC in Alloy 82/182 dissimilar metal welds satisfactorily.

4.7.3.3 USAR Supplement

The applicant provided a USAR supplement summary description of its TLAA of the LBB analyses for the reactor coolant loop piping, pressurizer surge line piping, and reactor coolant loop branch piping, including portions of the SI and RHR systems in LRA Section A.3.5.3. On the basis of its review of the USAR supplement in LRA Section A.3.5.3, the staff concludes that the summary description of the applicant's actions to address the TLAA for LBB analyses of the subject LBB piping is adequate.

4.7.3.4 Conclusion

On the basis of its review, the staff concludes that, pursuant to 10 CFR 54.21(c)(1)(i), the applicant has demonstrated that the LBB analyses for the reactor coolant loop piping, pressurizer surge line piping, and reactor coolant loop branch piping, including portions of the SI and RHR systems, remain valid for the period of extended operation. Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant has demonstrated that the effects of aging on the intended function of the subject LBB piping will be adequately managed for the period of extended operation. The USAR supplement contains an appropriate summary description of the TLAA evaluation of the subject LBB piping, as required by 10 CFR 54.21(d).

4.7.4 Reactor Vessel Underclad Cracking

4.7.4.1 Summary of Technical Information in the Application

In LRA Section 4.7.4, the applicant stated that the transient list which was used in WCAP-15338-A, "A Review of Cracking Associated with Weld Deposited Cladding in Operating PWR Plants," has been compared to the operational transients list in KPS USAR Table 4.1-8, "Reactor Coolant System Operating Transients," and it was determined that the WCAP transient set is bounding for the KPS RPV. The transients listed in USAR Table 4.1-8 have been shown to be bounding for the period of extended operation in LRA Section 4.3.1.1, "Component Design Transient Cycles." Thus the WCAP-15338 conclusions related to underclad cracking are determined to be applicable to the KPS RPV. Therefore, the reactor vessel underclad cracking TLAA remains valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

4.7.4.2 Staff Evaluation

Underclad cracks were first discovered in October 1970 during examination of the Atucha reactor vessel. They have been reported to exist only in SA-508, Class 2 RPV forgings manufactured with a coarse grain microstructure and clad by high heat input submerged arc welding processes. The underclad cracking issue was first addressed by Westinghouse Topical Report WCAP-7733, "Reactor Vessels Weld Cladding - Base Metal Interaction," which justified the continued operation of Westinghouse plants for 32 EFPYs. Subsequently, Westinghouse submitted WCAP-15338-A, which extended the analysis to justify operation of Westinghouse plants for 60 years of plant operation. The staff review of WCAP-15338-A is contained in a

September 25, 2002, letter to R.A. Newton (Westinghouse Owners Group) and concluded that LRAs should include the following two action items:

(1) The license renewal applicant is to verify that its plant is bounded by the WCAP-15338-A report. Specifically, the renewal applicant is to indicate whether the number of design cycles and transients assumed in the WCAP-15338-A analysis bounds the number of cycles for 60 years of operation of its RPV.

(2) As required by 10 CFR 54.21(d), a USAR supplement for the facility must contain a summary description of the programs and activities for managing the effects of aging and the evaluation of the TLAA for the period of extended operation. Those applicants for license renewal referencing the WCAP-15338-A report for the RPV components shall ensure that the evaluation of the TLAA is summarily described in the USAR supplement.

The NRC safety evaluation for WCAP-15338-A requires the applicant to verify that its plant is bounded by the WCAP report. LRA Section 4.7.4 states that the applicant compared the WCAP-15338-A transients with the KPS operational transients and determined that the WCAP-15338-A transients bound the KPS transients for 60 years. The applicant did not, however, provide information regarding how the comparison was performed to arrive at this conclusion. Therefore, the staff issued RAI 4.7.4-1 by letter dated August 28, 2009.

RAI 4.7.4-1:

LRA Section 4.7.4, "Reactor Vessel Underclad Cracking," states that the applicant compared the transients utilized in the WCAP-15338-A report, with the Kewaunee operational transients and determined that the WCAP-15338-A transients bound the Kewaunee transients. Please elaborate on this comparison using a couple of examples (transients) to substantiate the conclusion.

In its response dated September 28, 2009, the applicant stated that the assumed number of occurrences of the transients used as input to the WCAP-15338-A report was compared to the NSSS operational transients included in USAR Table 4.1-8 to determine whether the WCAP-15338-A inputs were bounding for KPS. Two examples were provided: (1) the number of heatup and cooldown transients of 300 each for 60 years used in the WCAP-15388-A report bounds the number of heatup and cooldown transients listed in USAR Table 4.1-8 (i.e., 200 each), and (2) the number of loss of power transient occurrences of 60 for 60 years used in the WCAP-15388-A report bounds the 40 operating transient value listed in USAR Table 4.1-8. Additionally, the transients listed in USAR Table 4.1-8 have been shown to be bounding for a 60-year plant lifetime as described in LRA Section 4.3.1.1. Based on this information, the staff considers that RAI 4.7.4-1 has been resolved and agrees with the applicant that the WCAP-15338-A conclusions related to underclad cracking are applicable to the KPS RPV and that this TLAA is in accordance with 10 CFR 54.21(c)(1)(i).

4.7.4.3 USAR Supplement

On the basis of the staff's evaluation described above, the summary description for the RCS TLAA for RPV unclad cracking described in the USAR supplement (LRA Appendix A) provides an adequate description of this TLAA, as required by 10 CFR 54.21(d).

4.7.4.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that for RPV underclad cracking, the WCAP-15338-A analysis applies to KPS and the analyses remain valid for the period of extended operation. The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.7.5 Reactor Coolant Loop Piping Flaw Tolerance Evaluation

4.7.5.1 Summary of Technical Information in the Application

LRA Section 4.7.5 describes the reactor coolant loop piping flaw tolerance evaluation to account for susceptibility of the CASS piping materials to thermal aging embrittlement. The applicant stated that an evaluation of the susceptibility of the loop piping to thermal aging and the potential for flaw growth in the piping due to reduced fracture toughness has been performed consistent with the recommendations of GALL AMP XI.M12, "Thermal Embrittlement of Cast Austenitic Stainless Steel (CASS)." The applicant indicated that the evaluation approach consisted of: (1) screening the CASS material properties for susceptibility to thermal aging embrittlement, and (2) for susceptible materials, performing a plant-specific flaw tolerance evaluation, consistent with the GALL Report and the letter dated May 19, 2000, from Christopher Grimes, NRC, to Douglas Walters, NEI (LRA Reference 4.8-27).

The applicant further stated that evaluation was performed for the susceptible CASS piping locations using plant-specific bounding material properties, geometry, and stresses in each leg (i.e., hot leg, cold leg, and cross-over leg) of the reactor coolant loop piping. Based on the evaluation, the applicant concluded that even in the fully-aged condition, the CASS reactor coolant loop piping has adequate fracture toughness for a minimum service life of 30 years, which envelops the period of extended operation. Therefore, it is not necessary to manage the effects of thermal aging embrittlement of CASS reactor coolant loop piping for the period of extended operation.

However, in LRA Table 4.1-1 the applicant indicated that the reactor coolant loop piping flaw tolerance evaluation does not meet the definition of a TLAA per 10 CFR 54.3.

4.7.5.2 Staff Evaluation

The staff reviewed LRA Section 4.7.5 to evaluate the applicant's claim of consistency with the recommendations of GALL AMP XI.M12. The applicant stated that the loop piping, constructed of ASME SA-351 Grade CF8M with 2–3 percent molybdenum content, consists of centrifugally-cast piping segments and statically-cast elbows, and that the material delta-ferrite did not exceed 25 percent. The applicant further stated that screening results indicated that based on the delta-ferrite content, four statically-cast elbows and one centrifugally-cast pipe were identified to be potentially susceptible to thermal aging embrittlement (i.e., contained more than 14 percent and more than 20 percent ferrite, respectively). The staff noted that the applicant had not mentioned whether the method used to determine the ferrite content of the CASS materials was consistent with the GALL Report, which states that for susceptibility screening, ferrite content is calculated by using the Hull's equivalent factors (described in NUREG/CR-4513, Revision 1), or a method producing an equivalent level of accuracy (plus or minus 6 percent deviation between measured and calculated values). By letter dated October

13, 2009, the staff issued RAI 3.1.2.1.2-1 requesting that the applicant confirm whether the Hull's equivalent factors were used to determine the delta-ferrite content of the CASS materials, and if they were not, verify that the method produced an equivalent level of accuracy.

In its response dated November 13, 2009, the applicant stated that the susceptibility screening for the CASS reactor coolant loop piping was performed consistent with the letter from Christopher Grimes, NRC, to Douglas Walters, NEI, License Renewal Issue No. 98-0030, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components," dated May 19, 2000, with the exception that delta-ferrite content was determined using the method outlined in ASTM A800, "*Standard Practice for Steel Casting, Austenitic Alloy, Ferrite Content Thereof*," rather than the Hull's equivalent factors method identified in the letter. In addition, the applicant provided the following information:

> In accordance with ASTM A800, estimation of ferrite content in the base metal of the reactor coolant loop piping was performed by analysis of the chemical composition of the castings. The ferrite content of the casting was estimated from the equation of the central line of the Schoefer diagram at the composition ratio of "chromium equivalent" (Cre) to "nickel equivalent" (Nie) determined from the formula in ASTM A800. The ASTM A800 Schoefer diagram method details, provided in Appendix XI to the standard, include a description of potential error associated with the estimation of ferrite content based on chemical composition. The probable error determined in the Standard is approximately +3.5%/-2.5% ferrite at ferrite contents of 5%; +4.5%/-3.5% at 10%; +6%/-4.5% at 15%; and +8%/-5.5% at 20% ferrite content. As stated in the NRC License Renewal Issue No. 98-0030 letter dated May 19, 2000, the Hull's equivalent factors method produces results with +/-6% ferrite potential error. The difference in potential error at higher levels of ferrite content between the Hull's equivalent factors method and the Schoefer diagram method provided in ASTM A800 is small, and the Schoefer diagram method used for estimating the ferrite content of the steel was considered to provide an acceptable level of accuracy.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.1.2-1 acceptable because: (1) the applicant provided the information regarding the method used to determine the ferrite content of the CASS reactor coolant loop piping, and (2) the applicant's method to determine ferrite content is in accordance with ASTM A800, which provides an acceptable level of accuracy. The staff's concern described in RAI 3.1.2.1.3-1 is resolved.

