3. AGING MANAGEMENT REVIEW

3.0 Aging Management Review

The applicant has fully utilized the Generic Aging Lessons Learned (GALL) process defined in the SRP-LR (NUREG-1800) and the GALL report (NUREG-1801, Volumes 1 and 2). The purpose of the GALL report is to provide the staff with a summary of staff-approved AMPs for the aging of most structures and components that are 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 is a compilation of existing programs and activities used by commercial nuclear power plants to manage the aging of structures, systems, and components within the scope of license renewal and which are subject to an AMR. The GALL report summarizes the aging management evaluations, programs, and activities credited for managing aging for most of the structures and components used throughout the industry, and serves as a reference for both applicants and staff reviewers to quickly identify those aging management programs and activities that the staff has determined will provide adequate aging management during the period of extended operation.

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

In order to determine whether the GALL process would improve the efficiency of the license renewal review, the staff conducted a demonstration project to exercise the GALL process and determine the format and content of a safety evaluation based on the GALL review process. The SRP-LR was prepared based on both the GALL model and the lessons learned from the demonstration project.

As part of its review of the LRA, the staff performed an AMR inspection (Inspection Report 50-237/2003-010; 50-249/2003-010; 50-254/2003-14; 50-265/2003-14) from September 29–October 22, 2003, at both Dresden and Quad Cities Stations. The purpose of the inspection was to examine activities that support the LRA and consisted of a selected examination of procedures, representative records, and interviews with the applicant regarding proposed aging management activities. The team also reviewed the proposed implementation of all AMPs credited in the LRA for managing aging.

The staff also performed an AMP audit on October 7-8, 2003. The audit team reviewed those AMPs credited in the LRA for managing aging that the applicant claimed consistent with GALL. The audit team evaluated each of the 10 attributes of the applicant's AMP, which the applicant claimed were consistent with the attributes of the associated AMP described in the GALL report. Those AMPs that were not claimed to be consistent with the GALL Report, and those attributes that were deviations from the attributes described in the GALL Report AMPs, were provided to the NRC staff for review. The team concluded that, with the exception of the Fire

Protection Program, One-time Inspection Program, and the Selective Leaching Program, the applicant's AMPs were consistent with the GALL Report AMPs with differences/exceptions as stated in the LRA/RAIs. As result of this audit, the applicant has implemented enhancements to these AMPs. The AMP audit issues can be found in the staff's AMP Audit Report, dated February **XX**, 2004, and are addressed in this SER.

As a result of the staff's review of the LRA, including the additional information and clarifications submitted subsequently, the staff identified two proposed license conditions. The first license condition requires the applicant to include the updated final safety analysis report (UFSAR) Supplement in the next UFSAR update required by 10 CFR 50.71(e) following issuance of the renewed license. The second license condition requires that the future activities identified in the UFSAR Supplement be completed prior to the period of extended operation.

3.0.1 The GALL Format for the LRA

The Dresden/Quad Cities LRA closely follows the standard LRA format. This format has been used by previous applicants and will continue to be used by future applicants. However, there are several important changes within the format that reflect the GALL process. First, the tables in LRA Section 2 that identify the structures and components that are subject to an AMR now include a third column which links plant-specific structures and components in the Section 2 tables to generic GALL component groups in Section 3 (this is discussed in more detail below). Second, the tables in LRA Section 3 are different from the Section 3 tables used in previous LRAs. There are no system-specific tables in Section 3 of the LRA. The individual components within a system have been rolled up into a series of system group tables. For example, Section 2.3.3 of the Dresden/Quad Cities LRA addresses scoping and screening results for 28 auxiliary systems. Each system has several components. In previous LRAs, each system had a separate table that listed the components in the system, but with the Dresden/Quad Cities LRA, there are no such individual system tables. Instead, all the components in the 28 auxiliary systems are rolled up into two separate auxiliary system tables. LRA Table 3.3-1 consists of auxiliary system components that were evaluated in the GALL report, and LRA Table 3.3-2 consists of auxiliary systems components that were not evaluated in the GALL report. Similarly, the LRA tables for the other system groups (3.1 - reactor systems, 3.2 - engineered safety feature systems, 3.4 - steam and power conversion systems, 3.5 - structures, and 3.6 - electrical systems) have 3.X-1 LRA tables for components that were evaluated in the GALL report and 3.X-2 LRA tables for components that were not evaluated in the GALL report (where X corresponds to the appropriate subsection in Section 3).

The 3.X-1 tables provide information regarding AMPs that are consistent with the GALL Report. The first four columns of Table 3.X-1 are derived from Tables 3.1-1 through 3.1-6 of the SRP-LR. Included in this table is a discussion column. The discussion column provides a conclusion indicating if the aging management evaluation results are consistent with GALL, along with any clarifications or explanations required to support the conclusion, if the conclusion is different than those of the GALL Report. For a determination to be made that a table line item is "Consistent with GALL," several criteria must be met. First, the plant-specific component is reviewed against the GALL to ensure that the component, materials of construction, and internal or external service environments are comparable to those described in a particular GALL item. Second, for those that are comparable, the results of the plant aging management review/aging effect evaluation are compared to the aging effects/mechanisms in the GALL.

Finally, the programs credited in the GALL for managing those aging effects are compared to the programs described in the plant evaluation. If, using good engineering judgment, it could be reasonably concluded that the plant evaluation is in agreement with the GALL evaluation, a line item was considered consistent with GALL or NUREG-1801. There are cases where components, and component material/environment combinations, and aging effects are common between a NUREG-1801 line item and the plant evaluation, but the AMP selections differ. In those cases the discussion column indicates the plant AMP selection, but no conclusion will be made that the line item is consistent with the GALL.

The 3.X-2 tables provide information regarding AMPs that are different from or not addressed in the GALL Report. A plant component is considered not addressed by the NUREG if the component type is not evaluated in the GALL or has a different material of construction or operating environment than evaluated in the GALL.

The 3.X-2 tables are different from the 3.X-1 tables. The 3.X-2 tables include the component types, materials, environments, aging effects requiring management, the programs and activities for managing aging, and a discussion column. Because these structures and components were not evaluated in GALL, the staff performed a review, similar to those done for past applications.

3.0.2 The Staff's Review Process for GALL

The staff's review of Dresden/Quad Cities LRA for the AMR results and the associated AMPs was performed in three phases. In Phase 1, the staff reviewed the applicant's AMP descriptions to identify those AMPs for which the applicant claimed consistency with those reviewed and approved in the GALL report. In Section 3.0 of the LRA, the applicant stated the following in describing what it means for AMPs to be considered "consistent" with the GALL report (NUREG-1801):

> Identifies aging management reviews that are consistent with the NUREG-1801. This means that the component group, material and environment are applicable, the aging effect and aging mechanisms identified require management, the aging management program identified is appropriate, and the review results of the key elements provided in Appendix B concludes that the program elements are consistent with those elements provided in Chapters X and XI of NUREG-1801.

For the AMPs which the applicant claimed consistency with the AMPs in the GALL report, the staff conducted an audit to confirm that the applicant's AMPs were consistent with the AMPs in the GALL report.

Several AMPs were described by the applicant as being consistent with the GALL report, but with some deviation. These deviations are of three types: (1) exceptions to the GALL report - those evaluations where several of the individual NUREG-1801 line items may be evaluated as consistent with NUREG-1801 while other line items may be evaluated as exception to NUREG-1801; (2) further evaluations recommended by the GALL report - provides reference to sections providing further evaluation of aging management recommended by NUREG-1801; and (3) clarifications to the GALL report - provides notes to clarify NUREG-1801 Volume 2 line items such as those that are not in scope of license renewal or not installed at Dresden or Quad Cities. For each AMP that had one or more of these deviations, the staff reviewed each deviation to determine whether the AMP, as modified, would adequately manage the aging effect(s) for which it is credited. Through a license condition, the staff will require that any revisions to the AMP and UFSAR Supplement that must be made as a result of the deviation(s) are completed and implemented before the start of the period of extended operation.

Some AMPs were identified by the applicant as exceptions to the GALL report which means: those evaluations which are an exception to the NUREG-1801 aging effects or aging management program or activity and provides reference in Section 3 and/or Appendix B which provides further explanation and justification. In these cases, the exception refers to all of the NUREG-1801 line items. For those AMPs that are either identified as exceptions to the GALL report or not evaluated in the GALL report, the staff evaluated each AMP against the 10 AMP elements (Branch Technical Position RLSB-1 in Section A-1 of SRP-LR Appendix A). Through a license condition, the staff will confirm any new AMPs and associated UFSAR Supplements will be developed and implemented before the start of the period of extended operation.

The AMRs and associated AMPs in the GALL report fall into two broad categories: those AMRs and associated AMPs that the GALL report concludes are adequate to manage aging of the components referenced in the GALL report, and those AMRs and associated AMPs for which the GALL report concludes that aging management is adequate, but further evaluation must be done for certain aspects of the aging management process. In Phase 2, the staff compared the applicant's AMR results and associated AMPs to the AMR results and associated AMPs in the GALL report, to determine whether the applicant's AMRs and associated AMPs were consistent with those reviewed and approved in the GALL report. For those AMR results and associated AMPs for which the applicant claimed to be consistent with the GALL report, the staff conducted an inspection to confirm that the applicant's AMRs and associated AMPs were consistent with AMRs and associated AMPs in the GALL report. For AMRs and associated AMPs that were not consistent with the GALL report, the staff's review determined whether the AMRs and associated AMPs were adequate to manage the aging effects for which they were credited. Finally, for those AMRs and associated AMPs for which the GALL report recommended further evaluation, the staff reviewed the applicant's evaluation to determine whether the applicable aging effect would be adequately managed during the period of extended operation.

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

3.0.3 Common Aging Management Programs

Table 3.0.3-1 presents the common aging management programs.

Table 3.0.3-1: Common Aging Management Programs

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)
Inservice Inspection (B.1.1)	XI.M1, XI.S3	3.1 - RCS 3.5 - Structures	3.0.3.1
Water Chemistry (B.1.2)	XI.M2, XI.M21	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 -Steam and Power Conversion 3.5 - Structures	3.0.3.2
BWR Stress Corrosion Cracking AMP (B.1.7)	XI.M7	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary	3.0.3.3
Flow-Accelerated Corrosion (B.1.11)	XI.M17	3.1 - RCS 3.4 - Steam and Power Conversion	3.0.3.4
Bolting Integrity (B.1.12)	XI.M3, XI.M18	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.5
Open-cycle Cooling Water System (B.1.13)	XI.M20, XI.M21	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.6
Closed-cycle Cooling Water System (B.1.14)	XI.M20, XI.M21	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.7
Compressed Air Monitoring (B.1.16)	XI.M24	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.8
Above Ground Carbon Steel Tanks (B.1.20)	XI.M29	3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.9
One-Time Inspection (B.1.23)	XI.M32	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.10
Selective Leaching (B.1.24)	XI.M33	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.11
Buried Piping and Tanks Inspection (B.1.25)	XI.M34	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.12

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)
Containment ISI (B.1.28)	X.S1, XI.S1, XI.S2	3.5 - Structures 4.5 - Concrete and Containment Tendon Pre-Stress TLAA	3.0.3.13
Structures Monitoring (B.1.30)	XI.S6, XI.S7	3.3 - Auxiliary 3.5 - Structures	3.0.3.14
Corrective Action Program (B.2.1)	Plant Specific	All	3.0.4
Heat Exchanger Test and Inspection Activities (B.2.6)	Plant Specific	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.15
Lube Oil Monitoring Activities (B.2.5)	Plant Specific	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.16
Periodic Inspection of Ventilation System Elastomers (B.2.3)	Plant Specific	3.1 - RCS 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.17

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

Table 3.0.3-2: System-Specific Management Programs

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)
Reactor Head closure studs AMP (B.1.3)	XI.M3	3.1 - RCS	3.1.2.3.1
BWR vessel ID attachment welds AMP (B.1.4)	XI.M4	3.1 - RCS	3.1.2.3.2
Feedwater nozzle AMP (B.1.5)	XI.M5	3.1 - RCS	3.1.2.3.3
CRD return line nozzle AMP (B.1.6)	XI.M6	3.1 - RCS	3.1.2.3.4
BWR penetrations AMP (B.1.8)	XI.M7	3.1 - RCS	3.1.2.3.5
BWR vessel internals AMP (B.1.9)	XI.M13, XI.M16	3.1 - RCS	3.1.2.3.6
Thermal aging and neutron irradiation embrittlement (B.1.10)	XI.M13	3.1 - RCS	3.1.2.3.7
Reactor vessel surveillance (B.1.22)	XI.M31	3.1 - RCS	3.1.2.3.8