In LRA Section 4.7.5, the applicant also stated that for the susceptible CASS piping locations, a flaw tolerance evaluation was performed by using plant-specific bounding material properties, geometry, and stresses in the hot leg, cold leg, and cross-over leg of the reactor coolant loop piping. The applicant further stated that because the delta-ferrite content of the CASS materials does not exceed 25 percent, a flaw evaluation was performed in accordance with the principles associated with IWB-3640 procedures for submerged arc welds (SAW), discarding the Code restriction of 20 percent delta-ferrite content in IWB-3641(b)(1). The staff finds this to be an acceptable approach as stated in the NRC letter from Christopher Grimes to Douglas Walters regarding License Renewal Issue No. 98-0030, dated May 19, 2000 (LRA Reference 4.8-27), because of the similarity between the lower bound fracture toughness data for CF8M steels with 15–25 percent ferrite and the IWB-3640 SAW data. The applicant indicated that the effects of unstable ductile tearing due to the reduced toughness of thermally-aged CASS material are addressed through the use of penalty factors, called "Z factors," in accordance with the

IWB-3640 flaw evaluation procedure and acceptance criteria. The staff finds this consistent with the GALL Report.

The applicant further stated that the results indicated that the limiting initial flaw depth for an aspect ratio of 6 was in the crossover leg (i.e., 28.2 percent through-wall) and that a flaw of this initial size would not grow to critical size (i.e., a size that could result in piping failure at design-basis loading conditions) during an additional 30 years of service. Based on these results, the applicant concluded that even with thermal aging embrittlement of CASS loop piping materials to the fully-aged condition, the susceptible piping locations are tolerant of large flaws. Therefore, the applicant concluded that there is no requirement to manage the effects of thermal aging embrittlement of CASS reactor coolant loop piping for the period of extended operation. The staff finds this methodology to be consistent with GALL AMP XI.M12 and, therefore, acceptable. GALL AMP XI.M12 states, "... for potentially susceptible components, aging management is accomplished through either enhanced volumetric examination or plant-or component-specific flaw tolerance evaluation."

However, in its review, the staff finds that the applicant did not provide sufficient details regarding the stresses in specific pipe sections, cyclic crack growth rates, or bounding fracture toughness of thermally-aged CASS, to verify the applicant's statement that the initial flaw will not grow to critical size, or to check the critical flaw size. For example, the applicant stated that the number of occurrences of design transients considered in the generation of flaw tolerance analysis were based on the revisions for KPS 7.4 percent uprating and steam generator replacement. However, it is not clear to the staff whether the 7.4 percent uprating was also considered in determining the design stresses for the flaw tolerance evaluation. Also, although the applicant stated that the loop piping was constructed of CF-8M steel with less than 25 percent ferrite, the applicant did not confirm whether or not it contained niobium. The staff noted that typically, niobium is not specified in CF-8M steel. The staff further noted that the recommendations of GALL AMP XI.M12 are not applicable to niobium-bearing steels. In addition, the applicant stated that an environmental factor of 2 was applied to the crack growth reference curves for austenitic stainless steel in air to account for the effect of PWR environment on growth rates. However, the applicant did not provide the basis for choosing an environmental factor of 2. The staff noted that several recent studies have reported data showing that the fatigue crack growth rates can be enhanced appreciably in a PWR primary coolant environment at low loading frequencies.

By letter dated October 13, 2009, the staff issued RAI 4.7.5-1 requesting that the applicant: (1) confirm that the loop piping material is not niobium bearing, (2) confirm that the 7.4 percent uprating was considered in determining the design stresses for the flaw tolerance evaluation, and (3) provide details regarding flaw growth analyses, in particular, the technical basis for the choice of the environmental factor of 2 for fatigue crack growth rates in a PWR environment.

In its response dated November 13, 2009, the applicant stated that the reactor coolant loop piping was supplied in accordance with material specification of ASTM A351, Grade CF-8M, which does not require the addition of niobium or columbium. The applicant further stated that the chemical compositions for the loop piping heats were reviewed and there was no indication of niobium content. The applicant also confirmed that the KPS 7.4 percent uprating was considered in determining the design stresses for the flaw tolerance evaluation.

In its response to the request for details regarding the flaw growth analyses associated with the reactor coolant loop piping flaw tolerance evaluation, the applicant stated that the analyses were based on the methods described in the ASME B&PV Code Section XI, Subsection IWB-3640.

The applicant further stated the use of an environmental factor of 2 applied to the crack growth rate determined for austenitic stainless steels in air, to account for the effect of a PWR environment, is based on the factor recommended for the PWR environment in "Evaluation of Flaws in Austenitic Steel Piping—Section XI Task Group for Piping Flaw Evaluation," Transactions of ASME, Journal of Pressure Vessel Technology, Volume 108, August 1986.

Based on its review, the staff finds the applicant's response to RAI 4.7.5-1 acceptable because: (1) the applicant confirmed that its reactor coolant loop piping does not have indications of niobium, (2) the applicant confirmed that the 7.4 percent uprating was considered in determining the design stresses for the flaw tolerance evaluation, and (3) the applicant's analyses were based on the methods described in the ASME Code Section XI, Subsection IWB-3640. The staff's concern described in RAI 4.7.5-1 is resolved. The applicant has demonstrated how a drop in the fracture toughness property will be adequately addressed for components made from these CASS materials.

The staff notes that the applicant has applied fully thermally-aged conditions to the flaw tolerance analysis for these CASS materials, and that the applicant's flaw tolerance analysis assumes, therefore, the most limiting reduced fracture toughness property value (i.e., K_{ic} value) for its analysis. Since the applicant applies the most limiting fracture toughness property value (i.e., the lowest K_{ic} value possible) to the assessment, the staff finds that this aspect of the analysis does not include a time dependency. Based on this review, the staff concludes that the drop in the fracture toughness property value does not need to be treated as a TLAA because, contrary to TLAA identification criterion in 10 CFR 54.3(a)(3),[1] the value used for the analysis does not include a time dependency.

The staff also noted that the applicant has applied the flaw growth analysis aspect of its flaw tolerance for a presumed additional 30 years of licensed operation, which is beyond the remainder of the 40-year current licensed operating period plus the additional 20 years of the period of extended operation. Therefore, the staff concludes that the flaw growth analysis aspect of the flaw tolerance evaluation does not need to be treated as a TLAA because, contrary to the TLAA identification criterion in 10 CFR 54.3(a)(3), the period of applicability for this aspect of the analysis extends beyond what would constitute a 60-year licensed plant life.

Based on this assessment, the staff concurs with the TLAA identification basis in LRA Table 4.1-1, that the flaw tolerance evaluation for the CASS materials does not conform to 10 CFR 54.3(a)(3) (i.e., does not conform to one of the six criteria in 10 CFR 54.3(a) that must be met to define an analysis in the CLB as a TLAA) and that, therefore, this analysis does not need to be identified as a TLAA for this LRA.

4.7.5.3 USAR Supplement

The applicant provided a USAR supplement summary of its evaluation of the susceptibility of CASS reactor coolant loop piping to thermal aging and the potential for flaw growth in the piping due to reduced fracture toughness in LRA Section A3.5.5. Based on its review of the USAR

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[1] As one of the six criteria in 10 CFR 54.3(a) for identifying analyses as TLAAs, Criterion 3 states that, to be identified as a TLAA, the analysis must involve time-limited assumptions defined by the current operating term (for example 40 years). Section III.g.(i) in the Statement of Consideration on 10 CFR Part 54 clarifies what is within the scope and context of the TLAA identification criterion (refer to *Federal Register* Notification Volume 60, Number 88, pages 22461–22495 [May 8, 1995]).

supplement, the staff concludes that the applicant provided an adequate summary description and that the applicant's actions to address reduced fracture toughness of CASS reactor coolant loop piping is adequate, even though this analysis does not need to be identified as a TLAA for this LRA.

4.7.5.4 Conclusion

Based on its review , the staff concludes that the reactor coolant loop piping flaw tolerance evaluation does not need to be identified as a TLAA for the KPS LRA because the analysis does not conform to the TLAA identification criterion in 10 CFR 54.3(a)(3). However, the staff concludes that the analysis description in LRA Section 4.7.5 provides an adequate discussion on why the flaw tolerance analysis for the CASS materials is considered to be capable of addressing thermal aging in the CASS ASME Code Class 1 piping components. Based on this review, and given the application of this analysis to the CASS ASME Code Class 1 piping components, the staff finds that the applicant has provided an acceptable basis for addressing loss of fracture toughness due to thermal aging in these CASS piping components, such that no augmented inspection of the components is necessary beyond what is currently required for these components under the ASME Code Section XI, Table IWB-2500-1. This basis is consistent with the staff's assessment in SER Section 3.1.3.1.2.

4.8 Conclusion for Time-Limited Aging Analyses

The staff reviewed the information in LRA Section 4, "Time-Limited Aging Analyses." On the basis of its review, the staff concludes that the applicant has provided an adequate list of TLAAs, as defined in 10 CFR 54.3. Furthermore, the staff concludes that the applicant demonstrated that: (1) the TLAAs will remain valid for the period of extended operation, as required by 10 CFR 54.21(c)(1)(i); (2) the TLAAs have been projected to the end of the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii); or (3) that the effects of aging on the intended functions will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(c)(1)(iii). The staff also reviewed the USAR supplement for the TLAAs and found that the USAR supplement contains descriptions of the TLAAs sufficient to satisfy the requirements of 10 CFR 54.21(d). In addition, the staff concludes that one plant-specific exemption is in effect that is based on TLAAs and that the applicant has provided an adequate evaluation that justifies the continuation of this exemption for the period of extended operation, as required by 10 CFR 54.21(c)(2).

With regard to these matters, the staff concludes that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB and that any changes made to the CLB, in order to comply with 10 CFR 54.21(c), are in accordance with the Atomic Energy Act of 1954 and NRC regulations.

SECTION 5

REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The U.S. Nuclear Regulatory Commission (NRC or the staff) issued its safety evaluation report (SER) with open items related to the renewal of the operating license for Kewaunee Power Station (KPS) on July 16, 2010. On August 18, 2010, the applicant presented its license renewal application (LRA), and the staff presented its review findings to the Advisory Committee on Reactor Safeguards (ACRS) Plant License Renewal Subcommittee. The staff reviewed the applicant's comments on the SER and completed its review of the LRA. The staff's evaluation is documented in an SER that was issued by letter dated November 4, 2010. Subsequently, the staff received additional information from the applicant dated November 9, 2010, and November 23, 2010, that provided clarifications regarding its Aging Management Programs for Selective Leaching, ASME Section XI Inservice Inspection, and Masonry Wall and Structures Monitoring. The staff's review of this information is documented in sections 3.0.3.1.12, 3.0.3.2.1, and 3.0.3.2.18, respectively, of this SER.