Applicant's AMP (LRA section)	**Associated GALL AMP**	**LRA System Groups that Credit the AMP for Aging Management**	**Staff Evaluation (SER Section)**
Periodic testing of drywell/torus nozzles (B.2.4)	Plant Specific	3.2 - ESF	3.2.2.3.2
Overhead load handling system (B.1.15)	XI.M23	3.3 - Auxiliary	3.3.2.3.1
Reactor water cleanup system inspection (B.1.17)	XI.M25	3.3 - Auxiliary	3.3.2.3.2
Fire Protection (B.1.18)	XI.M26	3.3 - Auxiliary	3.3.2.3.3
Fire water system (B.1.19)	XI.M27	3.3 - Auxiliary	3.3.2.3.4
Fuel oil chemistry (B.1.21)	XI.M30	3.3 - Auxiliary	3.3.2.3.5
Boraflex monitoring (B.1.36)	XI.M22	3.3 - Auxiliary	3.3.2.3.6
Main generator stator cooling water chemistry (B.2.7)	Plant Specific	3.4 - Steam and Power Conversion	3.4.2.3.1
Containment ISI (B.1.26- ASME XI IWE)	XI.S1, XI.S4	3.5 - Structures	3.5.2.3.1
ASME Section XI, subsection IWF (B.1.27)	XI.S3	3.5 - Structures	3.5.2.3.2
Masonry wall program (B.1.29)	XI.S5	3.5 - Structures	3.5.2.3.3
Inspection of water-control structures (B.1.31)	XI.S7	3.5 - Structures	3.5.2.3.4
Protective coating monitoring and maintenance (B.1.32)	XI.S8	3.5 - Structures	3.5.2.3.5
Electrical Cables and Connections not Subject to EQ (B.1.33)	XI.E1	3.6 - Electrical	3.6.2.3.1
Electrical Cables used in Instrumentation Circuits not Subject to EQ (B.1.37)	XI.E2	3.6 - Electrical	3.6.2.3.2
Inaccessible Medium voltage Cables not Subject to EQ (B.1.37)	XI.E3	3.6 - Electrical	3.6.2.3.3
Bus Ducts	Plant Specific	3.6 - Electrical	3.6.2.4.1
High Voltage Switchyard Bus	Plant Specific	3.6 - Electrical	3.6.2.4.2
High Voltage Transmission Conductors	Plant Specific	3.6 - Electrical	3.6.2.4.3
High Voltage Insulators	Plant Specific	3.6 - Electrical	3.6.2.4.4
Non-EQ Electrical Penetration Assemblies	Plant Specific	3.6 - Electrical	3.6.2.4.5
Environmental Qualification (B.1.35)	X.E1	3.6 - Electrical	4.4

3.0.3.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.1.1)

3.0.3.1.1 Summary of Technical Information in the Application

The applicant's inservice inspection program is discussed in LRA Section B.1.1."ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The applicant states that with enhancements the program is consistent with the ten elements of aging management program XI.M1. "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," identified in the GALL, with the exception that the GALL specifies that the aging management of the isolation condenser be performed under Subsection IWB (for Class 1 components) of the ASME Code, Section XI. However, the isolation condenser of Dresden is classified as ASME Code Class 2 on the tube side and Class 3 on the shell side. Therefore, the applicant states in the LRA that Subsections IWC and IWD are applicable for aging management of the isolation condenser in lieu of IWB, since Class 1 requirements do not apply.

This AMP is credited with managing aging in the RCS piping, reactor internals, and components in the RCS except the reactor vessel and structures. The GALL specifies the program to comply with the 1995 Edition through the 1996 Addenda of the ASME Code, Section XI. The current Code of record for Dresden and Quad Cities is the 1989 Edition of ASME Section XI. The LRA contains a commitment by the applicant to enhance the program to be consistent with the requirements of the 1995 Edition through the 1996 Addenda of the ASME Code, Section XI. This enhancement is scheduled for implementation prior to the period of extended operation. This is Commitment #1 in Appendix A of this SER.

The LRA notes that both Dresden and Quad Cities have successfully identified indications of age-related degradation prior to any loss of intended function of components, and have taken appropriate corrective actions through evaluation, repair, or replacement of components in accordance with the ASME Code, Section XI and station implementing procedures.

The applicant concludes that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program provides reasonable assurance that aging effects are adequately managed so that the intended functions of components within the scope of license renewal that are covered by this program are maintained during the period of extended operation.

3.0.3.1.2 Staff Evaluation

In LRA Section B.1.1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," the applicant described its AMP to manage aging in the reactor coolant pressure retaining piping and components within the scope of license renewal, except for the reactor pressure vessel. The LRA stated that this AMP is consistent with the GALL AMP XI.M1, "ASME Section XI, Subsections IWB, IWC, and IWD," with an exception regarding the application of Subsection IWB for the Dresden isolation condenser, which is not a Class 1 component and therefore, Subsection IWB does not apply. For this AMP, the GALL recommends further evaluation. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and enhancement and justification of the deviation to determine whether the AMP, with the deviation, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. Finally, the staff determined whether the applicant properly applied the GALL program to its facilities. In a letter dated, August 7, 2003, the staff requested additional information from the applicant relative to the inservice inspection program. The applicant responded in a letter dated October 3, 2003.

In response to RAI B.1.1(d) the applicant provided additional clarification related to ASME Section XI Subsection IWB and IWC program requirements and the alternative risk-informed inservice inspection (RI-ISI) programs for Class 1 and 2 piping within the scope of license renewal previously reviewed and approved by the NRC. The applicant stated that LRA Appendix B, B.1.1 should have noted an exception for the implementation of RI-ISI and its alternative inspections for Class 1 and 2 piping within the scope of license renewal, which will be implemented at both Dresden and Quad Cities. In addition the applicant confirmed that the plant specific RI-ISI evaluations have not identified any particular risk significant components subject to aging management or particular aging effects not addressed in the GALL. Since the Dresden and Quad Cities RI-ISI programs have been approved as an acceptable alternative to the ASME Section XI Subsection IWB and IWC program requirements and the alternative risk-informed inservice inspection (RI-ISI) programs for Class 1 and 2 piping and since the RI-ISI evaluations did not identify any particular risk significant components subject to aging management or particular aging effects not addressed in the GALL, the staff finds the use of RI-ISI to be acceptable.

3.0.3.1.3 Conclusions

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

3.0.3.2 Water Chemistry Program (B.1.2)

3.0.3.2.1 Summary of Technical Information in the Application

The applicant's water chemistry program is discussed in LRA Section B.1.2 "Water Chemistry". The applicant states that with exceptions and enhancements the program is consistent with the ten elements of aging management program XI.M2."Water Chemistry," specified in the GALL.

The applicant identified the following exceptions to the GALL:

- The Dresden and Quad Cities water chemistry programs are based on EPRI-TR-103515-Rev. 2, while the GALL references Revision 1.

- The GALL indicates that hydrogen peroxide is monitored to mitigate degradation of structural materials. Dresden and Quad Cities programs do not monitor for hydrogen peroxide.

- The GALL indicates that the condensate storage tank, demineralized water storage tank, and torus (pressure suppression pool) water are sampled for dissolved oxygen. The Dresden and Quad Cities programs do not sample for dissolved oxygen.

- The GALL indicates that water quality (pH and conductivity) is maintained in accordance with established guidance. Dresden and Quad Cities programs do not monitor pH in the condensate storage tank, demineralized water storage tank, or torus (pressure suppression pool) water.

- Aging of SBLC system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring of SBLC makeup water chemistry. The makeup water is monitored in lieu of the storage tank. The effectiveness of the water chemistry program will be verified by a one-time VT-3 inspection of a Dresden SBLC pump discharge valve casing and a Quad Cities SBLC pump casing as discussed in the One-Time Inspection (B.1.23) aging management program.

The applicant indicates that the Dresden and Quad Cities Water Chemistry programs will be enhanced by revising procedures to provide for increased sampling to verify corrective actions taken to address abnormal chemistry conditions and the Quad Cities procedure for turbine building sample panel collection will be revised to assure maintenance of the chemistry integrity of samples. These enhancements are scheduled for implementation prior to the period of extended operation. This is Commitment #2 in Appendix A of this SER.

The applicant states that appropriate guidance for maintaining the contaminants below specific limits is provided and that periodic self-assessments of the water chemistry activities have been and continue to be performed to identify areas that need improvement to maintain the quality performance of the activity.

According to the applicant, the water chemistry program has identified instances where parameters were outside the established specifications. Increased sampling and actions to bring the parameters back into specification were initiated.

This AMP is credited with managing the RCS, ESF, auxiliary, and steam and power conversion systems and structures.

The applicant concludes that with the exceptions and enhancements, the Water Chemistry aging management program provides reasonable assurance that aging effects are adequately managed so that the intended functions of components within the scope of license renewal that are covered by this program are maintained during the period of extended operation.

3.0.3.1.2 Staff Evaluation

In LRA Section B.1.2, “Water Chemistry,” the applicant described its AMP to manage aging of components exposed to reactor water, condensate and feedwater, control rod drive water, demineralized water storage tank water, condensate tank water, torus water (pressure suppression pool), and spent fuel pool water. The LRA stated that this AMP is consistent with GALL AMP XI.M2, “Water Chemistry,” with exceptions and enhancements. For this AMP, GALL recommends further assessment in the form of a plant specific evaluation. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. The staff also reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL report and confirmed that the AMP would adequately address these issues. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

In a letter dated, August 7, 2003, the staff requested additional information from the applicant relative to the water chemistry program. The applicant responded to these RAIs in a letter dated October 3, 2003.

The GALL water chemistry program references revision 1 of the EPRI BWR Water Chemistry Guidelines, TR-103515, while the applicant currently employs revision 2 of the EPRI BWR Water Chemistry Guidelines. The exceptions identified in the applicant's LRA all relate to the applicant's use of Revision 2 of EPRI TR-103515, "BWR Water Chemistry Guidelines". In addition to the exceptions identified in the applicant's LRA, the staff requested that the applicant outline the key differences between revision 1 and revision 2 and justify why revision 2 is acceptable for use at Dresden and Quad Cities in RAI B.1.2a. The applicant indicated that Revision 2 of the EPRI BWR Water Chemistry Guideline recommends that chlorides and sulfates need not be measured on a daily basis provided conductivity is trended to ensure action level I limits are not exceeded. The applicant has not implemented this change and continues to monitor chlorides and sulfates in accordance with the guidance of Revision 1. The applicant indicated that Revision 2 of the EPRI BWR Water Chemistry Guideline recommends that plants using hydrogen water chemistry (HWC) with noble metals chemical addition (NMCA) no longer need to measure electrochemical potential (ECP) on a continuous basis. The applicant uses HWC with NMCA; however, the applicant continues to use ECP monitoring. The applicant indicated that Revision 2 of the EPRI BWR Water Chemistry Guideline allows plants utilizing HWC with NMCA to employ higher action levels for chlorides and sulfates based on the increased protection provided by the HWC with NMCA. The applicant indicated these increased chloride and sulfate limits have been incorporated into chemistry procedures. The applicant further stated that corrective action is required to reduce chloride and sulfate level if parameters exceed plant goal values which are established at values significantly below the EPRI Guideline chloride and sulfate action levels.   The applicant indicated that Revision 2 of the EPRI BWR Water Chemistry Guideline recommends the reactor water iron levels be monitored as a new diagnostic parameter and that the action level for feedwater copper be decreased. The applicant has incorporated these conservative actions into the plant chemistry procedures. The applicant indicated that Revision 2 of the EPRI BWR Water Chemistry Guidelines recommends that the action level for minimum feedwater dissolved oxygen be increased. This change is considered conservative relative to reducing the FAC wear rates and the applicant has incorporated this change into the plant chemistry procedures. The staff finds that the applicant's use of revision 2 of the EPRI BWR Water Chemistry Guidelines acceptable because the applicant has conservatively implemented the requirements of revision 2 by continuing to monitor chlorides and sulfates on a daily basis, continuing to monitor ECP in conjunction with the use of HWC with NMCA, implementing monitoring of new parameters (feedwater iron concentration) and conservatively adjusting the limits of other parameters (feedwater copper and dissolved oxygen) as recommended in revision 2 of the EPRI BWR Water Chemistry Guidelines. Further, the staff has previously reviewed implementation of Revision 2 of the EPRI BWR Water Chemistry Guidelines as documented in NUREG-1769, “Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3". Therefore, the staff finds the use of revision 2 to be acceptable.

The applicant took exception to the GALL BWR water chemistry program and indicated that dissolved oxygen and pH are not monitored in the condensate storage tank, demineralized water storage tank, and the torus water. In RAIs B.1.2c & e, the staff requested the applicant to identify if alternative methods are applied to characterize the aggressiveness of the water chemistry in lieu of pH and oxygen measurements, and, if so, to describe the methods and its implementation. The applicant responded that the following alternative methods are applied: monitoring of conductivity, chlorides, and sulfates are in accordance with limits set by EPRI TR-103515, Rev.2 and procedures employ goal values set below the EPRI guideline action limits. Further, the applicant indicated that if parameters exceed the goal values, the parameters are verified, and if necessary corrective action is implemented to return the parameters to the desired ranges. These actions include increased sampling frequency to verify the effectiveness of corrective action. The staff finds the response to be acceptable because the alternate methods are recommended in the EPRI guidelines, plant goal values are conservatively set, and corrective actions, including increased sampling, are taken when the goal values are exceeded.

The applicant indicated that aging management for the SBLC system relies on monitoring the SBLC make-up water in lieu of the storage tank water because the sodium pentaborate solution would likely mask most chemistry parameters monitored. Since the applicant does not monitor the storage tank solution, the staff requested in RAI B.1.2d, that the applicant provide assurance that the receipt inspection process will preclude introduction of unexpected impurities with the sodium pentaborate to avoid aggressive conditions in the tank. The applicant stated that Borax and Boric Acid (which are combined to make the sodium pentaborate) are purchased and verified by receipt inspection to meet General Electric Material Specification D50YP1, Revision 3. The staff requested that the applicant provide information regarding how aging degradation of the SBLC tank and piping up to the pump will be managed since sampling chemistry downstream of the tank and receipt inspection of the chemicals used in the tank will not provide adequate assurance that degradation is not occurring in this section of the system. In its supplemental information dated December 22, 2003, the applicant committed to perform an inspection of a Dresden SBLC pump discharge valve and a Quad Cities SBLC pump casing. This is part of Commitment #23 of Appendix A of this SER. This is Confirmatory Item B.1.2-1.

The staff requested in RAI B.1.2g that the applicant indicate how the One-Time Inspection Program will be applied to the most vulnerable areas, the basis for selection of these areas, how these areas are applicable to other system locations covered by the Water Chemistry AMP, and to confirm the effectiveness of the AMP to manage aging effects in areas of low flow and other areas subject to degradation if the management of water chemistry is inadequate. A similar request was made in RAI B.1.23-1. The applicant’s response indicated that components are selected based on materials of construction and system conditions, such as stagnant or low flow areas, that would be most susceptible to general, crevice and pitting corrosion and noted that if test or inspection results do not satisfy inspection criteria, an evaluation will be performed and a condition report initiated to document the concern in accordance with plant administrative procedures. The staff requested the applicant clarify their response regarding chemistry one-time inspections for detecting general and pitting corrosion. The applicant responded in a letter dated November 20, 2003 and indicated that the Chemistry One-Time Inspections will inspect for general, pitting and crevice corrosion of carbon steel and stainless steel components. The staff concluded that the applicant's use of one time inspection will adequately verify the effectiveness of the water chemistry program to manage aging because the applicant will perform inspections in stagnant and low flow areas to detect general crevice and pitting corrosion as outlined in the GALL.

The staff requested in RAI B.1.2h, the applicant provide further information with regard to how the water chemistry program will manage the effects of aging of the aluminum tanks containing condensate and demineralized water. The applicant responded that crevice and pitting corrosion are the aging mechanisms of concern for the aluminum tanks and described the guidance that will be followed in maintaining a low impurity environment (EPRI TR-103515, Rev. 2) to minimize crevice and pitting corrosion. Further, the applicant stated in a letter dated November 20, 2003, that the aluminum tanks will have periodic internal visual inspections and UT inspection will be performed on the tank bottoms as part of the above ground tank AMP described in Section 3.0.3.9. The response is acceptable to the staff because the aging mechanisms identified are those of concern with these components, the applicant will follow the EPRI BWR Chemistry guidelines and internal inspections will be performed.

RAI B.1.2i requested the applicant to provide additional information relative to its operating experience by discussing the abnormal chemistry conditions mentioned in the LRA, and the actions taken. The applicant responded with several examples where water chemistry parameters were observed to be outside established specifications, discussed the conditions and the resulting corrective actions, including increased sampling to verify the effectiveness of corrective actions. The applicant indicated that their review of operating experience at both Dresden and Quad Cities did not note any degradation attributable to abnormal chemistry conditions. The staff finds the applicant's response acceptable because the applicant's review of operating experience indicates that degradation has not been traceable to instances of abnormal chemistry.

3.0.3.1.3 Conclusions

On the basis of its review and audit of the applicants program, pending satisfactory resolution of Confirmatory Item B-1.2-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 BWR Stress Corrosion Cracking (B.1.7)

3.0.3.3.1 Summary of Technical Information in the Application

The applicant's stress corrosion cracking aging management program is discussed in LRA Section B.1.7 "BWR Stress Corrosion Cracking". The purpose of this program is to mitigate intergranular stress corrosion cracking (IGSCC) in stainless steel reactor coolant pressure boundary components and in stainless steel piping four inches and greater nominal pipe size. Preventive measures include monitoring and controlling of water impurities by water chemistry program activities and providing replacement stainless steel components in the solution annealed condition with a maximum carbon content of 0.035 wt.% and a minimum ferrite level of 7.5 wt. %. The applicant conducts inspection and flaw evaluation activities in accordance with the inservice inspection program plans for the stations.

This AMP is credited with managing aging in RCS, ESF, and auxiliary systems.

The applicant states that the program will be enhanced prior to the period of extended operation to be consistent with the requirements of the 1995 Edition through the 1996 Addenda of the ASME Section XI Code. With the enhancement, the applicant states that the program is consistent with the ten elements of aging management program XI.M7."BWR Stress Corrosion Cracking" specified in the GALL report. An exception is that GALL specifies the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The applicant is applying the 2000 revision of the EPRI guidelines.

According to the applicant, the BWR stress corrosion cracking aging management program activities have detected flaw indications in reactor coolant pressure boundary piping prior to loss of intended functions of the component. Examples are indications on the reactor vessel safe ends, and recirculation piping. The applicant's engineering staff evaluated these indications and, where necessary, performed repairs in accordance with ASME Section XI and station procedural requirements. The LRA indicates that periodic self-assessments of program activities have been performed and will continue to be performed to identify areas that need improvement. The applicant states that when problems have been identified, corrective actions have been taken to prevent recurrence.

The applicant concludes that the BWR Stress Corrosion Cracking aging management program including the exception and enhancement provides reasonable assurance that IGSCC aging effects will be adequately managed so that the intended functions of the stainless steel components in the reactor coolant pressure boundary are maintained during the period of extended operation.

3.0.3.3.2 Staff Evaluation

In LRA Section B.1.7, "BWR Stress Corrosion Cracking," the applicant described its AMP and stated that this AMP is consistent with the GALL AMP XI.M7, "BWR Stress Corrosion Cracking," with exceptions regarding the use of an updated edition of EPRI-TR-103515 "BWR Water Chemistry". The staff evaluation of exceptions to the water chemistry program is contained in Section 3.0.3.2 of this SER. The staff confirmed the applicant's claim of consistency with GALL. Furthermore, the staff reviewed the exception and justifications to determine whether the AMP, with the exception, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. In addition, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program.

In a letter dated, August 7, 2003, the staff requested the applicant to expand on the operating experience in the BWR Stress Corrosion Cracking Program description by providing plant specific experiences with managing IGSCC using this program. The applicant was also requested to provide information regarding whether hydrogen water chemistry and noble metal chemical addition (NMCA) are implemented at the Dresden and Quad Cities plants and how implementation has affected monitoring of water chemistry parameters.

The applicant responded in a letter dated October 3, 2003, providing a representative account of past experience in managing IGSCC at Dresden and Quad Cities. The applicant has identified IGSCC throughout plant history at D/QCNPS and has performed engineering evaluations and repairs or has replaced components with IGSCC resistant material. Mitigative actions such as induction heat stress improvement (IHSI) of susceptible welds and HWC with NMCA have been implemented to assist in managing IGSCC. The applicant related cases where the program inspection schedule has been conservatively adjusted based on plant operating experience to support management of IGSCC detection.

For instance, the applicant indicated that at Quad Cities they follow the inspection frequencies identified in BWRVIP-75 for Category C through E welds (there are no Category B welds) for normal water chemistry although HWC with NMCA has been implemented and BWRVIP 75 would support reduced inspection frequencies with HWC with NMCA implemented. At Dresden, the applicant indicated that inspection frequencies are based on BWRVIP-75 guidelines for either normal water chemistry or HWC with NMCA. The applicant stated that inspection frequencies are only reduced (per BWRVIP-75) in Unit 2 where improved water chemistry has been demonstrated to be effective. The applicant indicated that improved water chemistry has been used in Unit 2 since 1983, but was not implemented in Unit 3 until 1996. The staff finds the applicant’s response acceptable because the applicant’s program follows the guidelines of BWRVIP-75 and has incorporated plant operating experience to manage IGSCC.

3.0.3.3.3 Conclusions

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

3.0.3.4 Flow-Accelerated Corrosion (B.1.11)

3.0.3.4.1 Summary of Technical Information in the Application

The applicant's flow-accelerated corrosion (FAC) aging management program is discussed in LRA Section B.1.11, "Flow-Accelerated Corrosion," and is based on EPRI guidelines found in NSAC-202L-R2, "Recommendations for an Effective Flow Accelerated Corrosion Program." The program predicts, detects, and monitors for loss of material by wall thinning in piping, fittings, and valve bodies due to FAC.

This AMP is credited with managing aging in piping, fittings, and valve bodies in the RCS and Steam and Power Conversion systems.

The applicant states that analytical evaluations and periodic examinations of locations that are most susceptible to wall thinning due to FAC are used to predict the amount of wall thinning in pipes and fittings. Program activities include analyses to determine critical locations, baseline inspections to determine the extent of thinning at these critical locations, and follow-up inspections to confirm the predictions. Repairs and replacements are performed as necessary. The applicant states that operating experience has shown that the program can determine susceptible locations for FAC, predict component degradation, and detect wall thinning in piping and valves due to FAC.

The applicant states that with an enhancement, the FAC AMP is consistent with the ten elements of aging management program XI.M17, "Flow-Accelerated Corrosion," specified in NUREG-1801. The enhancement required to make the applicant's program consistent with the GALL is to expand the program scope to include main steam piping within the scope of license renewal. The applicant stated that this enhancement is scheduled for implementation prior to the period of extended operation.

3.0.3.4.2 Staff Evaluation

In LRA Section B.1.11, "Flow-Accelerated Corrosion," the applicant described its AMP to manage flow-accelerated corrosion in piping, fittings, and valves within the scope of license renewal. The LRA stated that this AMP is consistent with GALL AMP XI.M17, "Flow-Accelerated Corrosion" with no deviations. The program will require one enhancement, which the applicant has committed to make prior to the period of extended operation, to make it consistent with GALL. This is Commitment #11 in Appendix A of this SER. The staff confirmed the applicant's claim of consistency with GALL during the AMR inspection. In addition, the staff determined whether the applicant properly applied the GALL program to its facilities. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

In a letter dated, August 7, 2003, the staff requested in RAI B.1.11, that the applicant provide operating experience demonstrating the effectiveness of the program such as corrective actions taken, identifying changes to the program to ensure that flow accelerated corrosion has been successfully managed and provide evidence that the current aging management program has been effective to successfully mitigate and detect wall thinning during the time period addressed by the LRA.

In a letter dated October 3, 2003, the applicant responded with a detailed account of operating experience related to the Flow Accelerated Corrosion (FAC) programs at both Dresden and Quad Cities. The applicant noted that the FAC programs at Dresden and Quad Cities have identified wall thinning prior to the loss of intended function of the piping. Program changes made to improve effectiveness were also identified. The EPRI approved FAC software (CHECWORKS) is maintained by the applicant to improve the modeling and prediction of wall thinning. In addition, when degradation is detected, additional inspections are performed to ensure that the area of thinning has been bounded. The program has resulted in the timely replacement of degraded piping, in most cases with piping made of FAC resistant materials, and the programs have been maintained and upgraded on the basis of plant operating experience. The response addresses the issues posed in the RAI and demonstrated to the staff satisfaction that the FAC programs have been effective in managing aging effects from wall thinning.

The staff finds the FAC AMP to be acceptable because the program is consistent with the GALL and because the program has used plant specific experience to ensure that the program is adequately managing aging effects.

3.0.3.4.3 Conclusions

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

3.0.3.5 Bolting Integrity (B.1.12)

3.0.3.5.1 Summary of Technical Information in the Application

The applicant's bolting integrity program is discussed in LRA Section B.1.12, "Bolting Integrity Program." The applicant states that the program is consistent with GALL program XI.M18, "Bolting Integrity," with the following exceptions:

- The GALL indicates that EPRI TR-104213, "Bolted Joint Maintenance and Applications Guide," is used as a basis for evaluation of the structural integrity of non-safety related bolting. The Dresden and Quad Cities programs address the guidance contained in EPRI TR-104213 but do not specifically cite its use.

- The GALL indicates that the program covers all bolting within the scope of license renewal including structural bolting. The Dresden and Quad Cities bolting integrity programs do not address structural bolting. The Structures Monitoring Program (B.1.30) covers aging management of structural bolting.

- The GALL indicates that the program covers all bolting within the scope of license renewal including bolting for Class 1 NSSS component supports. The Dresden and Quad Cities bolting integrity programs do not address Class 1 NSSS component support bolts which are covered under the ASME Section XI, Subsection IWF aging management program (B.1.27).

- The GALL indicates that the program generally includes periodic inspection for loss of preload. The Dresden and Quad Cities programs do not include inspections for loss of preload because loss of preload in a mechanical joint is a design driven effect and not an aging effect.

The applicant also identified two enhancements which will be required to make the AMP consistent with GALL. The program will be revised to be in accordance with the 1995 Edition through the 1996 Addenda and approved relief requests of ASME Section XI for inservice inspection of Class 1,2, and 3 components. Also, the program will provide for formal inspections of bolted joints in diesel generator components and performing periodic inspection of components with bolted joint is in high humidity/moisture areas (pump vaults). These enhancements will be implemented prior to the period of extended operation.

The applicant states that Dresden and Quad Cities have experienced isolated cases of bolting degradation attributed to aging effects due to loss of material and cracking. System engineer walkdowns have also identified incidental surface rust on exterior component surfaces. In all cases, the existing inspection and testing methodologies have discovered deficiencies and corrective actions were implemented prior to loss of system or component intended functions.

This AMP is credited for managing degradation of bolting in the RCS, ESF, Auxiliary, and Steam and Power Conversion Systems.