During the 578th meeting of the ACRS held December 2–4, 2010, the ACRS completed its review of the KPS LRA and the staff's SER. The ACRS documented its findings in a letter to the Commission dated January 7, 2011. A copy of this letter is provided on the following pages of this SER section.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

January 7, 2011

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REPORT ON THE SAFETY ASPECTS OF THE LICENSE RENEWAL APPLICATION FOR THE KEWAUNEE POWER STATION

During the 578th meeting of the Advisory Committee on Reactor Safeguards, December 2-4, 2010, we completed our review of the license renewal application for the Kewaunee Power Station (KPS) and the Safety Evaluation Report (SER) prepared by the NRC staff. Our Plant License Renewal Subcommittee also reviewed this matter during its meeting on August 18, 2010. During these reviews, we had the benefit of discussions with representatives of the NRC staff and the applicant, Dominion Energy Kewaunee, Inc. (DEK). We also had the benefit of the documents referenced. This report fulfills the requirements of 10 CFR 54.25 that the ACRS review and report on all license renewal applications.

CONCLUSION AND RECOMMENDATION

1. The programs established and committed to by the applicant to manage age-related degradation provide reasonable assurance that KPS can be operated in accordance with its licensing basis for the period of extended operation without undue risk to the health and safety of the public.

2. The application for the renewal of the operating license of KPS should be approved.

BACKGROUND AND DISCUSSION

KPS is a 2-loop pressurized water reactor of Westinghouse design with a dry, ambient containment. KPS operates at a licensed power output of 1,772 megawatt-thermal. DEK requested renewal of the KPS license for 20 years beyond the current license term, which expires on December 21, 2013. In the SER, the staff documented their review of the license renewal application and other information submitted by the applicant or obtained during three staff audits and a two-week inspection conducted at the plant site. The staff reviewed the completeness of the applicant's identification of structures, systems and components (SSCs) that are within the scope of license renewal; the integrated plant assessment process; the applicant's identification of the plausible aging mechanisms associated with passive, long-lived components; the adequacy of the applicant's Aging Management Programs (AMPs); and the identification and assessment of time-limited aging analyses (TLAAs) requiring review.

The applicant identified the SSCs that fall within the scope of license renewal and performed an aging management review for these SSCs. The applicant will implement 34 AMPs for license renewal. Thirteen AMPs are consistent with the guidance in the Generic Aging Lessons Learned (GALL) Report, seven are consistent with exceptions, eight are consistent with enhancements, five are consistent with both enhancements and exceptions, and one is plant-specific. We reviewed the plant-specific program and the AMP exceptions to the GALL Report, and we agree with the staff that they are acceptable.

The applicant identified the systems and components requiring TLAAs and reevaluated them for the period of extended operation. The staff concluded that the applicant has provided an acceptable list of TLAAs, as defined in 10 CFR 54.3. Furthermore, the staff concluded that in all cases the applicant has met the requirements of the License Renewal Rule by demonstrating that the TLAAs will remain valid for the period of extended operation, or the TLAAs have been projected to the end of the period of extended operation, or the aging effects will be adequately managed for the period of extended operation. We concur with the staff conclusion that the TLAAs have been properly identified and that the required criteria will be met for the period of extended operation.

The staff conducted three license renewal audits and one inspection at KPS. The audits verified the appropriateness of the aging management review, scoping and screening methodology, and associated AMPs. The inspection examined the scoping and screening of non-safety related SSCs and verified the adequacy of the guidance, documentation, and implementation of selected AMPs. The audit and inspection teams also performed independent examinations of KPS condition reports to confirm that plant-specific operating experience has been adequately addressed during the AMP development and implementation processes. Based on the audits and inspections, the staff concluded in the SER that the proposed activities will adequately manage the aging of SSCs identified in the application and that the intended functions of these SSCs will be maintained during the period of extended operation. We agree with this conclusion.

KPS steam generators have divider plates fabricated from Alloy 600. DEK credits its Primary Water Chemistry Program (PWCP) to manage cracking due to primary water stress corrosion cracking (PWSCC) for Alloy 600 steam generator divider plates exposed to reactor coolant. Significant cracking due to PWSCC has been identified in some European steam generator divider plates, even with proper primary water chemistry.

The staff noted that the PWCP alone may not be effective in managing the aging effect of cracking due to PWSCC divider plates. In order to address the staff concerns, the applicant has committed to participate in ongoing industry efforts related to the divider plate cracking issue. Recognizing that the industry resolution is still under development, the applicant will assess the condition of the divider plate assembly in each steam generator by inspection during the period of extended operation, in a time period consistent with the detection of potential PWSCC cracks, and with appropriate examination techniques. We agree with the staff that the applicant has demonstrated that the effects of aging for these components will be adequately managed.

The staff is concerned that for Alloy 600 tubesheet cladding, autogenous welds may not have sufficient PWSCC resistance, even when tubes are made of Alloy 690. The applicant has committed to developing a plan prior to the period of extended operation, to exercise one of two options: 1) Perform an analytical evaluation of the tube-tubesheet region to establish the technical basis for this boundary being maintained even if cracked, and to demonstrate that the weld is not needed for reactor coolant pressure boundary integrity; or 2) Perform a one-time inspection of a representative number of welds in each steam generator. If cracking is identified, cracks will be evaluated or repaired and aging management inspections will be performed for the remaining life of the steam generators. We agree with the staff that this plan should be effective in managing this aging issue.

The applicant has chosen to address environmentally assisted fatigue by demonstrating that the cumulative usage factor (CUF) at the most sensitive locations will remain below 1.0 throughout the period of extended operation, considering both mechanical and environmental effects. Analyses were performed by the applicant. These analyses showed that the CUF at all analyzed locations will remain below 1.0 throughout the period of extended operation. However, the staff challenged the methodology used by the applicant because this methodology does not consider the full stress state on the component. At the request of the staff, the applicant performed additional analyses. These analyses confirmed that the CUF will not exceed 1.0 during the period of extended operation. The applicant also restricted consideration of environmental effects to those locations identified in NUREG/CR-6260. The staff requested that the applicant review its design to confirm that these are the most limiting locations in its plant. The applicant agreed with this request. We concur with this process.

Following issuance of the SER, the applicant submitted commitments that expand the scope and means to detect aging effects in several license renewal programs. The most significant are those summarized below.

The staff has identified industry operating experience which indicates that power cables energized to 480V and higher can experience failures where extended exposure to moisture is a contributing factor. The Inaccessible Medium Voltage Cable Program in Revision 1 to the GALL Report does not recommend testing for inaccessible cables energized to less than 2kV and does not require testing of inaccessible cables that are not normally energized. Although KPS has not experienced any 480V to 35kV power cable failures due to aging, DEK has addressed the staff's concerns by expanding the scope of the Medium Voltage Power Cable Program to include all inaccessible 480V to 2kV power cables, energized and not. This expanded scope of cable monitoring is consistent with the draft Final Revision 2 of the GALL Report we recently reviewed.

The staff has concluded that external visual inspections do not provide adequate assurance that cracking is not present at the internal radius of socket welds in Class 1 small bore piping systems. There are currently no approved industry standard methods or qualified techniques to perform volumetric examinations of these welds. The KPS operating experience indicates that cracking has not occurred in any small bore socket welds. Nevertheless, in addition to visual inspections, DEK will perform volumetric examinations of ten Class 1 socket welds for the period of extended operation. If no industry demonstrated technique is available at the time of inspection, the applicant will perform destructive examinations of at least five socket welds in lieu of volumetric examinations. These commitments provide reasonable assurance that this issue will be adequately addressed.

The staff has noted a number of recent industry events involving leakage from buried and underground piping and tanks within the scope of license renewal. KPS has never experienced a piping failure of in-scope piping; but the circulating water, fire protection, and diesel fuel oil systems have a significant amount of buried piping. Buried steel piping is coated, and recent inspections of excavated fire protection and diesel generator fuel oil piping demonstrate that coatings are in very good condition, with appropriate backfill. The applicant has committed to continue to periodically inspect components in a vault below grade. KPS will maintain availability of cathodic protection of the buried portions of the circulating water system and 400 feet of buried fuel oil piping at least 90 percent of the time. National Association of Corrosion Engineers (NACE) surveys of cathodic protection will be conducted during the period of extended operation. Visual inspections will be performed on portions of all buried piping and one of the three fuel oil storage tanks within each 10 year period starting 10 years prior to the period of extended operation. The staff has concluded that, with these enhancements, the proposed program will adequately monitor and manage the aging of buried piping and tanks. We agree with this conclusion.

We agree with the staff that there are no issues related to the matters described in 10 CFR 54.29(a)(1) and (a)(2) that preclude renewal of the operating license for KPS. The programs established and committed to by DEK provide reasonable assurance that KPS can be operated in accordance with its current licensing basis for the period of extended operation without undue risk to the health and safety of the public. The DEK application for renewal of the operating license for KPS should be approved.

Sincerely,

/RA/

Said Abdel-Khalik
Chairman

References:

1. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the License Renewal of Kewaunee Power Station," November 2010 (ML103090024)

2. Letter from David A. Christian, dated August 12, 2008, "Dominion Energy Kewaunee, Inc. (DEK) Kewaunee Power Station Application for Renewed Operating License" (ML082341020)

3. Letter from Ann Marie Stone dated November 12, 2009, "Kewaunee Power Station - NRC License Renewal Scoping, Screening, and Aging Management Inspection Report 05000305/2009007" (ML093160727)

4. Letter from Samuel Hernandez dated August 12, 2009, "AMP Audit Report Regarding the Kewaunee Power Station License Renewal Application" (ML091900449)

5. Letter from Samuel Hernandez dated December 14, 2009, "Work Control Process Aging Management Program Audit Report Regarding the Kewaunee Power Station License Renewal Application" (ML093260003)

6. Letter from Samuel Hernandez dated July 13, 2009, "Scoping and Screening Audit Report Regarding the Kewaunee Power Station License Renewal Application" (ML091900081)

7. Letter from J. Alan Price dated October 20, 2010, "Dominion Energy Kewaunee, Inc. Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application" (ML102930573)

8. Letter from J. Alan Price dated November 9, 2010, "Dominion Energy Kewaunee, Inc. Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application" (ML103130472)

9. Letter from J. Alan Price dated November 23, 2010, "Dominion Energy Kewaunee, Inc. Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application" (ML103270580)

10. Memorandum from B. Pham dated December 17, 2010, "Advisory Committee Reactor Safeguards Review of the Kewaunee Power Station License Renewal Application – Safety Evaluation Report (ML103500555)

SECTION 6

CONCLUSION

The staff of the U.S. Nuclear Regulatory Commission (the staff), reviewed the license renewal application (LRA) for Kewaunee Power Station (KPS), in accordance with NRC regulations and NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," Revision 1, dated September 2005. Title 10, Section 54.29, of the *Code of Federal Regulations* (10 CFR 54.29) provides the standards for issuance of a renewed license.

On the basis of its review of the LRA, the staff concludes that the requirements of 10 CFR 54.29(a) have been met.

The staff notes that any requirements of Subpart A of 10 CFR Part 51 are documented in Supplement 40 to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Kewaunee Power Station," dated August 19, 2010.

APPENDIX A

COMMITMENTS FOR LICENSE RENEWAL OF KEWAUNEE POWER STATION

During the review of the Kewaunee Power Station (KPS) license renewal application (LRA) by the staff of the U.S. Nuclear Regulatory Commission (the staff), Dominion Energy Kewaunee, Inc. (Dominion, DEK, or the applicant), made commitments related to aging management programs (AMPs) to manage aging effects of structures and components (SCs) prior to the period of extended operation. The following table lists these commitments, along with the implementation schedules and the sources of the commitment.

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF KPS			
No.	**Commitment**	**Implementation Schedule**	**Source**
1	The ASME Code Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program will be enhanced to: (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the staff for review and approval to augment the current inspections.	At least 2 years prior to entering the period of extended operation.	ASME Code Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
2	The ASME Code Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program will be enhanced to include identification of the limiting susceptible cast austenitic stainless (CASS) steel reactor vessel internal components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking. For each identified component, a plan will be developed that accomplishes aging management through either a supplemental examination or a component-specific evaluation. The plan will be submitted for staff review and approval, not less than 24 months before entering the period of extended operation.	At least 2 years prior to entering the period of extended operation.	ASME Code Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
3	The Bolting Integrity Program will be enhanced to further incorporate applicable Electric Power Research Institute (EPRI) and industry bolting guidance. Topic enhancements will include proper joint assembly, torque values, gasket types, use of lubricants, and other bolting fundamentals.	Prior to the Period of Extended Operation	Bolting Integrity
4	The Buried Piping and Tanks Inspection program will be enhanced to perform visual inspections of a representative sample of material/protective measure combinations for in-scope buried piping and tanks. The following materials are utilized in buried applications with the associated protective measures: • Steel (including cast iron)/coated, • Steel/coated and wrapped, • Steel/uncoated, and • Stainless steel/coated and wrapped Visual inspections of the external surfaces of the components will be performed to identify damaged wrapping (if present), degraded or damaged coating (if present), and evidence of loss of material. Each piping inspection will include a minimum of 10 linear feet of piping. The following inspections will be performed: The circulating water system 30 inch diameter recirculation line, which is coated and wrapped carbon steel, will receive one inspection prior to the period of extended operation, and additional inspections within the first 10 years and second 10 years of the period of extended operation. (Continued next page)	Prior to the Period of Extended Operation And During the first 10 years of the period of extended operation And During the second 10 years of the period of extended operation	Letter 10-548, Response to RAI B2.1.7-3a.

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF KPS			
No.	**Commitment**	**Implementation Schedule**	**Source**
	The circulating water system recirculation line vent piping, which is coated and wrapped stainless steel, will receive one inspection prior to the period of extended operation and additional inspections within the first 10 years and second 10 years of the period of extended operation. The diesel generator system fuel oil piping, which includes coated and wrapped carbon steel fuel oil supply and return piping, storage tank vent piping, and day tank vent piping, will receive one inspection prior to the period of extended operation and additional inspections within the first 10 years and second 10 years of the period of extended operation. The inspections will be performed in the non-cathodically protected portion of the piping. The diesel generator system fuel oil storage tanks, which are coated carbon steel, will receive one inspection of one tank prior to the period of extended operation. An additional tank inspection will be performed within each of the first and second 10 years of the period of extended operation. The diesel generator system fuel oil storage tanks hold down straps, which are uncoated carbon steel, will be inspected in conjunction with the associated fuel oil storage tank inspection. One set will be inspected prior to the period of extended operation, and one set will be inspected within each of the first and second 10 years of the period of extended operation. The fire protection system piping, which is coated ductile iron, will receive three inspections prior to the period of extended operation, and three additional inspections within each of the first and second 10 years of the period of extended operation.		
5	The Compressed Air Monitoring Program will be enhanced to incorporate the compressed air system testing and maintenance recommendations from the ASME OM-S/G-1998, Part 17 and the EPRI TR-108147 and to identify these documents as part of the program basis.	Prior to the Period of Extended Operation	Compressed Air Monitoring
6	The External Surfaces Monitoring Program will be enhanced to inspect the accessible external surfaces of in-scope components, piping, supports, structural members, and structural commodities, in the infrequently accessed areas, consistent with the criteria used in other plant areas.	Prior to the Period of Extended Operation	External Surfaces Monitoring
7	The External Surfaces Monitoring Program will be enhanced to provide training for operations, engineering, and health physics personnel performing the program inspections and walkdowns. The training will address: (1) the requirements of the External Surfaces Monitoring Program for license renewal, (2) the need to document the identified conditions with sufficient detail to support monitoring and trending the aging effects, and (3) the aging effects monitored by the program and how to identify them.	Prior to the Period of Extended Operation	External Surfaces Monitoring
8	The Fire Protection Program will be enhanced to test a representative sample of sprinkler heads or to replace all affected sprinkler heads in accordance with the requirements of National Fire Protection Association (NFPA) 25.	Prior to the sprinkler heads achieving 50 years of service life.	Fire Protection

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No.	**Commitment**	**Implementation Schedule**	**Source**
9	The Fire Protection Program fire barrier penetration seal inspections will be revised to include the elastomer shield building fire boots.	Prior to the Period of Extended Operation	Fire Protection
10.	The Fire Protection Program inspections of the reactor coolant pump oil collection system will be revised to include additional inspection criteria for the visual inspection of the system and to perform a one-time inspection of the internal surfaces of the reactor coolant pump oil collection tank.	Prior to the Period of Extended Operation	Fire Protection
11.	The Fuel Oil Tank Inspections Program will be enhanced to provide guidance for the periodic draining, cleaning, and inspection activities.	Prior to the Period of Extended Operation	Fuel Oil Tanks Inspection
12.	The Inspection of Overhead Heavy Load and Refueling Handling Systems Program will be enhanced to clarify the requirements of visual inspection of structural members, including structural bolting, of the in-scope heavy load and refueling handling cranes and associated equipment.	Prior to the Period of Extended Operation	Inspection of Overhead Heavy Load and Refueling Handling Systems
13.	The Metal-Enclosed Bus (MEB) Program will be enhanced to include augmented periodical visual inspections of the MEB internal surfaces, bus supports, bus insulation, taped joints, and boots for signs of degradation or aging.	Prior to the Period of Extended Operation. Thereafter, the inspection of all MEB will not exceed a 10-year interval and the inspection of the sample of bolted connections will not exceed a 5-year interval.	Letter 09-469, Response to RAI B2.1.18-1
14.	The Non-EQ Electrical Cables and Connections Program will be established. The program will periodically visually inspect for accessible electrical cables and connections installed in an adverse localized equipment environment. Should an adverse localized environment be observed, a representative sample of electrical cables and connections installed within that environment will be visually inspected for jacket surface anomalies.	Prior to the Period of Extended Operation. Thereafter, the inspections will not exceed a 10-year interval.	Non-EQ Electrical Cables and Connections
15.	The Non-EQ Electrical Cable Connections Program will be established. The program will perform a one-time inspection, on a sampling basis, to confirm the absence of loosening of bolted connections.	Prior to the Period of Extended Operation	Non-EQ Electrical Cables and Connections

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No.	**Commitment**	**Implementation Schedule**	**Source**
16.	The Non-EQ Inaccessible Medium-Voltage Cables Program will be established. The program will periodically inspect the in-scope manholes and pulling pit for water collection and will remove water, if required. The program will periodically perform a test on the in-scope cables to provide an indication of the condition of the conductor insulation.	Prior to the Period of Extended Operation. Thereafter, the manholes and pulling pit inspections will be performed at least every 2 years. And Thereafter, the cable testing will be performed at least every 10 years.	Non-EQ Inaccessible Medium-Voltage Cables, and Letter 10-548, RAI response to RAI B2.1.21-1a.
17.	The Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals Program will be established. The program will periodically perform a proven cable system test for detecting deterioration of the insulation system for those electrical cables and connections disconnected during calibration, or will periodically review the results and findings of calibrations for those electrical cables that remain connected during the calibration process.	Prior to the Period of Extended Operation. Thereafter, the cable testing and calibration reviews will not exceed a 10-year interval.	Non-EQ Instrumentation Circuits Subject to Sensitive, High-Voltage, Low-Level Signals
18.	The Open-Cycle Cooling Water System Program will be enhanced to add the applicable aging effects as inspection criteria for the circulating water system underwater visual inspections.	Prior to the Period of Extended Operation	Open-Cycle Cooling Water System
19.	The Reactor Vessel Surveillance Program will be enhanced to include the applicable limitations on operating conditions to which the surveillance capsules were exposed (e.g., neutron flux, spectrum, irradiation temperature, etc.).	Prior to the Period of Extended Operation	Reactor Vessel Surveillance
20.	The Reactor Vessel Surveillance Program will be enhanced to include requirements for storing, and possible recovery, of tested and untested capsules (removed from the reactor vessel after August 31, 2000).	Prior to the Period of Extended Operation	Reactor Vessel Surveillance
21.	The Selective Leaching of Materials Program will be established. The program will perform a one-time visual inspection and hardness measurement or qualitative examination of selected components, within the scope of license renewal for selective leaching.	Prior to the Period of Extended Operation	Selective Leaching of Materials
22.	The Structures Monitoring Program will be enhanced to clearly define structures, structural elements, and miscellaneous structural commodities that are in-scope. Defined scope to include the MEB enclosure assemblies, structural supports, and enclosure seals.	Prior to the Period of Extended Operation	Letter 09-469, Response to RAI B2.1.18-2
23.	The Structures Monitoring Program will be enhanced to monitor groundwater quality and verify that it remains non-aggressive to below-grade concrete.	Prior to the Period of Extended Operation	Structures Monitoring Program
24.	The Structures Monitoring Program will be enhanced to improve criteria for the detection of aging effects for the underwater visual inspections of the in-scope structures.	Prior to the Period of Extended Operation	Structures Monitoring Program