3.0.3.5.2 Staff Evaluation

In LRA Section B.1.12, "Bolting Integrity Program," the applicant described its AMP to manage effects of aging in bolting. The LRA states that this AMP is consistent with GALL AMP XI.M18, "Bolting Integrity," with the exceptions in regard to (1) the reference to EPRI TR-104213; (2) this AMP does not cover structural bolting; (3) this AMP does not include aging management of ASME Section XI Class 1, 2, and 3, and Class MC support members, including mechanical connections; and (4) inspection for loss of preload is not included in this AMP. The staff reviewed the applicant's claim of consistency with GALL, including the exceptions and justifications, during the AMR inspection. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program. In a letter dated August 7, 2003, the staff requested additional information from the applicant on the bolting integrity program. The applicant responded to staff's RAI in letter dated October 3, 2003.

With regard to non-safety related bolting, the applicant clarified their compliance with the GALL referenced industry consensus recommendations in EPRI TR-104213 in their response to RAI B.1.12(c). The applicant confirmed that the non-safety related bolting integrity program addressed in LRA Section B.1.12 meets the intent of the aging management attributes delineated in EPRI TR-104213 including material procurement, use of approved lubricants and sealants, proper torquing, and leakage evaluations. However, the bolting program implementing procedures do not specifically reference EPRI TR-104213. The applicant committed to enhance the implementing procedures for this aging management program to reference maintenance evaluations and repairs of non-safety related bolted connections follow the EPRI bolting guidelines per EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants," and TR-113859 "Proceeding of the 1st International Conference on Sealing Technology and Plant Leakage Reduction (ICSTPLR-99)" for the evaluation and repairs of the flange and bolts. This is part of Commitment #12 in Appendix A of this SER. The staff finds that the applicant's bolting integrity aging management program for non-safety related bolting consistent with the recommendations in the GALL and will meet or exceed the standards delineated in EPRI TR-104213.

For safety related bolting, the GALL relies on the NRC recommendations and guidelines on comprehensive bolting integrity program delineated in NUREG-1339 "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," and industry's technical basis for the program and guidelines in regard to material selection and testing, bolting preload control, inservice inspection (ISI), plant operation and maintenance, and evaluation of structural integrity of bolted joints outlined in EPRI NP-5769, with the exceptions noted in NUREG-1339. The LRA states that the bolting integrity program at Dresden and Quad Cities incorporates industry recommendations addressed in EPRI NP-5769, yet makes no reference to the NRC recommendations delineated in NUREG-1339 and NRC exceptions to EPRI NP-5769. In their response to RAI B.1.12(d) the applicant confirmed that Dresden and Quad Cities programs meets the intent of EPRI NP-5769, and the exceptions noted in NUREG-1339, for material selection, testing, inservice inspection (ISI), and plant surveillance and maintenance practices. The corporate and station implementing procedures specifically cite EPRI NP-5769, however NUREG-1339 is not specifically referenced. The applicant committed to enhance the implementing procedures for this aging management program to reference NUREG-1339. This is part of Commitment #12 in Appendix A of this SER.

The scope of the Bolting Integrity program in the GALL primarily applies to the ASME code piping and components including high strength bolting used in NSSS component supports where the actual yield strength is greater than 150 ksi (GALL item number III.B.1.1.2-a). Other structural bolting used in supports, including expansion and anchor bolts are managed under ASME Section XI, Subsection IWF (B.1.27) or the Structures Monitoring program (B.1.30) in accordance with GALL.

The LRA states that the Dresden and Quad Cities bolting integrity programs do not include bolting for Class 1 NSSS component support bolts. However, the applicant identified two uses of high strength bolting in supports for Class 1 piping and components - refer to Staff's discussion in Section 3.5.2.4.5.2 in this SER. The staff finds that the applicant's information related to ASTM A193, Grade B7 bolting material is sufficient to establish that the upper limit on yield strength is less than 150 ksi; consequently, the additional inspections of XI.M.18 Bolting Integrity are not warranted for A193, Grade B7. However, in part (c) of its response, the applicant has assumed that the bolt material used in "a friction type connection at the reactor skirt base" is ASTM A193, Grade B7 or equivalent. The applicant was requested to confirm that assumption or commit to inspection in accordance with NUREG-1801, Program XI.M.18 Bolting Integrity. In a letter dated December 5, 2003, the applicant stated that it would commit to inspection in accordance with NUREG-1801, Program XI.M.18 Bolting Integrity since it could not confirm that the yield strength of the bolts would be less than 150 ksi. This is part of Commitment #12 in Appendix A of this SER. The staff finds the applicant's response acceptable and considers RAI 3.5-13 resolved.

In response to RAI B.1.12(e) the applicant stated that the monitoring of the loss of preload for closure bolting in the reactor vessel, recirculation pumps, reactor recirculation valves, vessel head vent valves, and the reactor coolant piping will be monitored under the Bolting Integrity Program. Further, in response to staff's RAI 3.3-9, the applicant also included management of age-related degradation due to general corrosion on the external surfaces of non-bolting components such as piping, valves, and mufflers within the Bolting Integrity Program and will rely on component inspections under preventive maintenance, and routine walk down inspections. Presence of external surface corrosion will require engineering evaluation. The applicant asserted that these activities will detect early leakage and material degradation of closure bolting.

The staff has previously accepted the use of periodic inservice inspections of closure bolting as an acceptable aging management program for loss of mechanical closure integrity since failure of the mechanical joint, as evidenced by leakage, can be attributed to, loss of material, cracking of bolting materials, and loss of preload. The staff determined that periodic ASME Section XI inservice inspections and plant preventative maintenance programs can be effectively relied upon to identify loss of closure integrity for bolted assemblies. Therefore, the applicant's management of loss of mechanical closure integrity is adequate for managing the aging effects of loss of material, cracking, and loss of preload.

3.0.3.5.3 Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.6 Open-Cycle Cooling Water System (B.1.13)

3.0.3.6.1 Summary of Technical Information in the Application

The applicant's open-cycle cooling water system program is discussed in LRA Section B.1.13, "Open-Cycle Cooling Water Program." The applicant states that, with enhancements, the program is consistent with GALL program XI.M20, "Open-Cycle Cooling Water Program" with exceptions. The following enhancements and exceptions are identified in the LRA.

> Enhancements
>
> The program will provide for inspection of cooling water pump internal lining, additional heat exchangers and sub-components, inspection of external surfaces of various submerged pumps and piping.
>
> The program will provide for new periodic component inspections in the pump vaults that have a high humidity/moisture environment.

Exceptions to NUREG-1801

NUREG-1801 indicates that program testing and inspections are performed annually and during refueling outages. The Dresden/Quad Cities open-cycle cooling water system aging management program activities provide for adjustment of inspection intervals due to specific inspection results as stated in the response to GL 89-13.

In LRA Section B.1.13 and UFSAR supplement A.1.13, the applicant describes the Open-Cycle Cooling Water System program as an existing aging management program that manages loss of material, cracking, buildup of deposits and flow blockage aging effects in cooling water systems that are tested and inspected in accordance with the guidelines of GL 89-13. More specifically, the Open-Cycle Cooling Water System program is credited with managing the following aging effects during the period of extended operation:

- loss of material due to general, pitting, crevice corrosion, galvanic, erosion, wear, selective leaching and MIC
- cracking due to stress corrosion cracking and mechanical fatigue
- buildup of deposit/fouling/flow blockage due to biofouling and silting.

This AMP is credited with managing the ESF, Auxiliary, and Steam and Power Conversion systems.

The applicant states that the operating experience of the Dresden/Quad Cities Nuclear Stations has shown that its open-cycle cooling water system aging management activities have detected aging degradation and implemented appropriate corrective actions to maintain system and component intended function. The applicant also states that the program consists of system test procedures, inservice testing, periodic component inspections, piping nondestructive examinations, station maintenance inspections, component preventive maintenance testing, inservice inspections, and inspections for the Class 3 portions of raw water system. The LRA credits system and component tests, visual inspections, NDE, flushing and chemical treatment to ensure that aging effects are managed such that system and component functions are maintained. The applicant also identifies that inservice inspections of the Class 3 portions of the raw water systems are also conducted to provide periodic leakage detection of the aboveground and buried piping, but external surfaces of buried components are managed by AMP B.1.25.

In Section B.1.13 of the LRA, the applicant concluded that the open-cycle cooling water program provides reasonable assurance that the aging effects are adequately managed so that the intended functions of open-cycle cooling water components within scope of license renewal are maintained during the period of the extended operation.

3.0.3.6.2 Staff Evaluation

In LRA Section B.1.13, “Open-Cycle Cooling Water System,” the applicant describes its AMP to manage aging on raw cooling water system piping and components. The LRA stated that with enhancements this AMP is consistent with GALL AMPs XI.M20, “Open-Cycle Cooling Water System” with an exception. The staff confirmed the applicant’s claim of consistency during the AMR inspection. The staff reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. The staff also reviewed the exception and its justification to determine whether the AMP, with the exception, remains adequate to manage the aging effects for which it is credited. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

In the description of the AMP B.1.13, the applicant includes an exception to NUREG-1801 concerning the adjustment of inspection intervals due to specific inspection results as stated in the response to GL 89-13. By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (a), the applicant to clarify if these adjustments are in accordance with the information provided in GL 89-13 concerning a routine inspection and maintenance program and section D, “frequency of testing and maintenance,” in GL 89-13, Supplement 1.

In its response dated October 3, 2003, the applicant stated that the adjustments to the inspection intervals for the Dresden and Quad Cities open-cycle cooling water system aging management program activities are in accordance with the information provided in GL 89-13 concerning routine inspection and maintenance programs and section D, “frequency of testing and maintenance”, in GL 89-13, Supplement 1. The applicant clarified that one representative heat exchanger for each heat exchanger type with similar operating conditions would be tested/inspected as required by Supplement 1 of GL 89-13 to establish the appropriate test frequency for that type of heat exchanger.

On the basis of its review, the staff finds that the applicant’s response to RAI B.1.13 (a) adequate and acceptable because the applicant has demonstrated that the test frequency would be tested/inspected as required by Supplement 1 of GL 89-13. This issue is characterized as resolved.

In the description of the AMP B.1.13, the applicant lists its first enhancement to NUREG-1801 as "The program will provide for inspection of cooling water pump internal linings, additional heat exchangers and sub-components, inspection of external surfaces of various submerged pumps and piping."   By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (b), the applicant to identify the specific additional heat exchangers and sub-components that are to be inspected, the inspection frequency, and the technical basis, including operating experience for the inspection frequency.

In its response dated October 3, 2003, the applicant stated that additional inspection requirements were added for the heat exchanger as shown in the table below. The applicant identified that the frequencies of these inspections are based on reviews of industry, company, and vendor operating experience. The applicant clarified that station and corporate procedures and policies contain provisions for adjustment of inspection frequencies based on periodic reviews of operating experience, inspection results, and vendor recommendations.

Heat Exchanger	**EPN(s)**	**Frequency**
Dresden TBCCW Heat Exchanger (tube side only)	2(3)-3802-A(B)	6-year
Dresden RBCCW Heat Exchanger	2/3-3702, 2(3)-3702-A(B)	3-year

In addition, the applicant identified that new inspection requirements delineated specific sub-components to be inspected for the affected heat exchanger. The specific sub-components include:

- Inlet/outlet end bells, divider plates, joint welds as applicable
- Inlet/outlet tube sheets, divider plates, joint welds as applicable
- Inlet side tubes
- Outlet side tubes
- Inlet/outlet piping
- Anodes
- Supports (particularly tube/support joint and support/shell joint areas)
- Shell/fins as applicable
- Inlet/outlet nozzles, primary and secondary process sides as applicable.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (b) adequate and acceptable because; (1) the applicant uses a combination of periodic reviews of operating experience, inspection results, and vendor recommendations, and (2) the applicant has clearly identified the components that are to be inspected and tested, and these identified components are the most susceptible locations for the identified aging effects.

In the description of the AMP B.1.13, the applicant identifies an enhancement regarding new periodic component inspections in the pump vaults that have a high humidity/moisture environment. By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (c), the applicant to specify the inspection frequency and its technical basis, including operating experience.

In its response dated October 3, 2003, the applicant stated that the frequency for the new periodic component inspections in the pump vaults is once per year and the frequency of these inspections is based on input provided by cognizant system/program engineers. Less intensive inspections of the affected areas are conducted on a more frequent basis as part of operator rounds, maintenance activities, and routine walkdowns and surface degradation, leakage or other adverse conditions would be noted as part of these inspections.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (c) adequate and acceptable because the combination of the applicant's once a year intensive inspection and less intensive inspections of the affected areas conducted on a more frequent basis as part of operator rounds, maintenance activities, and routine walkdowns will provide that the aging effects on the applicable components will be detected and managed.

In the description of the AMP B.1.13, the applicant states: "the open-cycle cooling water system aging management activities have detected aging degradation and implemented appropriate corrective actions to maintain system and component intended functions..." This operating experience suggests that the preventive actions prescribed in this AMP may not be as effective as expected. By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (d), the applicant to provide justifications on the effectiveness of the preventive actions based on the plant operating experience, with consideration of Information Notice 94-03.