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No.	**Commitment**	**Implementation Schedule**	**Source**
25.	The Work Control Process Program will be established. The program will perform one-time inspections as a verification of the effectiveness of chemistry control programs. The program will also perform visual inspections of component internal surfaces and external surfaces of selected components to manage the effects of aging when the surfaces are made available for examination through surveillance and maintenance activities.	Prior to the Period of Extended Operation	Letter 09-597, Changes to the WCP Program
26.	Deleted	N/A	Letter 09-597
27.	Deleted	N/A	Letter 09-597
28.	The Metal Fatigue of Reactor Coolant Pressure Boundary Program will be enhanced to include a routine assessment of the transient cycle count totals and fatigue usage status for monitored locations, including an action limit for the initiation of corrective action.	Prior to the Period of Extended Operation	Metal Fatigue of Reactor Coolant Pressure Boundary
29.	The following will be further evaluated as part of the applicant's ongoing performance improvement programs: • SAMA 160: Install Emergency Diesel Generator (EDG) exhaust duct insulation. • Concurrent implementation of SAMAs 81,160,166, and 167. • Implementation of temporary screenhouse ventilation.	Prior to the Period of Extended Operation	Environmental Report – SAMA Analysis, Letters 09-028 and 09-291
30.	Quarterly laboratory testing of fuel oil samples for water, sediment, and particulates will be performed on the EDG day tanks and on the technical support center diesel generator (TSC DG) day tank. The testing acceptance criteria will be consistent with the requirements specified in American Society for Testing and Materials (ASTM) D975-06b for water and sediment and ASTM D6217 for particulates.	Prior to the Period of Extended Operation	Letter 09-680, RAI response to B2.1.14-3
31.	The Work Control Process Program will be enhanced to provide for a one-time-inspection of the EDG day tanks and the TSC DG day tank. An exterior surfaces ultrasonic test (UT) inspection will be performed to verify wall thickness of the bottom of each day tank. Based upon the UT inspections, the most limiting EDG day tank will also be drained, cleaned, and visually inspected as a leading indicator for the remaining tanks.	Prior to the Period of Extended Operation	Letter 09-469, Response to RAI B2.1.15-1
32.	The 14 potentially cost beneficial SAMAs identified in LRA Appendix E, Attachment F, will be further evaluated as part of the applicant's ongoing performance improvement programs.	Prior to the Period of Extended Operation	Environmental Report – SAMA Analysis
33.	Develop a plan for identification and remediation of reactor refueling cavity liner leakage to be implemented during the period of extended operation.	Prior to the Period of Extended Operation	Letter 09-760, Response to RAI B2.1.31-4a
34.	At least one core bore sample will be taken from the waste drumming room reinforced concrete ceiling below the spent fuel pool. The core sample location and depth will be sufficient to validate the strength of the concrete and the extent of any degradation. The core sample will be tested for compressive strength and will be subject to petrographic examination. Reinforcing steel in the core sample area will be exposed and inspected for material condition.	Prior to the end of 2011	Letter 10-093, Response to RAI B2.1.31-5a

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No.	**Commitment**	**Implementation Schedule**	**Source**
35.	Develop an action plan for identification and remediation of spent fuel pool (SFP) liner leakage to be implemented during the period of extended operation.	Prior to the Period of Extended Operation	Letter 09-760, Response to RAI B2.1.31-5a
36.	If SFP liner leakage persists during the period of extended operation, an additional concrete core sample will be taken from the waste drumming room reinforced concrete ceiling below the spent fuel pool. The core sample location and depth will be sufficient to validate the strength of the concrete and the extent of any degradation. The core sample will be tested for compressive strength and will be subject to petrographic examination. Reinforcing steel in the core sample area will be exposed and inspected for material condition.	Prior to the end of the first 10 years of the Period of Extended Operation	Letter 09-760, Response to RAI B2.1.31-5a
37.	Perform a VT-1 visual examination of the stainless steel cladding of a safety injection pump for indications of cracking or corrosion due to cladding breach.	Prior to the Period of Extended Operation	Letter 09-777, Response to RAI 3.2.2.2.2
38.	The Boron Carbide Surveillance Program, which includes neutron attenuation testing, will continue to be performed during the period of extended operation every 3 years.	During the Period of Extended Operation	Letter 09-777, Supplemental Response to RAI 3.3.2.2.6-1
39.	A surveillance program will be implemented to perform verification that the Boral spent fuel storage rack neutron absorber B-10 areal density is maintained within the bounds of the spent fuel pool criticality analysis. Alternatively, the criticality analysis for the spent fuel pool will be revised to eliminate credit for the Boral neutron absorber material.	Prior to 2017. Surveillance program will be performed every 10 years thereafter	Letter 09-777, Supplemental Response to RAI 3.3.2.2.6-2
40.	Implement nitrate monitoring for the component cooling system on a frequency consistent with the existing monitoring for ammonia.	Prior to the Period of Extended Operation	Letter 10-008, Response to RAI B2.1.8-3a
41.	Perform a fatigue analysis of the surge line hot leg nozzle and the charging line nozzle in accordance with ASME Boiler and Pressure Vessel (B&PV) Code Section III, Subsection NB-3200 guidance and determine the cumulative usage factor (CUF), considering the effects of the reactor coolant environment. Confirm that CUF is less than 1.0 at the end of 60 years of plant operation.	Completed	Letter 10-033, Final Response to RAI B3.2-2, Letter 10-324, Completion of Kewaunee Power Station License Renewal Commitment 41.
42.	For Examination Category B-J, item No. B9.21, eight ASME Class 1 small-bore circumferential welds will receive volumetric and surface examinations during each 10-year ISI inspection interval during the period of extended operation.	During each 10-year ISI inspection interval during the period of extended operation	Letter 10-033, Supplemental Response to RAI B2.1.2-1

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No.	**Commitment**	**Implementation Schedule**	**Source**
43.	Ten volumetric examinations of ASME Class 1 small-bore socket welds will be performed using a demonstrated, nuclear-industry endorsed, inspection methodology that can detect cracking within the specified examination volume, if a methodology becomes available. In the event that a demonstrated, nuclear-industry endorsed, inspection methodology is not available, destructive examinations of socket welds will be substituted for volumetric nondestructive examinations. Each destructive weld examination will be considered equivalent to performing two volumetric weld examinations, such that a maximum of five destructive examinations will be performed.	Four volumetric examinations or two destructive examinations (or an equivalent combination of examinations) prior to the period of extended operation. *Remaining examinations* within three years of entering the period of extended operation.	Letter 10-665, Supplemental Response to RAI B2.1.2-2
44.	Core samples will be obtained from the inside surface of a concrete wall (below the groundwater table elevation) or from the foundation basemat in the vicinity of the groundwater wells for which average sampling results have exceeded the chloride concentration limit of 500 ppm. The concrete core samples will be tested to determine if the chloride content within the concrete could cause degradation due to corrosion of reinforcing steel.	Prior to the Period of Extended Operation	Letter 10-093, Response to RAI B2.1.31-3a
45.	In the event that the chloride content in the groundwater does not decrease to below 500 ppm within the first ten years of the period of extended operation, core samples will be obtained from the inside surface of a concrete wall (below the groundwater table elevation) or from the foundation basemat in the vicinity of a groundwater well for which average sampling results have exceeded the chloride concentration limit of 500 ppm. The concrete core samples will be tested to determine if the chloride content within the concrete could cause degradation due to corrosion of reinforcing steel.	Prior to the end of the first 10 years of extended operation.	Letter 10-093, Response to RAI B2.1.31-3a
46.	If the results of the core sample testing of the waste drumming room reinforced concrete ceiling leakage site (related to potential SFP liner leakage - Commitment 34) indicate degradation of the structural integrity of the concrete, at least one core bore sample will be taken near at least one of the refueling cavity liner leakage indication sites. The core sample location and depth will be sufficient to validate the strength of the concrete and the extent of any degradation. The core sample will be tested for compressive strength and will be subject to petrographic examination. Reinforcing steel in the core sample area will be exposed and inspected for material condition.	Prior to the Period of Extended Operation	Letter 10-093, Response to RAI B2.1.31-4a
47.	Submit three examples of operating experience associated with the Work Control Process – Internal Surfaces Monitoring Program for NRC staff review in determining the effectiveness of the program to detect and correct the effects of aging prior to the loss of function.	Within 2 years following implementation of the WCP aging management program	Letter 10-286; Response to RAI B2.1.32-5

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF KPS			
No.	**Commitment**	**Implementation Schedule**	**Source**
48.	The cathodic protection system associated with the diesel generator fuel oil storage tanks and protected portions of the fuel oil lines, and the circulating water system recirculation piping, will each be maintained available a minimum of 90% of the time during the period of extended operation. In addition, NACE cathodic protection system surveys will be performed at least annually during the period of extended operation.	During the Period of Extended Operation	Letter 10-548 Response to RAI-B2.1.7-3a
49	Recognizing that the EPRI Steam Generator Maintenance Program (SGMP) resolution is still under development, Kewaunee will perform an inspection of each steam generator to assess the condition of the divider plate assembly. The examination technique(s) will be capable of detecting PWSCC in the divider plate assembly and associated welds. The steam generator divider plate inspections will be completed prior to exceeding 10 years into the period of extended operation. In addition, Dominion Energy Kewaunee, Inc., (Dominion, DEK, or the applicant) will continue to actively participate in the EPRI SGMP studies.	Prior to 2023	Letter 10-548 Response to RAI-3.1.2.2.13-1a
50	Perform an audit of the Internal Surfaces Monitoring portion of the Work Control Process Program inspections to confirm that the components representing the leading indicators of aging for each of the material/environment combinations have been inspected at least once during the audit period. If any scheduled surveillance and maintenance activities which were intended to encompass components as leading indicators of aging in each of the material/environment combinations have not been performed, then perform deliberate focused inspections of these components.	Prior to the Period of Extended Operation and every 10 years thereafter. Deliberate focused inspections will be performed within 5 years of completion of the audits.	Letter 10-595 (Supplemental Response to RAI B2.1.32-5a)
51	DEK will perform a fatigue evaluation of the pressurizer lower head and surge line that is consistent with the requirements of ASME B&PV Code, Section III, NB-3200 and will determine the cumulative fatigue usage through the period of extended operation.	Prior to the Period of Extended Operation	Letter 10-595 Supplemental Response to RAI B3.2-2a
52	DEK will perform a review of design basis ASME Code Class 1 component fatigue evaluations to determine whether the NUREG/CR-6260-based components that have been evaluated for the effects of the reactor coolant environment on fatigue usage are the limiting components for the Kewaunee plant configuration. If more limiting components are identified, the most limiting component will be evaluated for the effects of the reactor coolant environment on fatigue usage.	Prior to the Period of Extended Operation	Letter 10-595 Supplemental Response to RAI B3.2-2a

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF KPS			
No.	**Commitment**	**Implementation Schedule**	**Source**
53	DEK will develop a plan to address the potential for failure of the primary-to-secondary pressure boundary due to PWSCC cracking of tube-to-tubesheet welds. The plan will consist of two resolution options: 1. Perform an analytical evaluation of the steam generator tube-to-tubesheet welds in order to: a) Establish a technical basis which concludes that the structural integrity of the steam generator tube-to-tubesheet interface is adequately maintained with the presence of tube-to-tubesheet weld cracking, and b) Establish a technical basis which concludes that the steam generator tube-to-tubesheet welds are not required to perform a reactor coolant pressure boundary function. -or- 2. Perform a one-time inspection of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. If weld cracking is identified: a) The condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and b) An ongoing monitoring program will be established to perform routine tube-to-tubesheet inspections for the remaining life of the steam generators.	Develop a plan prior to the Period of Extended Operation Implement the requirements of the plan prior to 2023	Letter 10-595
54	The Structures Monitoring Program will be revised to include the evaluation criteria of ACI 349.3R-96, Chapter 5, as the criteria to be used when evaluating conditions or findings identified during concrete structure inspections. This will be done prior to the performance of the next scheduled inspection, which will occur prior to the period of extended operation.	Prior to the Period of Extended Operation	Letter 10-707, Response to RAI B2.1.31-9.

APPENDIX B

CHRONOLOGY

This appendix contains a chronological listing of the routine correspondence between the staff of the U.S. Nuclear Regulatory Commission (NRC or the staff) and the Dominion Energy Kewaunee, Inc.(Dominion, DEK, or the applicant), and other correspondence regarding the staff's reviews of the Kewaunee Power Station (KPS), Docket Number 50-305, license renewal application (LRA).

Document Date	Title
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 4: Reactor Coolant System. (Accession No. ML071150387)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 5: Containment System. (Accession No. ML071150388)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 6: Engineered Safety Features. (Accession No. ML071150389)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 7: Instrumentation and Control. (Accession No. ML071150391)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 8: Electrical System. (Accession No. ML071150393)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 9: Auxiliary and Emergency Systems. (Accession No. ML071150394)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 10: Steam and Power Conversion System. (Accession No. ML071150399)
April 19, 2007	Kewaunee Power Station, Updated Safety Analysis Report, Revision 20. Chapter 11: Waste Disposal and Radiation Protection System. (Accession No. ML071150402)
July 14, 2008	Kewaunee License Renewal Drawing LRM-532, Revision 0, "Personnel and Emergency Airlock Test Piping." (Accession No. ML082470141)
July 22, 2008	Kewaunee License Renewal Drawing LRM-211, Revision 0, "Turbine and Auxiliary Bldg. Traps and Drains." (Accession No. ML082470110)
August 12, 2008	Kewaunee Power Station, Applicant's Environmental Report, Operating License Renewal Stage. (Accession No. ML082341039)
August 14, 2008	Kewaunee License Renewal Drawing LRM-213-9, Revision 0, "Diesel Generator Startup Air Compressor A & B and Fish Screen Air Compressor System." (Accession No. ML082470117)
August 25, 2008	Kewaunee Power Station, Receipt and Availability License Renewal Application. (Accession No. ML082120504)
August 25, 2008	Kewaunee Power Station, Notice of Receipt and Availability License Renewal Application. (Accession No. ML082120515)
September 2, 2008	Press Release-08-161: License Renewal Application for Kewaunee Nuclear Plant Available for Public Inspection. (Accession No. ML082460767)

Document Date	Title
September 25, 2008	*Federal Register* Notice Regarding Renewal of Facility Operating License No. DPR-42 for an Additional 20-Year Period. (Accession No. ML082610294)
September 25, 2008	Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for the Kewaunee Power Station. (Accession No. ML082610303)
September 30, 2008	Request for List of State Protected Species Within the Area Under Evaluation for the Kewaunee Power Station License Renewal Application Review. (Accession No. ML082610748)
October 2, 2008	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for Kewaunee Power Station (TAC No. MD9409). (Accession No. ML082520774)
October 8, 2008	Kewaunee Power Station License Renewal Application Review. (Accession No. ML082610168)
October 8, 2008	10/22/2008 — Notice of Meeting to Discuss License Renewal Process and Environmental Scoping Kewaunee Power Station. (Accession No. ML082750112)
October 10, 2008	Kewaunee Power Station License Renewal Application Review. (Accession No. ML082661119)
October 10, 2008	Kewaunee Power Station License Renewal Application Review. (Accession No. ML082670685)
October 10, 2008	Kewaunee Power Station License Renewal Application Review. (Accession No. ML082680027)
October 16, 2008	Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review. (Accession No. ML082800098)
October 16, 2008	Press Release-08-190: NRC Seeks Public Input on Environmental Impact Statement for Kewaunee Nuclear Plant License Renewal Application. (Accession No. ML082900265)
October 22, 2008	Kewaunee Power Station License Renewal Public Meeting Presentation Slides. (Accession No. ML083050589)
October 22, 2008	Written Comment Submitted by State Representative Jim Soletski Supporting the Kewaunee Power Station License Renewal. (Accession No. ML083100092)
October 22, 2008	Written Comment Submitted by Nancy Crowley, Manitowoc Emergency Services Coordinator, regarding the Kewaunee Power Station License Renewal. (Accession No. ML083100093)
October 22, 2008	Written Comment from Bob Ziegelbauer, Manitowoc County Executive, regarding Kewaunee Power Station License Renewal. (Accession No. ML083100094)
October 22, 2008	Comment (1) of Bob Ziegelbauer on Behalf of the State of WI, Supporting Dominion Energy Kewaunee's Application for License Renewal. (Accession No. ML083100586)
October 22, 2008	Transcript of the Kewaunee License Renewal Afternoon Scoping Meeting Afternoon Session, October 22, 2008. (Accession No. ML083190734)
October 22, 2008	Transcript of the Kewaunee License Renewal Evening Scoping Meeting Evening Session, October 22, 2008. (Accession No. ML083190744)
October 27, 2008	Request for Additional Information Regarding the Review of the License Renewal Application for Kewaunee Power Station (TAC No. MD9409). (Accession No. ML082560558)

Document Date	Title
October 28, 2008	U.S. Department of Interior, Fish and Wildlife Service, Response to Request for a List of Federally-Listed, Proposed, and Candidate Species and Critical Habitat in the Vicinity of Kewaunee Power Station. (Accession No. ML083390643)
November 5, 2008	Comments of Greg Veith in Support of Kewaunee Power Station License Renewal. (Accession No. ML083380455)
November 17, 2008	10/22/08 – Summary of Public License Renewal Overview and Environmental Scoping Meeting Related to the Review of the Kewaunee Power Station License Renewal Application. (Accession No. ML083090452)
November 25, 2008	Kewaunee Power Station, Response to Request for Additional Information Regarding the Review of the License Renewal Application. (Accession No. ML083520612)
December 3, 2008	Project Manager Change for the License Renewal Review for Kewaunee Power Station (TAC No. MD9408). (Accession No. ML083370231)
December 9, 2008	Revision of Schedule for the Conduct of Review of the Kewaunee Power Station License Renewal Application (TAC No. MD9408). (Accession No. ML083370245)
March 9, 2009	Kewaunee Power Station, Response to Request for Additional Information Regarding Severe Accident Mitigation Alternatives for the Kewaunee Power Station License Renewal Application. (Accession No. ML090690458)
March 23, 2009	Request to Supplement the Kewaunee Power Station License Renewal Application in Regards to the Use of the Work Control Process as an Aging Management Program (TAC No. MD9408). (Accession No. ML090530003)
April 3, 2009	Kewaunee Power Station License Renewal Application Review, Request for Additional Information – Balance of Plant Scoping and Screening. (Accession No. ML090760786)
April 8, 2009	Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for Kewaunee Power Station (TAC No. MD9409). (Accession No. ML090770880)
April 8, 2009	04/28/2008 – Public Meeting Notice with Dominion Energy Kewaunee, Inc., to Discuss the NRC's End-of-Cycle Assessment of Kewaunee's Performance for the 2008 Calendar Year. (Accession No. ML090980435)
April 11, 2009	Environmental Site Audit Regarding the Kewaunee Power Station License Renewal Application (TAC No. MD9409). (Accession No. ML090750720)
April 15, 2009	Revision of Schedule for the Conduct of Review of the Kewaunee Power Station License Renewal Application. (Accession No. ML090860946)
April 20, 2009	Reissuing of the Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for Kewaunee Power Station (TAC No. MD9409). (Accession No. ML091100093)
April 27, 2009	Kewaunee Power Station, Response to Request for Additional Information Regarding the Review of the License Renewal Application – Balance of Plant Scoping and Screening. (Accession No. ML091180470)
April 30, 2009	Kewaunee Power Station, Request for Additional Information, Review of the License Renewal Application – Scoping & Screening Methodology. (Accession No. ML091120199)
May 28, 2009	Plan for the Aging Management Program Regulatory Audit Regarding the Kewaunee Power Station License Renewal Application Review. (Accession No. ML091470382)
May 28, 2009	Kewaunee Power Station, Response to Request for Additional Information Regarding the Review of the License Renewal Application – Scoping and Screening Methodology. (Accession No. ML091520540)