In its response dated October 3, 2003, the applicant addressed their program effectiveness relative to Information Notice 94-03 regarding deficiencies identified by the NRC during service water system operational performance inspections to assess licensee actions in response to GL 89-13. The applicant stated that testing and procedures governing service water system and performance at Dresden Station and Quad Cities Station are part of the station GL 89-13 program and that periodic GL 89-13 system performance tests and component visual inspections provide for timely detection of loss of material and flow blockage. The periodicity of the testing and inspections is based on previous findings and are adjusted accordingly. NDE tests consist of eddy current testing (for heat exchanger) and piping UTs and/or RTs to detect loss of material aging effects. Available flow to the heat exchangers and coolers is used to determine the extent of blockage (fouling) in the system. The station GL 89-13 program procedures outline the requirements to ensure that the testing and inspection activities have been performed and the results have been documented and sent to the appropriate station personnel for trending and analysis. The piping and components that are periodically inspected form a representative sampling for evaluating potential system-wide aging degradation. In addition, the applicant further stated that IST procedures provide for the periodic monitoring and trending of system performance per the notification of the appropriate system engineer of test results and notification of both the system engineer and unit supervisor of any inspection deficiencies. The response identified that documentation results are maintained in accordance with ASME Section XI, IWP-6000 and ISI documentation facilitates comparison with previous and subsequent inspection results are also maintained in accordance with ASME Section XI, IWA-6000.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (d) adequate and acceptable because the applicant has provided that the preventive actions prescribed in the AMP are effective.

In the operating experience section of AMP B.1.13, the applicant states that "Engineering evaluations have resulted in various specific component and programmatic enhancements and correction actions. In addition, program assessments have been reviewed for heat sink performance." By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (e), the applicant to describe the appropriate corrective actions made and the operating experience since these corrective actions were implemented and provide the results on the assessment for the heat sink performance review in regard to the adequacy of this AMP.

In its response dated October 3, 2003, the applicant stated that the appropriate corrective actions made included the following:

- implementing procedure revisions for more frequent pump bay cleaning to reduce silt and clam buildup

- revising the ISI boundary to include additional piping for periodic inspection

- monitoring minor Zebra Mussel infestations to prevent flow restriction

- implementing new inspections to periodically inspect components found to be susceptible to blockage (Y-strainers and keep-fill check valves)

- repairing or replacing specific piping and component minimum wall conditions and pinhole leaks (follow-up root cause evaluations were performed)

- implementing closer monitoring of marginal conditions (flow rates and piping wall thickness) to confirm continued system and component operability

- implementing additional flushing for lines determined to be susceptible to blockage.

In its response dated October 3, 2003, the applicant further stated that prior to the implementation of the station GL 89-13 program activities, component blockage was a recurring problem resulting in valves being unable to function and flow restrictions in the heat exchanger. More recent periodic system flushing and component inspections and cleaning have detected minor levels of biofouling and silting, primarily in system drain lines that were removed without any loss of system function.

In addition, the applicant stated: "Self-assessments of heat sink performance were performed for Dresden and Quad Cities in January 2001 and February 2001, respectively, to identify site heat exchanger deficiencies and verify resolution of previously identified heat sink performance issues. These self-assessments were reviewed in preparation of the LRA. The self-assessments were noted as identifying the following in support of the adequacy of the open-cycle cooling water system AMP:

- adequately identified areas for improved inspection/testing and/or component replacement/refurbishment to ensure adequate heat exchanger performance

- provided assurance that consideration was given to inclusion of risk significant heat exchanger, not just safety-related heat exchanger

- adequately identified deficiencies and initiated appropriate corrective actions

- provided on-going review of heat exchanger testing, maintenance, and performance documentation activities for incorporation of recent industry, regulatory, or vendor guidance.

The applicant concludes that the above information provides evidence that the GL 89-13 program and self-assessments have been effective at managing associated aging effects.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (e) adequate and acceptable because the applicant has provided a verification that the corrective actions prescribed in the AMP are effective.

In AMP B.1.13, the applicant states: "The open-cycle cooling water AMP... provides for managing loss of material aging degradation on the outside surfaces... by condition monitoring of the accessible external surfaces of components in moist air (indoor) or submerged (raw water) environments." However, this AMP does not address managing the loss of material on inaccessible outside surfaces. By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (f), the applicant to provide an explanation of how the loss of material aging effects on the outside surfaces in inaccessible locations is managed for the period of extended operation. Indicate to what extent eddy current testing is used.

In its response dated October 3, 2003, the applicant stated that management of the loss of material is not provided for all outside surfaces of inaccessible locations. The piping and components that are periodically inspected form a representative sampling for evaluating potential system-wide aging degradation. The applicant identified that eddy current testing is used for heat exchanger tubes, but not necessarily for all piping and components with inaccessible outside surfaces.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (f) adequate and acceptable because the applicant uses the results of piping and components that are periodically inspected to form a representative sampling for evaluating potential system-wide aging degradation.

LRA Table 3.3-2 credits the Open-Cycle Cooling Water System (AMP B.1.13) with managing galvanic corrosion. By letter dated August 4, 2003, the staff requested, in RAI B.1.13 (g), the applicant to; (1) identify any preventive measures used to minimize the effects of galvanic corrosion in heat exchangers such as sacrificial anodes or internal coatings and indicate if inspections verify that they are performing their intended function, and (2) clarify whether the inspection and testing described in the AMP "Open-Cycle Cooling Water System" (B.1.13) are targeted or opportunistic with respect to managing loss of material due to galvanic corrosion.

In its response dated October 3, 2003, the applicant stated there are no credited preventive measures used to minimize the effects of galvanic corrosion in affected heat exchangers and the aging effects of galvanic corrosion are managed through periodic heat exchanger inspections.

On the basis of its review, the staff finds that the applicant's response to RAI B.1.13 (g) adequate and acceptable because the applicant has stated that, although there are no credited preventive measures to minimize galvanic corrosion, galvanic corrosion will be managed by periodic heat exchanger inspections.

The staff reviewed the UFSAR supplement in LRA Appendix A.1.13 and found that the description of the Open-Cycle Cooling Water System is consistent with Section B.1.13 of the LRA.

3.0.3.6.3 Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.7 Closed-Cycle Cooling Water System (B.1.14)

3.0.3.7.1 Summary of Technical Information in the Application

The applicant's closed-cycle cooling water system aging management program is discussed in LRA Section B.1.14, "Closed-Cycle Cooling Water Program." The applicant states that with enhancements the program is consistent with GALL program XI.M21, “Closed-Cycle Cooling Water Program.” Enhancements consist of procedure revisions to provide for monitoring of specific parameters in accordance with EPRI TR-107396 guidance and to provide for monitoring pH and ammonia in the Dresden diesel generator jacket water. In LRA Section B.1.14 and UFSAR supplement A.1.14, the applicant describes the Closed-Cycle Cooling Water System program as an existing aging management program that manages loss of material, cracking and buildup of deposit through the use of preventive measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and NDE based on industry-recognized guidelines of EPRI-TR-107396. More specifically, the Closed-Cycle Cooling Water System is credited with managing the following aging effects during the period of extended operation:

- loss of material due to general, pitting, crevice corrosion, erosion, wear and MIC
- cracking due to stress corrosion cracking and mechanical fatigue
- buildup of deposit/fouling

In the LRA Operating Experience Section, the applicant states that its closed-cycle cooling water system aging management activities have detected aging degradation in heat exchangers prior to loss of system intended function. The applicant further states that engineering evaluations have resulted in various specific component and programmatic corrective actions. The applicant also states that performance monitoring provides indications of degradation in closed-cycle cooling water systems, with plant operating conditions providing indications of degradation in normally operating systems. Station maintenance inspections and NDE provide condition monitoring of heat exchangers exposed to closed-cycle cooling water environments.

This AMP is credited with managing the ESF, Auxiliary, and Steam and Power Conversion systems.

In Section B.1.14 of the LRA, the applicant concludes that the closed-cycle cooling water aging management program provides reasonable assurance that the aging effects are adequately managed so that the intended functions of components exposed to closed-cycle cooling water environments within scope of license renewal are maintained during the period of extended operation.

3.0.3.7.2 Staff Evaluation

In LRA Section B.1.14, “Closed-Cycle Cooling Water System,” the applicant described its AMP to manage aging on components exposed to closed-cycle cooling water environments. The LRA states that with enhancements this AMP is consistent with GALL AMP XI.M21, “Closed-Cycle Cooling Water System.” The staff confirmed the applicant’s claim of consistency during the AMR inspection. The staff reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. The staff also reviewed the program enhancements and its justification to determine whether the AMP, with the enhancements, remains adequate to manage the aging effects for which it is credited. The program enhancements will be implement prior to the period of extended operation. This Commitment #14 of Appendix A in this SER. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

During its review, the staff determined it needed additional information to complete this review. LRA AMP B1.14 states that closed-cycle cooling water system activities have detected aging degradation, and engineering evaluations have resulted in various specific component and programmatic corrective actions. This operating experience suggests that the preventive actions prescribed in this AMP may not be as effective as expected. Further, in the operating experience section, the AMP states, “engineering evaluations have resulted in various specific component and programmatic corrective actions.” By letter dated August 4, 2003, the staff requested, in RAI B.1.14 (a), the applicant to describe the appropriate corrective actions made, and the operating experience since these corrective actions were implemented.

In its response dated October 3, 2003 to RAI B.1.14 (a), the applicant stated that the preventive activities relied on by the closed-cycle cooling water system activities program include measures to maintain water purity and the addition of corrosion inhibitors to minimize corrosion. The activities will not by themselves eliminate corrosion altogether. The preventive activities of the program are only a part of a comprehensive program, which also includes periodic heat exchanger functional testing and monitoring of system parameters (i.e., flows, temperatures, pressures). The applicant further stated that the program activities, in total, will provide an effective means for management of the aging effects of the in-scope closed-cycle cooling water heat exchangers. The applicant provided specific examples of the program corrective actions made as a result of aging degradation and stated that no operating experience involving recurrence of heat exchanger degradations similar to those identified has been identified since implementation of the associated corrective actions.

On the basis of its review, the staff finds that the applicant’s response to part (a) of RAI B1.14 acceptable because the applicant has shown that; (1) the preventive activities of the program are only a part of a comprehensive program, which also includes periodic heat exchanger functional testing and monitoring of system parameters (i.e., flows, temperatures, pressures) and that the program activities, in total, will provide an effective means for management of the aging effects of the in-scope closed-cycle cooling water heat exchangers, and (2) the applicant has further specified several explicit examples of the program corrective actions made.

LRA Table 3.3-2 credits the Closed-Cycle Cooling Water System (B.1.14) for managing galvanic corrosion for certain components. By letter dated August 4, 2003, the staff requested, in RAI B.1.14 (b), the applicant to identify any preventive measures used to minimize the effects of galvanic corrosion in heat exchangers such as sacrificial anodes or internal coatings and to indicate if inspections verify that preventive measures are performing their intended function.

In its response dated October 3, 2003 to RAI B.1.14 (b), the applicant stated that some of the heat exchangers monitored in the closed cooling water aging management program contain sacrificial anodes, however, the applicant clarified that this preventive measure has not been credited to minimize the effects of galvanic corrosion in affected heat exchangers.

On the basis of its review, the staff finds the applicant’s response to part (b) of RAI B1.14 acceptable because the applicant has clarified that, although some of the heat exchangers monitored in the closed cooling water aging management program contain sacrificial anodes, this preventive measure has not been credited to minimize the effects of galvanic corrosion in affected heat exchangers. Therefore, chemistry control, inspections, and performance monitoring are used to mitigate and detect galvanic corrosion.

The applicant's UFSAR supplement for the Closed-Cycle Cooling Water System is documented in Section A.1.14 of Appendix A to the LRA and provides an overview of the program as described in Section B.1.14 of Appendix B to the LRA. The staff finds that the information provided in the UFSAR supplement is consistent with that in the AMP.

3.0.3.7.3 Conclusions

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

3.0.3.8 Compressed Air Monitoring (B.1.16)

3.0.3.8.1 Summary of Technical Information in the Application

The applicant's compressed air monitoring aging management program is discussed in LRA Section B.1.16 "Compressed Air Monitoring". The applicant states that with enhancements, the program is consistent with the ten elements of aging management program XI.M24, "Compressed Air Monitoring" specified in the GALL report, with exceptions. The following enhancements and exceptions are identified in the LRA:

> Enhancements
>
> - The program will provide for new periodic inspections for those portions of instrument air distribution piping at Dresden and Quad Cities that are within the scope of the rule.
>
> - The program will provide for periodic slowdowns of instrument air distribution piping at Dresden.
>
> Exceptions to NUREG-1801
>
> NUREG-1801 indicates that the program is based on responses to GL 88-14 and INTO SOER 88-01, "Instrument Air System Failures," as well as EPRI NP-7079-1990, EPRI TR-108147, "Compressor and Instrument Air System Maintenance Guide," ASME OM-S/G-1998, and ANSI/ISA-S7.0.01-1996. The Dresden and Quad Cities programs are based on the guidance provided in the GL 88-14 and ANSI/ISA-S7.3-1975 documents, which are part of the current licensing basis. Enhancements include inspection of instrument air distribution piping based on EPRI TR-108147.
>
> NUREG-1801 indicates that inservice inspection and testing is performed to verify proper air quality, and confirm that maintenance practices, emergency procedures, and training are adequate to ensure that the intended function of the air system is maintained. Inservice inspections at Dresden and Quad Cities do not verify air quality because air quality testing is performed in accordance with specific procedures based on ANSI/ISA-S7.3-1975. Maintenance practices, emergency procedures, and training are plant performance issues that are not directly related to aging management of the instrument air. Aging management consists of air quality tests and pressure decay tests of MSIV and safety/relief valve pneumatic system including accumulators, piping, and check valves, and periodic inspections to verify the integrity of the systems.