Document Date	Title
June 4, 2009	Kewaunee License Renewal Inspection, Request for Information. (Accession No. ML091560579)
July 6, 2009	7/28/2008 – Forthcoming Meeting to Discuss the Status of the License Renewal Review for the Kewaunee Power Station License Renewal Application. (Accession No. ML090670003)
July 6, 2009	Kewaunee Power Station, Response to Request to Docket Information Related to the Environmental Site Audit, Enclosure F, Archeological and Cultural Resources. (Accession No. ML091970516)
July 7, 2009	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application – Leak-Before-Break. (Accession No. ML090760786)
July 8, 2009	Environmental Project Manager Change for the License Renewal of Kewaunee Power Station. (Accession No. ML091880344)
July 10, 2009	Request for Additional Information Regarding the Environmental Review of the License Renewal Application for Kewaunee Power Station. (Accession No. ML091890017)
July 13, 2009	Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application – Aging Management Programs. (Accession No. ML091810958)
July 13, 2009	Scoping and Screening Audit Report Regarding the Kewaunee Power Station, License Renewal Application. (Accession No. ML091900081)
July 16, 2009	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application – Structures Scoping/Fire Protection. (Accession No. ML091880555)
July 27, 2009	Kewaunee Power Station, Response to Request for Additional Information Regarding the Environmental Review of the Kewaunee Power Station License Renewal Application. (Accession No. ML092090277)
July 27, 2009	Kewaunee Power Station, License Renewal Application First Annual Update Required by 10 CFR 54.21(b). (Accession No. ML092090314)
July 28, 2009	Kewaunee License Renewal Application, Slides Public Meeting July 28, 2009. (Accession No. ML092100603)
August 6, 2009	Kewaunee Power Station, Response to Request for Additional Information for the Review of the License Renewal Application – Structures Scoping/Fire Protection. (Accession No. ML092190757)
August 6, 2009	Kewaunee Power Station, Response to Request for Additional Information for the Review of the License Renewal Application – Leak-Before-Break/Boral. (Accession No. ML092230618)
August 10, 2009	Summary of Public Meeting Related to the Review of the Kewaunee Power Station License Renewal Application (TAC No. MD9408). (Accession No. ML092100612)
August 12, 2009	Aging Management Program Audit Report Regarding the Kewaunee Power Station, License Renewal Application. (Accession No. ML091900449)
August 12, 2009	Summary of Site Audit Related to the Review of the License Renewal Application for Kewaunee Power Station (TAC No. MD9409). (Accession No. ML092050144)
August 12, 2009	Summary Site Audit Related to the Review of the License Renewal Application for Kewaunee Power Station. (Accession No. ML092180137)
August 17, 2009	Kewaunee Power Station, Response to Request for Additional Information for Review of License Renewal Application – Aging Management Programs. (Accession No. ML092320093)

Document Date	Title
August 28, 2009	Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application – Aging Management Review Results. (Accession No. ML092120546)
September 10, 2009	Kewaunee Letter Re: Notice of Public Exit Meeting for NRC License Renewal Inspection. (Accession No. ML092530732)
September 10, 2009	9/30/2009 – Notice of Meeting with Dominion Energy Kewaunee, Inc. Re: Exit Meeting for IR 05000305/2009007, License Renewal Inspection. (Accession No. ML092540381)
September 24, 2009	Press Release-III-09-028: NRC to Discuss Results of License Renewal Inspection for Kewaunee Nuclear Power Plant. (Accession No. ML092670399)
September 25, 2009	Kewaunee Power Station, Supplemental Information for the Review of the License Renewal Application – Changes to the Work Control Process Aging Management Program. (Accession No. ML092710045)
September 28, 2009	Kewaunee Power Station, Response to Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application – Ventilation Systems. (Accession No. ML092720184)
October 13, 2009	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application – Aging Management Review Results. (Accession No. ML092390063)
October 13, 2009	Revision of Schedule for the Conduct of Review of the Kewaunee Power Station License Renewal Application. (Accession No. ML092790585)
October 14, 2009	Plan for the Aging Management Program Regulatory Audit Regarding the Kewaunee Power Station License Renewal Application Review. (Accession No. ML092790582)
November 12, 2009	IR 05000305-09-007, on 08/17/2009–09/30/2009, Kewaunee Power Station, License Renewal Inspection. (Accession No. ML093160727)
November 13, 2009	Kewaunee Power Station, Response to Request for Additional Information for Review of the Kewaunee Power Station License Renewal Application – Aging Management Review Results. (Accession No. ML093170751)
November 20, 2009	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application. (Accession No. ML091890836)
December 3, 2009	Request for Additional Information for the Review of the Kewaunee License Renewal Application – Aging Management Review/Aging Management Program. (Accession No. ML093240095)
December 14, 2009	Work Control Process Program Audit Report Regarding the Kewaunee Power Station License Renewal Application. (Accession No. ML093260003)
December 16, 2009	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application – Aging Management Reviews. (Accession No. ML093310443)
December 17, 2009	Safety Project Manager Change for the License Renewal Review for the Kewaunee Power Station. (Accession No. ML093310360)
December 28, 2009	Kewaunee Power Station, Response to Request for Additional Information for the Review of the License Renewal Application. (Accession No. ML100110061)
January 4, 2010	Request for Additional Information Regarding the Review of the Kewaunee Power Station License Renewal Application – Aging Management Reviews. (Accession No. ML093500306)
January 21, 2010	Kewaunee Power Station, Response to Request for Additional Information for the Review of the License Renewal Application – Aging Management Review/Aging Management Program. (Accession No. ML100220066)

Document Date	Title
January 21, 2010	Kewaunee Power Station, Response to Request for Additional Information for the Review of the License Renewal Application – Aging Management Review/Aging Management Program. (Accession No. ML100220082)
January 29, 2010	Notice of Availability of the Draft Plant-Specific Supplement 40 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Kewaunee Power Station. (Accession No. ML093240009)
January 29, 2010	Notice of Availability of the Draft Plant-Specific Supplement 40 to the Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants Regarding Kewaunee Power Station. (Accession No. ML093240014)
January 29, 2010	Notice of Availability of the Draft Plant-Specific Supplement 40 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Kewaunee Power Station. (Accession No. ML093280799)
February 1, 2010	Press Release 10-022: NRC Seeks Public Input on Draft Environmental Impact Statement for Kewaunee Nuclear Plant License Renewal; Meetings Scheduled. (Accession No. ML100322044)
February 2, 2010	Kewaunee Power Station – Response to Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application – Aging Management Review/Aging Management Program. (Accession No. ML100331879)
February 2, 2010	Kewaunee Power Station, Response to Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application – Aging Management Review/Aging Management Program. (Accession No. ML100360085)
February 2, 2010	Price J A, Dominion Energy Kewaunee, Inc., "Kewaunee Power Station - Response to Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application Aging Management Review/Aging Management Program." (Accession No. ML100331879)
February 2, 2010	Price J A, Dominion Energy Kewaunee, Inc., "Kewaunee Power Station, Response to Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application-Aging Management Review/Aging Management Program." (Accession No. ML100360085)
February 15, 2010	Price J A, Dominion Energy Kewaunee, Inc., "Kewaunee, Supplemental Information for Review of License Renewal Application-Aging Management Review/Aging Management Program." (Accession No. ML100470795)
February 16, 2010	Daily J W, "Summary of Telephone Conference Call Between Dominion Energy Kewaunee, Inc. and USNRC to Discuss Certain Request for Additional Information on Structural Items" (TAC No. MD9408). (Accession No. ML100321077)
March 11, 2010	Request for Additional Information for the Review of the Kewaunee Power Station, License Renewal Application. (Accession No. ML100690399)
March 26, 2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee, Response to Request for Additional Information Associated with Review of License Renewal Application." (Accession No. ML100890229)
March 31, 2010	Meeting Summary, Daily J W, "Summary of Telephone Conference Call Between Dominion Energy Kewaunee, Inc. and the NRC to Discuss Certain RAI Responses on Two Mechanical Systems." (Accession No. ML100710741)
April 14, 2010	Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application. (TAC No. MD9408). (Accession No. ML100950379)
May 5, 2010	Gilman T D, Structural Integrity Associates, Inc, Report No. 0900090.401, Revision 0, "60-Year EAF Analyses Summary Report, Kewaunee Power Station Charging Nozzle & RCS Hot Leg Surge Nozzle." (Accession No. ML101610286)
May 13, 2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee, Response to Request for Additional Information Related to the Review of the License Renewal Application." (Accession No. ML101340182)
May 27, 2010	Daily J, NRC/NRR/DLR/RPOB, to Heacock D A, Dominion Energy Kewaunee, Inc, "Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application." (Accession No. ML101410322)

Document Date	Title
June 1, 2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee, Completion of License Renewal Commitment 41 re Fatigue Analysis of Surge Line Hot leg Nozzle. Report No. 0900090.401 Enclosed." (Accession No. ML101610233)
June 16, 2010	Daily J W, NRC/NRR/DLR/RPOB, to Heacock D A, Dominion Energy Kewaunee, Inc, Letter re: "Change in Schedule for Review of the Kewaunee Power Station License Renewal Application Safety Evaluation (TAC No. MD9408)." (Accession No. ML101600324)
July 15, 2010	Robinson J E, NRC/NRR/DLR/RPOB, to Hackett E H, NRC/ACRS, "Memorandum to ACRS Subcommittee re Kewaunee SER." (Accession No. ML101190116)
July 15, 2010	Holian B E, NRC/NRR/DLR, to Heacock D A, Dominion Energy Kewaunee, Inc, "Transmittal of Kewaunee Safety Evaluation Report with Open Items Related to License Renewal of Kewaunee Power Station." (Accession No. ML101190345)
July 22, 2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee Power Station - Response to Request for Additional Information for the Review of License Renewal Application." (Accession No. ML102240062)
August 9, 2010	Hartz L N, Dominion, Dominion Energy Kewaunee, Inc, "Kewaunee - License Renewal Application Second Annual Update Required by 10 CFR 54.21(b)." (Accession No. ML102290141)
August 30,2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee, License Renewal - Comments on SER with Open Items." (Accession No. ML102430118)
September 9, 2010	*Daily*, J, NRC/NRR/DLR/RPOB, *Record of conversation-email re: Operator* Response to High dP in IA Dryers - related to Kewaunee SER with open items-September 9, 2010. (Accession No. ML102700431)
September 9, 2010	Daily, J, NRC/NRR/DLR/RPOB, Summary of Discussion on September 9, 2010, Between Dominion Energy Kewaunee, Inc. and the U.S. Nuclear Regulatory Commission to Discuss Draft Follow-Up RAI on Steam Generator Divider Plates. (Accession No. ML102700438)
September 20, 2010	Daily, J, NRC/NRR/DLR/RPOB, Summary of Discussion on September 20, 2010, Between Dominion Energy Kewaunee, Inc. and the U.S. Nuclear Regulatory Commission to Discuss Applicant's Commitment #43 Small Bore Piping. (Accession No. ML102700447)
September 22, 2010	Satorius M A, NRC/RGN-III/ORA, to Leeds E J, NRC/NRR, "Memo 09/22/10 Kewaunee Power Station License Renewal Application." (Accession No. ML102660247)
September 23, 2010	Hartz L N, Dominion Energy Kewaunee, Inc, "Kewaunee Power Station - Response to Request for Additional Information for the Review of the License Renewal Application." (Accession No. ML102700162)
September 30, 2010	Daily, J, NRC/NRR/DLR/RPOB, Summary of Discussion on September 30, 2010, Between Dominion Energy Kewaunee, Inc. and the U.S. Nuclear Regulatory Commission to Discuss Draft Follow-Up RAI on Metal Fatigue and FatiguePro™. (Accession No. ML102910050)
October 13, 2010	Daily, J, NRC/NRR/DLR/RPB1, Summary of Discussion on October 13, 2010, Between Dominion Energy Kewaunee, Inc. and the U.S. Nuclear Regulatory Commission to Discuss Issues Related to LRA Item 3.1.1-35 and to Dominion's Responses on Work Control Process Program. (Accession No. ML102910058)
October 20, 2010	Price, J A, Dominion Energy Kewaunee, Inc., "Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application." (Accession No. ML102930573)
November 9, 2010	Daily, J, NRC/NRR/DLR/RPB1, Summary of Discussion on November 4, 2010, Between Dominion Energy Kewaunee, Inc. and the U.S. Nuclear Regulatory Commission to discuss latest issue related to ASME Class 1 small-bore socket welds. (Accession No. ML103130124)