The compressed air monitoring aging management program activities manage loss of material due to general, crevice, and pitting corrosion for portions of the instrument air system within the scope of license renewal. Program activities consist of air quality testing, pressure decay testing, and visual inspections at various system locations.

According to the applicant, Dresden has experienced recent occurrences of corrosion, corrosion product buildup and dirt buildup in instrument air system piping, positioners, and valve operators. The program enhancement of providing periodic slowdowns of instrument air distribution piping is being done to address this condition. Testing and monitoring activities are implemented through station specific procedures and assigned tasks.

The applicant indicates that Quad Cities has not experienced a failure of a pneumatic component within the scope of license renewal due to corrosion, corrosion product buildup, or dirt buildup since 1993. The Quad Cities experience is consistent with the implementation of corrective actions in response to GL 88-14.

The LRA states that Dresden and Quad Cities have experienced equipment failures including MSIVs, dampers, and process valves due to instrument air leaks. These failures were to individual components and did not propagate to other components within the system. Dresden and Quad Cities have not experienced a common mode failure caused by the instrument air system. The Dresden and Quad Cities enhancements of performing predefined tasks that require periodic inspections of instrument air distribution piping address this condition.

This AMP is credited with managing the RCS, ESF, Auxiliary, and Steam and Power Conversion systems.

The applicant concludes that with the exception and enhancement, the Compressed Air Monitoring aging management program provides reasonable assurance that loss of material aging effects are adequately managed so that the intended functions of the instrument air components within the scope of license renewal are maintained during the period of extended operation.

3.0.3.8.2 Staff Evaluation

In LRA Section B.1.16, “Compressed Air Monitoring,” the applicant described its AMP to manage loss of material due to general, crevice, and pitting corrosion for portions of the instrument air system within the scope of license renewal. The LRA stated that this AMP is consistent with GALL AMP XI.M24, “Compressed Air Monitoring,” with exceptions and enhancements as noted above. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. The staff also reviewed the applicant’s evaluation to determine whether it addressed the additional issues recommended in the GALL report and confirm that the AMP would adequately address these issues. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

The staff noted that maintenance practices, emergency procedures, and training are not aging management issues and the applicant's exception to this is acceptable.

In a letter dated August 4, 2003, the staff requested in RAI B.1.16a additional information from the applicant relative to the Compressed Air Monitoring program. The staff noted that the applicant's Compressed Air Monitoring program as described in the LRA is not based on all of the references IN 81-38, IN 87-28, IN 87-28S1, INTO SOER 88-01, EPRI-108147, ASME OM-S/G-1998, Part 17, ISA-S7.0.01-1996, and EPRI 7079 identified in the GALL report AMP XI.M24 and requested that the applicant explain why these references were not included in the development of the applicant's program. In the response dated October 3, 2003 and supplemental response dated December 12, 2003, the applicant stated:

The Dresden and Quad Cities programs are based on GL 88-14 and ANSI/ISA-S7.3-1975 and are enhanced with inspection based on EPRI TR-108147. NUREG-1801 XI.M24 (Compressed Air Monitoring) states that GL 88-14 is augmented by References IN 81-38, IN 87-28, IN 87-28S1 and INTO SOER 88-01. The sentence in the exception section of LRA Appendix B, Section B.1.16, that currently reads:

> The Dresden and Quad Cities programs are based on the guidance provided in the GL 88-14 and ANSI/ISA-S7.3-1975 documents, which are part of the current licensing basis.

should have read:

> The Dresden and Quad Cities programs are based on the guidance provided in ANSI/ISA-S7.3-1975 and GL 88-14 which is augmented by previous NRC Information Notices IN 81-38, IN 87-28, IN 87-28 S1, and by the Institute of Nuclear Power Operations Significant Operating Experience Report (INTO SOER) 88-01.

In response to GL 88-14, Exelon committed to implementing an instrument air quality-monitoring program using ANSI/ISA-S7.3-1975. ANIS/ISA-S7.0.01-1996 is a newer revision to ANSI/ISA-S7.3-1975 that is less conservative then ANSI/ISA-S7.3-1975. Exelon has a licensing commitment contained in the response to GL 88-14 that uses ANSI/ISA-S7.3-1975. The following is a comparison of ANIS/ISA-S7.0.01-1996 to ANSI/ISA-S7.3-1975:

Parameter	**ANSI/ISA-S7.0.01-1996**	**ANSI/ISA-S7.3-1975**
Dewpoint	18°F below the minimum temperature of any part of the air system. The dewpoint shall not exceed 39°F at line pressure.	18°F below the minimum temperature of any part of the air system. The dewpoint shall not exceed 35°F at line pressure.
Particle Size	40 microns maximum.	3 microns maximum. (Test procedures allow up to 4 particles/ft3 to exceed the 3 micron size limit)
Hydrocarbons (lubricant content)	As close to zero as possible, not to exceed 1ppm w/w or v/v.	As close to zero (0) w/w or v/v as possible, not to exceed 1ppm w/w or v/v under normal operating conditions.

EPRI TR-108147 is a new revision to EPRI NP-7079. Exelon has enhanced the Dresden and Quad Cities programs to include inspection of instrument air distribution piping based on ERPI TR-108147.

The scope of components included in the compressed air monitoring aging management activities includes distribution piping, valves, and accumulators for air operated safety-related valves, and the containment isolation valves of the instrument air system. The instrument air system compressors, receivers, filters, and dryers are not within the scope of license renewal. Exelon takes exception to ASME OM-S/G-1998, Part 17 as specified in NUREG-1801 XI.M24. ASME OM-S/G-1998, Part 17 provides guidance concerning the performance testing of instrument air systems in light-water reactor power plants. Because the instrument air system compressors, receivers, filters, and dryers are not within the scope of license renewal, the instrument air systems do not require performance testing for aging management. Exelon aging management program B.1.16 (Compressed Air Monitoring) provides adequate aging management for the select number of instrument air system components that have been included within the scope of license renewal.

The staff finds the applicant's program adequately addresses the reference documents contained in the GALL program and is acceptable based on the additional information provided.

In RAI B.1.16b, the staff noted that it is not readily apparent how the Compressed Air Monitoring program will adequately manage the aging effect of loss of material due to corrosion, corrosion product build-up, or dirt build-up for brass or bronze valve components in the control rod drive hydraulic system. The applicant's response dated October 3, 2003 stated that occurrences of corrosion have not been noted in brass or bronze valve components in the control rod drive hydraulic system, as this portion of piping receives periodic blowdown whenever the reactor scrams or scram testing is conducted. The applicant also stated that the compressed air monitoring program will be enhanced to provide periodic slowdowns of the instrument air system at Dresden only and will target those portions of piping that have an operating history of aging deterioration. Because the applicant's experience has not shown deterioration due to corrosion in the control rod drive hydraulic system and the applicant has committed to enhance the program in areas where operating experience indicates deterioration, the staff finds this response to be acceptable. This is Commitment #16 in Appendix A of this SER.

3.0.3.8.3 Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.9 Above Ground Carbon Steel Tanks (B.1.20)

3.0.3.9.1 Summary of Technical Information in the Application

The applicant's above ground carbon steel tanks aging management program is discussed in LRA Section B.1.20, “Above Ground Carbon Steel Tanks”and provides for management of loss of material aging effects for outdoor carbon steel nitrogen storage tanks. The applicant states that the program is consistent with GALL program XI.M29 with the enhancement that the program provides for initiating documentation of inspection results of periodic system engineer walkdowns of the nitrogen storage tanks. The LRA contains a commitment that this enhancement will be implemented at both Dresden and Quad Cities prior to the period of extended operation. This is part of Commitment #20 in Appendix of A of this SER.

The program provides for the application of paint as a corrosion preventive measure and for periodic visual inspections to monitor degradation of the paint and any resulting metal degradation. The LRA notes that the Dresden and Quad Cities outdoor carbon steel storage tanks have not experienced leakage or degradation due to loss of material. The applicant states that the nitrogen storage tanks are above ground and are not directly supported by earthen or concrete foundations. Therefore, inspection of the sealant or caulking at the tank/foundation interface and inspection of inaccessible tank locations does not apply.

This AMP is credited with managing aging in auxiliary and steam and power conversion systems.

3.0.3.9.2 Staff Evaluation

In LRA Section B.1.20, “Above Ground Carbon Steel Tanks,” the applicant described its AMP to manage corrosion of above ground carbon steel tanks by protecting the external surfaces with paint or coatings in according with standard industry practice. The LRA stated this AMP is consistent with the GALL AMP XI.M29 with the exception that aging of aluminum tanks are managed by this AMP as well as carbon steel tanks. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and its justification to determine whether the AMP, with the deviation, remains adequate to manage the aging effects for which it is credited, and reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. In addition, the staff determined whether the applicant properly applied the GALL program to its facilities.

The applicant has aluminum above ground storage tanks used as condensate water storage tanks and demineralized water storage tanks at both the Dresden and Quad Cities sites. The applicant’s LRA specified that the applicable aging management program for the above ground aluminum water storage tanks would be the Buried Carbon Steel Pipe and Tank Program in Section B.1.25 of the LRA (GALL Program XI. M29). In a letter dated August 7, 2003, the staff requested additional information in RAI B.1.25 regarding the applicability of the Buried Carbon Steel Pipe and Tank Program B.1.25 (GALL Program XI. M29) for managing aging of above ground Aluminum Storage Tanks. The staff also requested that the applicant describe the inspection criteria, potential corrective actions if acceptance criteria are not met and why a one time UT inspection of a single tank bottom at one site will be representative of all tanks.

In a letter dated October 3, 2003, the applicant responded to the staff’s request for additional information. The applicant indicated that the proposed Buried Piping and Tank AMP, and associated aging mechanisms are not relevant to an above ground aluminum tank. The applicant indicated that the Buried Carbon Steel Pipe and Tank Program B.1.25 (GALL Program XI. M29) was inadvertently identified instead of the correct AMP, which is the Above Ground Carbon Steel Tanks AMP, LRA section B.1.20. The applicant also indicated the LRA should have included the following changes:

LRA Section B.1.20, Aboveground Carbon Steel Tanks, should have referenced the UT inspection requirement for the associated above ground aluminum tanks. Since the AMP for aboveground carbon steel tanks does not include aluminum as a material type, an exception statement to this effect should have been included in this section.

LRA Section B.1.25, Buried Piping and Tanks Inspection, should have removed reference to the UT inspection requirement for the associated above ground aluminum tanks.

Item 3.4.2.42 of LRA Table 3.4-2 should have referenced the aboveground carbon steel tanks AMP.

LRA Section A.1.20 (for Dresden and Quad Cities) should have referenced the UT inspection requirement for the associated above ground aluminum tanks.

LRA Section A.1.25 (for Dresden and Quad Cities) should have removed the reference to the UT inspection requirement for the associated above ground aluminum tanks.

In the applicant's response to RAI B.1.25, they also indicated that the tank selected for inspection would be a Quad Cities tank and would be based on operating experience input from the site. The applicant indicated that a Quad Cities tank would be selected because the tank bottoms were older than the Dresden tanks bottoms which had been replaced in the 1992/1993 timeframe because of corrosion. The applicant indicated that because the tanks are made of the same material, constructed in a like manner, have similar internal and external environments and the Quad Cities tank bottoms are older they will more likely show any aging effects and thus are representative of all the aluminum above ground tanks.

The staff requested that the applicant provide additional clarifying information related to their RAI response regarding tank selection. The staff requested that the applicant provide sufficient information relative to the elements of an aging management program to evaluate the program exception of aluminum tanks and to provide operating experience relative to the corrosion mechanism which led to the Dresden tank bottom replacement and what inspections have been performed at Dresden since tank bottom replacement for assessment of further corrosion. The applicant in a letter dated November 20, 2003 provided additional clarifying information. This information reiterated that aluminum was considered to be an exception to the Above Ground Carbon Steel Tank AMP, B.1.20 and provided pertinent information for managing the aging of the Aluminum Tanks in the form of the elements of an aging management program. The applicant indicated that there are no protective coatings used in or on the aluminum tanks and a sealant is used at the interface between the tank and its concrete foundation. The applicant indicated that the sealant is periodically monitored as part of the Structures Monitoring Program and that periodic internal/external inspections of the tanks will be in place prior to the period of extended operation. The applicant indicated aging effects will be detected by the periodic visual internal/external inspection, a UT inspection of one of the Quad Cities tank bottoms and through the periodic inspection of the foundation sealants. The applicant indicated the periodic visual examinations will be performed at a five year periodicity rather than every other outage, that detection of corrosion or degradation of the sealant would require further evaluation and that the UT inspection results would be compared against tank design criteria. This is part of Commitment #20 of Appendix A of this SER. The applicant also reiterated that the Dresden tank bottoms had been replaced due to corrosion and indicated that no inspections of the tank bottoms at Dresden had occurred since replacement. The applicant further stated that a requirement for periodic visual inspection of the tank bottoms was in development which would inspect for corrosion and pitting and if evidence of corrosion or pitting was observed NDE methods capable of determining wall thickness would be employed.