Document Date	Title
November 9, 2010	Price, J A, Dominion Energy Kewaunee, Inc., "Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application." (Accession No. ML103130472)
November 23, 2010	Price, J A, Dominion Energy Kewaunee, Inc., "Kewaunee Power Station Supplemental Information for the Review of the Kewaunee Power Station License Renewal Application." (Accession No. ML103270580)
December 8, 2010	Daily, J, NRC/NRR/DLR/RPB1, Record of Discussion with Dominion Energy Kewaunee on four issues related to DEK's Structures Monitoring and Selective Leaching Programs. (Accession No. ML103210140)
December 17, 2010	Pham, B, NRC/NRR/DLR/RPB1, "Advisory Committee Reactor Safeguards Review of the Kewaunee Power Station License Renewal Application – Safety Evaluation Report (Accession No. ML103500555)
January 7, 2011	Abdel-Khalik, S. to Gregory B. Jaczko, Chairman, U.S. Nuclear Regulatory Commission, "Report on the Safety Aspects of the License Renewal Application for the Kewaunee Power Station" (Accession No. ML103410361)

APPENDIX C

PRINCIPAL CONTRIBUTORS

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A. Sheik	Reviewer—Structural
A. Wong	Reviewer—Mechanical
B. Fu	Reviewer—Materials
B. Lehman	Reviewer—Structural
B. Parks	Reviewer—Mechanical
B. Rogers	Scoping and Screening Methodology Audit
C. Doutt	Reviewer—Electrical
C. Yang	Reviewer—Mechanical
D. Alley	Reviewer—Materials
D. Brittner	Reviewer—Mechanical
D. Diercks	Reviewer—Mechanical
D. Hoang	Reviewer—Structural
D. Naus	Reviewer—Structural
D. Nguyen	Reviewer—Electrical
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J. Shea	Reviewer—Mechanical
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Name	Responsibility
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R. Vaucher	Reviewer—Mechanical
S. Min	Reviewer—Materials
W. Holston	Reviewer—Mechanical
W. Smith	Reviewer—Materials

Contractor	Technical Area
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Advanced Technologies and Laboratories, Inc.	Plant Systems/GALL Audit

APPENDIX D

REFERENCES

This appendix contains a listing of the references used in the preparation of the safety evaluation report (SER) prepared during the review of the license renewal application (LRA) for Kewaunee Power Station (KPS), Docket Number 50-305.

APPENDIX D: REFERENCES
10 CFR Part 140, Appendix B, "Form of Indemnity Agreement With Licensees Furnishing Insurance Policies As Proof of Financial Protection."
10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."
10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."
AMSE OM-S/G-1998, Part 17, Section 5.3, "Inservice Performance Tests."
ANSI/ISA-7.0.01-1996.
ASME Boiler & Pressure Vessel Code.
ASME Code Case N-629, "Use of Fracture Toughness Test Data to Establish Reference Temperature for Pressure Retaining Materials."
ASME OM-S/G-1998, Part 17.
ASTM D130, "Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test."
ASTM D6217, "Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration."
EPRI, "Aging Assessment Field Guide."
EPRI 1002884, "Pressurized Water Reactor Primary Water Chemistry Guidelines."
EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, January 2006.
EPRI MRP-126 "Generic Guidance for Alloy 600 Management."
EPRI NP-7079, "Instrument air systems: A guide for power plant maintenance personnel."
EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, dated January 2006.
EPRI TR-1007820, "Closed Cooling Water Chemistry Guideline," Revision 1, 2004.
EPRI TR-1008224, "PWR Secondary Water Chemistry Guidelines," Revision 6, December 2004.
EPRI TR-1014986, "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volume1, Revision 6.
EPRI TR-104213, "Bolted Joint Maintenance & Applications Guide," December 1, 1995.
EPRI TR-107514, "Age-Related Degradation Inspection Method and Demonstration in Behalf of Calvert Cliffs Nuclear Power Plant License Renewal Application."
EPRI TR-108147, "Compressor and Instrument Air System Maintenance Guide," March 1998.
Generic Letter 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."

APPENDIX D: REFERENCES
GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance."
Kewaunee Power Station, Updated Safety Analysis Report (USAR).
Letter from Christopher I. Grimes, NRC to Douglas J. Walters, Nuclear Energy Institute, Subject: License Renewal Issue No. 98-0030, "Thermal Aging Embrittlement Of Cast Austenitic Stainless Steel Components," dated May 19, 2000.
License Renewal Application (LRA), Kewaunee Power Station, dated August 12, 2008.
NEI 03-08, "Guideline for the Management of Materials Issues."
NEI 95-10, Revision 6, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54-The License Renewal Rule," June 2005.
NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at PWRs."
NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors."
NRC Commission Order, Entergy Nuclear Vermont Yankee, LLC (Vermont Nuclear Power Station) CLI-10-17, dated July 8, 2010. (Accession No. ML101890775)
NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors."
NRC GL 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment."
NRC GL 92-01, "Reactor Vessel Structural Integrity," issued February 28, 1992.
NRC GL 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Components in PWR Plants."
NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."
NUREG/CR-4513, Revision 1, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems."
NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels," April 1999.
NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components."
NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," February 1998.
NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping."
NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," July 1980.
NUREG-1061, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee."
NUREG-1275, Volume 2, "Operating Experience Feedback Report – Air Systems Problems."
NUREG-1350, "2007-2008 Information Digest."
NUREG-1431, "Standard Technical Specifications Westinghouse Plants."
NUREG-1557, "Summary of technical information and agreements from Nuclear Management and Resources Council industry reports addressing license renewal."
NUREG-1760, "Aging Assessment of Safety-Related Fuses Used in Low-and Medium-Voltage Application in Nuclear Power Plants."
NUREG-1800, Revision 1, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," September 2005.
NUREG-1801, Revision 1, "Generic Aging Lessons Learned (GALL) Report," September 2005.
NUREG-1833, "Technical Bases for Revision to the License Renewal Guidance Documents," October 2005.

APPENDIX D: REFERENCES
Regulatory Guide (RG) 1.89, Revision 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants."
RG 1.188, Revision 1, "Standard Format and Content for Applications To Renew Nuclear Power Plant Operating Licenses," September 2005.
RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," March 2001.
RG 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants."
RG 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," May 1988.
WCAP-12866, "Bottom Mounted Instrumentation Flux Thimble Tube Wear," 1991.
WCAP-16609, "Master Curve Assessment of Kewaunee Power Station Reactor Vessel Weld Metal."
WCAP-16642, "Evaluation of Pressurized Thermal Shock for Kewaunee Power Station."
WCAP-12841, "Structural Evaluation of the Kewaunee Pressurizer Surge Line, Considering the Effects of Thermal Stratification."
WCAP-12842, "Structural Evaluation of the Kewaunee Pressurizer Surge Line, Considering the Effects of Thermal Stratification" (non-proprietary).
WCAP-16641, "Analysis of Capsule T from Dominion Energy Kewaunee Power Station Reactor Vessel Radiation Surveillance Program."
WCAP-14040-NP-A, "Methodology Used to Develop Cold Overpressure Mitigating Systems Setpoints and RCS Heatup and Cooldown Limit Curves."
WCAP-16083-NP-A, "Benchmark Testing of the FERRET Code for Least Squares Evaluation of Light Water Reactor Dosimetry, May 2006."
WCAP-16643, "Kewaunee Power Station Heatup and Cooldown Limit Curves for Normal Operation."
WCAP-14535, "Topical Report of Reactor Coolant Pump Flywheel Inspection Elimination."
WCAP-14535-A, "Topical Report of Reactor Coolant Pump Flywheel Inspection Elimination" (staff-approved version).
WCAP-15666-1A, "Extension of RCP Motor Flywheel Examination."
WCAP-15666, "Extension of Reactor Coolant Pump Motor Flywheel Examination." (TAC No. MB2819) (Accession No. ML031250595)
WCAP-16738-NP, "Technical Bases for Eliminating Large Primary Loop Pipe Rupture as the Structural Design Basis for the Kewaunee Power Station for the License Renewal Program." (Accession No. ML092230622)
WCAP-15338-A, "A Review of Cracking Associated with Weld Deposited Cladding in Operating PWR Plants."
WCAP-7733, "Reactor Vessels Weld Cladding – Base Metal Interaction."
WCAP-8330, "Westinghouse Anticipated Transients without Trip Analysis." (Accession No. ML0617902740)

NRC FORM 335 (12-2010) NRCMD 3.7 — U.S. NUCLEAR REGULATORY COMMISSION	1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)
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5. AUTHOR(S) John W. Daily and Principal Contributors in Appendix C of report	6. TYPE OF REPORT Technical 7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Division of License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as Above

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

This safety evaluation report documents the technical review of the Kewaunee Power Station (KPS) license renewal application (LRA) by the U.S. Nuclear Regulatory Commission (NRC) staff (the staff). By letter dated August 12, 2008, Dominion Energy Kewaunee, Inc. (DEK) submitted the LRA in accordance with Title 10, Part 54, of the Code of Federal Regulations, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." DEK requested renewal of the KPS Facility Operating License Number DPR 43 for a period of 20 years beyond the current expiration at midnight on December 21, 2013.

KPS is located in the southeast corner of Kewaunee County, Wisconsin, on the western shore of Lake Michigan. The plant's nuclear steam supply system consists of a 2 loop pressurized water reactor with a dry, ambient containment. KPS operates at a licensed power output of 1,772 megawatts thermal, with a gross electrical output of approximately 590 megawatts electric.

On the basis of its review of the LRA, the staff concludes that the requirements of 10 CFR 54.29(a) have been met.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*	13. AVAILABILITY STATEMENT
Kewaunee Power Station Dominion Energy Kewaunee, Inc. License Renewal Nuclear Power Plant 10 CFR Part 54 Docket No. 50-305 Aging Management Scoping and Screening Time limited aging analyses	unlimited 14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

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