In a letter dated December 12, 2003, the applicant responded to the staff's request for further clarification regarding the operating experience associated with corrosion of the Dresden tank bottoms. The applicant indicated that the corrosion initiated from the aluminum/soil interface and stated that no inspections of the Dresden tank bottoms had occurred since replacement. Because the periodic internal visual inspection cannot inspect this surface, the Dresden operating experience indicates corrosion has led to tank bottom replacement and no inspections of the Dresden tank bottoms have occurred since replacement the applicant will incorporate a periodic inspection of one Dresden tank bottom using an NDE method capable of detecting corrosion and pitting at the aluminum/soil interface into the program. The applicant indicated the periodicity of the tank bottom inspection was yet to be determined, but would not exceed a 10 year period. This is part of Commitment #20 of Appendix A of this SER.

The staff finds the applicant's response acceptable because the program is consistent with GALL, will provide for periodic internal visual inspection of the aluminum tanks and will provide for a one time inspection of a Quad Cities aluminum tank bottom using UT and will provide for a periodic inspection of a Dresden aluminum tank bottom using UT. The staff finds the one-time inspection of a Quad Cities tank bottom acceptable because operating history has not indicated degradation of the Quad Cities aluminum tank bottoms is occurring and these tank bottoms have greater accumulated service time than the tank bottoms replaced at Dresden. Therefore, one time inspection will focus on the lead component and identify if aging is occurring. The staff finds the maximum periodicity of 10 years for the UT of the Dresden aluminum tank bottoms acceptable because the tanks had been in service over 20 years prior to the degradation which lead to replacement of the tank bottoms. Therefore, the future inspections should be appropriate and adequate to manage the aging prior to loss of intended function.

The applicant indicated that Section A.1.20 of the LRA Appendix A (for each site) will be revised to reflect the inspections and information provided in the response.

3.0.3.9.3 Conclusions

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

3.0.3.10 One Time Inspection (B.1.23)

3.0.3.10.1 Summary of Technical Information in the Application

The applicant's one-time inspection aging management program (AMP) is discussed in LRA Section B.1.23, "One-Time Inspection." The applicant states that the program is consistent with the ten elements of AMP XI-M32, "One-Time Inspection," specified in the GALL report. The One-Time Inspection program provides one-time inspections that manage aging effects of identified components within the scope of license renewal. The purpose of the program is to determine if a specified aging effect is occurring. If the aging effect is occurring, the program provides for an evaluation the effect will have on the ability of affected components to perform their intended functions for the period of extended operation. The program also provides appropriate corrective actions if aging effects are found.

This AMP is credited with managing the RCS, ESF, Auxiliary, and Steam and Power Conversion systems.

Based on the above, the applicant concludes that implementation of the One-Time Inspection program provides reasonable assurance that the aging effects are adequately managed so that the intended functions of components within the scope of license renewal that are covered by this program are maintained during the period of extended operation.

3.0.3.10.2 Staff Evaluation

The applicant's One-Time Inspection Program is described in LRA Section B.1.23. The LRA states that the One-Time Inspection Program is consistent with the ten elements of AMP XI-M32, "One-Time Inspection," specified in the GALL report. No exceptions or enhancements to the GALL report AMP XI.M32 were identified by the applicant. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff determined whether the applicant properly applied the GALL program to its facilities. The staff also reviewed the UFSAR supplement (A.1.23, "One-Time Inspection") to determine whether it provides an adequate description of the program.

The GALL report recommends use of the One-Time Inspection Program to verify the effectiveness an aging management program and to confirm the absence of an aging effect in such cases where either an aging effect is not expected to occur but there is insufficient data to completely rule it out, or an aging effect is not expected to progress very slowly. The staff reviewed the tables in Sections 2 and 3 of the LRA to confirm that the structures and components credited by the One-Time Inspection Program are generally commensurate with the GALL report. The staff identified material and environment combinations for components where the One-Time Inspection Program is used in conjunction with an AMP to confirm the absence of aging effects or when the aging effect is not expected to occur. The staff considers these items to be consistent with the GALL program.

The staff also identified that the One-Time Inspection Program is credited for material and environment combinations where it was not clear from the LRA whether aging could be expected to occur. Where an aging effect is expected to occur, the GALL report recommends either an appropriate aging management program to manage the aging effect and a one-time inspection verify the effectiveness of the program, or the use of periodic inspections in lieu one-time inspections. The staff requested, in RAI B.1.23-2 and supplemental RAIs B.1.23 and B.1.23-2.1 thru B.1.23-2.6, the applicant to justify why a one-time inspection is appropriate for various carbon steel, alloy steel, stainless steel, cast iron, elastomer, and Neoprene components in environments such as:

- lubricating oil (with contaminates and moisture)
- air and steam up to 320 °C
- moist air

- moist containment atmosphere, steam, or demineralized water
- saturated air
- warm, moist air
- saturated steam and condensate
- diesel fuel oil
- generator hydrogen seal oil
- turbine EHC fluid
- air, moisture, humidity, and leaking fluids
- wet gas
- hot diesel engine exhaust gases containing moisture and particulates
- raw, untreated salt water or fresh water
- internal: occasional exposure to moist air
- external: ambient plant air environment.

By letter dated October 3, 2003 and January 26, 2004, the applicant responded to the staff's RAIs as follows:

(1) The applicant will expand the scope of Aging Management Program B.2.5 (Lubricating Oil Monitoring) or Aging Management Program B.1.21 (Fuel Oil Chemistry) to include components in the Reactor Core Isolation Cooling (RCIC) System, the High Pressure Coolant Injection (HPCI) System, the Emergency Diesel Generator and Auxiliaries System, and the Station Blackout Diesel System that are exposed to an environment of lubricating oil or fuel oil. The One-Time Inspection Program will be used to verify the effectiveness of these aging management programs. This is Commitment #43 of Appendix A of this SER.

(2) The applicant developed AMP B.2.8, "Periodic Inspection of Plant Heating System" to perform periodic inspections of selected plant heating system components that are exposed to an environment of saturated steam and condensate. The One-Time Inspection Program is no longer credited to managed aging effects for these components since periodic inspections will be performed.

(3) In response to RAI 3.2.1.4-3, the applicant stated that hardening and loss of strength due to elastomer degradation in the flexible hoses in a containment nitrogen environment would be managed by the One-Time Inspection Program. Upon further review, the applicant believes that these hoses are made of stainless steel with an overall stainless steel outer braided jacket and are not comprised of an elastomer. The One-Time Inspection Program will be used to verify that the hoses are constructed of metal rather than an elastomer material. Based on this inspection, any elastomer hoses will be replaced with metal flexible hoses. If metal hoses are found to be installed, the One-Time Inspection Program will perform inspections for mechanical damage. This is part of Commitment #23 of Appendix A of this SER.

(4) For non-safety related (NSR) vents or drains, piping, and valves in the main control room system, shutdown cooling system, and control rod drive hydraulic system, the LRA identifies loss of material due to corrosion for carbon steel, stainless steel, brass, or bronze in an environment of air, moisture, humidity, and leaking fluid. The staff requested the applicant to describe the types of corrosion expected and to provide criteria for selecting one-time

sample locations for these types of corrosion. The applicant clarified in RAI 3.3-2 response that general, crevice, and pitting corrosion are expected in these components. The applicant compiled a list of the in-scope NSR vents and drains for the various systems throughout the plants. The One-Time Inspection program will inspect a selected number of NSR vent and drains for the affected systems. The sample population will be representative of all material and environment combinations but may not include components for every system. The criteria used for selection of susceptible inspection locations are as follows: 1) Corrosiveness of fluid passing through the vent, drain, or piping when in service. Those components servicing more corrosive fluids are given preference; 2) Duration of service when performing venting and draining operations. Those components with higher durations of service are given preference; 3) Frequency of performance of venting and draining operations through the selected components. Those components with higher performance frequencies are given preference; 4) Period that component has been in service. Those components that have been in service longest are given preference. In addition, the applicant stated, in DRAFT supplemental response RAI B.1.23-2.2, that NSR vents and drains are attached to normally closed isolation valves and are not likely to contain moisture. Any appreciable leakage or condensation inside these vents and drains would be identified in the course of periodic operations or through the daily monitoring of unidentified inputs to radwaste. Malfunctioning isolation valves or other degraded conditions would be promptly repaired, replaced, or corrected. For the reasons stated above, the rate of material loss due to corrosion is expected to be slow. This is part of Commitment #23 of Appendix A of this SER.

(5) The applicant's AMP B.2.5, "Lubricating Oil Monitoring Activities," will be expanded to include the analysis of the turbine oil systems components (Dresden only) exposed to generator hydrogen seal oil and the main turbine and auxiliaries components exposed to turbine EHC fluid. The One-Time Inspection Program will be used to verify the effectiveness of this AMP. This is part of Commitment #23 of Appendix A of this SER.

Items 1-5 above are Confirmatory Item B.1.23-1.

(6) The staff questioned the basis for using a one-time inspection in an environment that 1) varies with normal plant conditions, 2) is impractical to monitor or control routinely, and 3) is similar to the environments associated with the Aging Management References listed in part b of RAI B.1.23-2. The applicant responded that environments with these characteristics are air and steam; moist air; saturated air; warm moist air; moist containment atmosphere; steam or demineralized water; internal: occasional exposure to moist air; external; ambient plant air environment; dry gas; and hot diesel engine exhaust gases containing moisture and particulates. Based on the material and environment characteristics, the applicant believes that the aging effect is not expected to occur or is expected to progress slowly such that a one-time inspection is adequate to manage the aging effects. For carbon steel, cast iron, alloy steel, elastomers, and neoprene components in these environments, staff does not consider a one-time inspection adequate since aging effects are likely to occur in these material/environment combinations. Staff considers periodic inspections or a one-time inspection used to verify the adequacy of another AMP more appropriate to manage these components. The applicant is requested to provide additional information on the environmental conditions and the operating experience in order to justify the use of a one-time inspection, or provide periodic inspections for these components. (Item 6 is Open Item

B.1.23-2.)

As discussed in letter dated January 26, 2004 for RAI B.1.23-2.1, the applicant will revise the statement in Section A.1.23, “One Time Inspection,” in the UFSAR Supplement for Dresden and Quad Cities from “Inspection of a sample of compressed gas system piping components for corrosion and a sample of compressed gas flexible hoses for elastomer degradation,” to “Inspection of a sample of compressed gas system piping components for corrosion and a sample of compressed gas flexible hoses.” This is part of Commitment #23 of Appendix A of this SER. The applicant also stated that a similar statement in Section B.1.23, “One Time Inspection,” in Appendix of the LRA should have read, “Inspection of a sample of compressed gas system piping components for corrosion and a sample of compressed gas flexible hoses.”

3.0.3.10.3 Conclusions

On the basis of its review of the applicant’s program, pending satisfactory resolution of Confirmatory Item B.1.23-1 and Open Item B.1.23-2, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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 UFSAR supplement for this AMP and finds, pending updates to UFSAR based on RAI responses, that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.11 Selective Leaching of Materials (B.1.24)

3.0.3.11.1 Summary of Technical Information in the Application

The applicant’s Selective Leaching of Materials aging management program is discussed in LRA Section B.1.24 “Selective Leaching of Materials”. The Selective Leaching of Materials aging management program consists of numerous one-time inspections to determine if selective leaching of materials is occurring. The scope of the program includes susceptible components within the scope of license renewal that are exposed to chemically treated water, demineralized water, raw water and ground water, and moist ventilation and gas environments. Susceptible component materials are gray cast iron, copper alloys with less than 85% copper, aluminum-bronze, and Muntz metal.

This AMP is credited with managing aging in the ESF, Auxiliary and Steam and Power Conversion systems and structures.

The LRA indicates that this new program will consist of one-time inspections including visual inspection or other appropriate examination methods of components of the different susceptible materials selected from each applicable environment. The purpose of the program is to determine if loss of material due to selective leaching is occurring. If selective leaching is occurring, the program provides for evaluation as to the effect it will have on the ability of the affected components to perform their intended function for the period of extended operation, and the need to expand the sample of components to be tested.

The applicant indicates that the Selective Leaching of Materials aging management program is consistent with the ten elements of aging management program XI.M33, "Selective Leaching of Materials" specified in the GALL, with the exception that the applicant will not perform hardness measurements on selected components. The GALL Program XI.M33 recommends both visual inspection and Brinell hardness measurements be made to assess the potential for selective leaching.

The applicant indicates that the Dresden and Quad Cities Selective Leaching of Materials program will be implemented prior to the period of extended operation.

The applicant concludes that the Selective Leaching of Materials aging management program (including the exception) provides reasonable assurance that selective leaching aging effects are adequately managed so that the intended functions of the components within the scope of license renewal are maintained during the period of extended operation.

3.0.3.11.2 Staff Evaluation

In LRA Section B.1.24, "Selective Leaching of Materials," the applicant described its AMP to ensure the integrity of components exposed to chemically treated water, demineralized water, raw water and ground water, and moist ventilation and gas environments. Susceptible component materials are described as gray cast iron, copper alloys with less than 85% copper, aluminum-bronze and Muntz metal. The LRA stated that this AMP is consistent with GALL AMP XI.M33, "Selective Leaching of Materials," with the exception that the Dresden and Quad Cities programs provide for only visual examination and do not include hardness testing. The applicant indicated that components that exhibit visual indications of selective leaching will receive further examination or evaluation, which may include non-destructive testing or other examinations that provide definitive results regarding the presence of selective leaching. The applicant indicates that the plant specific evaluation may include removal of specific components for examination under microscope. The applicant also committed to expand the sample size based on unfavorable inspection results. This is Commitment #24 in Appendix A of this SER. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exception and associated justifications to determine whether the AMP, with the exception, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

In a letter dated August 7, 2003, the staff requested additional information in RAI B.1.24 relative to the program exception not to perform hardness testing. The staff asked why visual inspection could be relied on especially when it was noted that selective leaching often occurs under deposits and in non-visible areas and what basis would be used for visual inspection. The staff requested the applicant to identify the criteria for selecting sample locations and how operating experience will be factored into the applicant's program. The staff also requested that the applicant supplement the UFSAR description of the program to specifically address visual inspection.

The applicant responded to the staff request in a letter dated October 3, 2003. In the response, the applicant provided additional justification for the program exception not to perform hardness testing. The applicant's justification focused on a lack of accurate baseline hardness values for susceptible plant components, difficulty in performing in-situ hardness testing and the need to interpret the results. The applicant indicated that visual inspection would be performed consistent with the requirements of ASME Section XI VT-1 visual inspection. The applicant indicated that inspectors would inspect surfaces for evidence of weak, porous or spongy layers in localized (plug-type) or general areas and if visual inspection indicated the potential for selective leaching other NDE methods (i.e., UT) may be used to assess the component. The applicant also noted that the program performs a number of one-time inspections on components with susceptible material environment combinations and the program scope will be expanded to additional components if selective leaching is identified. The applicant noted that the selective leaching of materials aging management program is new and that no programmatic operating experience is available at Dresden and Quad Cities.

The staff requested additional clarifying information related to the determination of selective leaching under deposits and guidance on scope expansion if selective leaching is identified. The applicant responded in a letter dated November 20, 2003. The applicant indicated that visual inspection will be performed in accordance with ASME Section XI VT-1 requirements and will be supplemented by work instruction. The applicant provided sample work instructions that include steps for surface preparation including the removal of dirt grease or other foreign material that could mask indications of selective leaching. The applicant's work steps also indicate that if selective leaching is identified, the affected area must be removed to sound metal and that minimum wall thickness be determined in conjunction with initiation of a corrective action report documenting identification of selective leaching. Regarding scope expansion, the applicant indicated that sampling would start with the most aggressive environments and if necessary be expanded into less aggressive environments. Additional samples of the same material in the same environment as well as the less aggressive environments will be chosen for inspection.

The staff reviewed the applicant's program exception not to perform hardness testing, the responses to the RAIs and to the requests for clarification.   The staff concurs with the applicant that the program will provide that aging will be managed because visual inspection will be performed using ASME Section XI VT-1 requirements, if necessary alternate NDE methods may be used to assess the component's condition, the applicant has taken steps to ensure that indications of selective leaching will not be masked through the use of surface preparation and surface preparation may be used to provide a somewhat qualitative assessment of surface hardness.

In response to the staff's request for the applicant to supplement the UFSAR description, the applicant responded in a letter dated October 3, 2003. The applicant indicated that the following statement should have been included in the UFSAR description:

> The selective leaching of materials aging management program includes numerous one-time inspections of components of the different susceptible materials selected from each of the applicable environments to determine if loss of material due to selective leaching is occurring. These inspections will consist of visual inspection consistent with ASME Section XI VT-1 visual inspection requirements. If selective leaching is occurring the program requires evaluation of the effect it will have on the ability of the affected components to perform their intended functions for the period of extended operation, and of the need to expand the test sample. For systems subjected to environments where water is not treated (i.e., the open-cycle cooling water system) the program also follows the guidance of NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment.

The staff finds the applicant's response to modify the UFSAR description of the program acceptable because it identifies that program inspections will be performed in accordance with ASME Section XI VT-1 visual inspection requirements and scope expansion will occur if selective leaching is identified.

3.0.3.11.3 Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.12 Buried Piping and Tanks Inspection (B.1.25)

3.0.3.12.1 Summary of Technical Information in the Application

The applicant's Buried Piping and Tanks Inspection aging management program is discussed in LRA Section B.1.25, "Buried Piping and Tanks Inspection". The applicant states that with enhancements, the program is consistent with the ten elements of GALL aging management program XI.M34, "Buried Piping and Tanks Inspection" specified in The GALL. The applicant states that the program consists of preventive and condition monitoring measures to manage loss of material due to corrosion from external environments for buried piping and tanks in the scope of license renewal.

This AMP is credited with managing loss of material in the ESF, Auxiliary and Steam and Power Conversion systems.

The applicant's program takes exception to the program as described in the GALL, which indicates that buried piping and tanks are inspected when they are excavated during maintenance. The applicant noted that access to buried components does not occur on specified frequencies, therefore the applicant's program includes the use of piping and component coatings and wrappings and enhancements that include periodic pressure testing, buried tank leakage checks, inspections of buried tank internal surfaces, and inspections of the ground above buried tanks and piping. The program enhancements also include one-time internal ultrasonic testing (UT) of buried steel tanks, a one-time internal UT of the bottom of an outdoor aluminum storage tank, and a one-time visual inspection of the external surface of a buried piping section. This AMP will be implemented at Dresden and Quad Cities prior to the period of extended operation.

3.0.3.12.2 Staff Evaluation

In LRA Section B.1.25, "Buried Piping and Tanks Inspection", the applicant described its AMP to perform inspections on buried piping and tanks. This AMP is provided to manage loss of material due to corrosion from external environments for buried piping and tanks in the scope of license renewal. The LRA stated that this AMP is consistent with GALL AMP XI.M34, “Buried Piping and Tanks Inspection”, with an exception regarding the visual inspection during maintenance, which the applicant regards as not having a defined frequency. Therefore, the applicant has proposed the use of coating and wrapping, periodic pressure testing, buried tank leakage checks, inspection of buried tank internal surfaces, and inspections of the ground above buried tanks and piping. The applicant’s program will also include one-time internal UT of buried steel tanks, and a one-time visual inspection of the external surface of a buried piping section. This is part of Commitment #25 of Appendix A of this SER. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and its justification to determine whether the AMP with the deviation and enhancements, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR supplement (A.1.25, “Buried Piping and Tanks Inspection”) to determine whether it provides an adequate description of the program. In addition, the staff determined whether the applicant properly applied the GALL program to its facilities.

The staff finds the applicant’s exception to the GALL acceptable, because the applicant will inspect buried piping and tanks which are uncovered during maintenance and the applicant will supplement this activity by performing one time inspections of selected components as well as using flow and pressure testing to assess system integrity. The enhancements proposed by the applicant verify that aging of buried pipe will be managed.

Based on its review of the LRA, the staff requested further information from the applicant related to the buried piping and tanks inspection AMP in a letter dated August 7, 2003. The applicant replied to the staff RAIs in a letter dated October 3, 2003.

In RAI B.1.25a, the applicant was requested to indicate if all buried tanks at both plants will be subject to a one time UT inspection and if not, how the tanks and internal areas will be selected, to provide the acceptance criteria for the UT inspections and the actions to be taken if the acceptance criteria are not met. The applicant responded that only one buried steel tank at each site will be inspected. This is part of Commitment #25 of Appendix A of this SER. The applicant also stated that selection and acceptance criteria will be based on applicable ASME Codes and ASTM Standards as well as engineering judgement. If tank wall thicknesses are outside the acceptance criteria the applicant indicated they will expand the sample area or population, evaluate results, and implement necessary repairs. The staff requested that the applicant clarify why scope expansion might not include expansion to other tanks with the same corrosion environment. The applicant in a letter dated December 12, 2003 indicated that there are only 2 buried tanks at each site and that the population of tanks inspected will be increased if acceptance criteria are not met during the one time inspection. The staff finds this response to be acceptable, because the applicant will apply engineering judgement to select the susceptible areas for age related degradation and acceptance criteria are based on tank design codes. Further, expanding the sample scope to include other tanks with similar environments will provide assurance that aging is managed in similar components.

The applicant included a one time inspection of an above ground aluminum storage tank bottom in this AMP originally. The staff requested an explanation of how the features of this AMP are relevant to an above ground aluminum tank and what correlation exists between degradation of the buried pipe and tank materials with degradation of the aluminum tank bottom in RAI B.1.25. The applicant was also requested to explain how the tank will be selected and why the inspection of one tank at either Dresden or Quad Cities will be representative of the soil-to-tank bottom interactions for all aluminum tanks at both plant sites. The applicant's response noted that this AMP was inadvertently identified instead of the correct AMP, which is the Above Ground Carbon Steel Tanks AMP (AMP B.1.20). The staff agrees that this activity is more correctly placed in AMP B.1.20 and the request for additional information is further discussed in Section 3.0.3.9 of the SER.

The applicant provided operating experience in the LRA indicating that failures had occurred in buried piping. In order to understand the failures, the staff requested in RAI B.1.25 that the applicant explain how operating experience illustrates the AMP is effective, what was the root cause of the related piping degradation, how pressure and flow testing are used to manage aging and what changes in the program resulted from operating experience. The applicant responded that the failures occurred in Fire Protection concrete asbestos piping and in demineralized water carbon steel piping. The applicant indicated that the failures were attributed to the aging effect "loss of material", but that a specific aging mechanism was not identified. The applicant also indicated the concrete asbestos piping was replaced with PVC. The applicant indicated that a comprehensive approach is used to manage aging in buried piping which includes inspections during excavation, one time inspections, flow and pressure testing as well as system walkdowns. The applicant related operating experience with the buried fire protection piping to illustrate how pressure and flow testing had been used to identify degradation. The applicant responded that pressure and flow testing were not intended to solely manage aging. Further, the applicant stated that based on the operating experience, the flow testing acceptance criteria were being enhanced to indicate that minor variations in system pressure could be indicative of pinhole leaks, although system pressure and flow requirements were still met. The applicant indicated that flow testing is performed on a three year periodicity which will identify pipe degradation prior to a loss of system function based on their operating experience.

The staff finds the applicant's response acceptable relative to the program's effectiveness based on the applicant's operating experience and the use of system and pressure tests because the applicant will perform one time inspections in conjunction with GALL recommended inspections during excavation. The staff finds the program appropriate and adequate to manage the aging of the buried piping prior to the loss of its intended function. However, the staff requested the applicant to provide additional clarifying information regarding how operating experience with buried concrete asbestos piping is applicable to managing buried carbon steel, whether all the concrete asbestos piping had been replaced with PVC, if concrete asbestos and PVC piping are exceptions to GALL, how aging of these materials are addressed and to provide information regarding the demineralized water line failure including why one time inspection of a similar section of pipe was not warranted.

The applicant responded to the additional questions in a letter dated December 12, 2003. The applicant indicated that experience with buried concrete asbestos piping was relative to the program based on the operating experience of how degradation was identified and that this method would be applicable to all piping material types. The applicant indicated that potential degradation of some of the replaced fire main piping was initially identified on the basis of periodic pressure drop testing. The applicant indicated that both concrete asbestos and PVC piping are currently used. The applicant stated that PVC piping in these environments has no aging effects and was identified as an exception to the GALL in the LRA. The applicant indicated that the concrete asbestos piping should have been included in the LRA as an exception to the GALL. The applicant stated the internal environment of the concrete asbestos piping is "raw water" and the external environment is "soil and groundwater." The applicant also stated that the concrete asbestos pipe is in an excellent environment; buried deep to avoid freeze/thaw cycles, heat and stress and that there are no know chemicals that adversely affect the concrete in the raw water or soil and ground water environments. The potential aging effects associated with both the internal and external environments are "increase in porosity and permeability, cracking and loss of material (spalling, scaling)" due to aggressive chemical attack. In addition, the applicant stated that the internal environment has the potential aging effect of "build up of deposits" due to biofouling. The applicant stated that the aging is managed by the use of Fire System flow and pressure drop testing along with the Buried Pipe Program B.1.25. The applicant indicated that the failure of the demineralized water line was provided as an example of operating experience related to failure and repair of buried piping. The applicant stated that the specific failure mechanism was not identified in maintenance history and that this portion of the demineralized water line was not within the scope of license renewal, thus, a one time inspection of the line was not warranted.

The staff requested additional clarifying information on November 26, 2003 relative to one time inspection of concrete piping since concrete asbestos piping remains in use and operating history indicates failures have occurred, confirmation that the soil environment is not aggressive to concrete aging, one time inspection of buried carbon steel piping and associated coating inspection (the applicant indicated that much of the buried carbon steel piping is not coated - the staff questioned why this was not identified as an exception to the GALL Program). This request for clarifying information is identified by the staff as Confirmatory Item B.1.25-1.

The staff requested in RAI B.1.25 the applicant to explain why a one-time inspection of the buried ductile iron fire pipe including a mechanical joint was appropriate to manage aging given there had been failures identified in the operating history. The staff also requested the applicant to address how pipe sections would be selected to represent the most likely location for degradation. The applicant's LRA and operating history did not indicate that the failures were located in concrete asbestos piping. The applicant indicated that the one time inspection is used in conjunction with inspection of piping uncovered during excavation. This is part of Commitment #25 of Appendix A of this SER. The applicant also stated that engineering judgement, including factors such as, age, operating experience, susceptible location and accessibility would be used to select the locations. The applicant's program will include provisions for expanding sample size if acceptance criteria are not met, establishing root cause and specifying corrective actions. The staff finds the applicant's response acceptable because one time inspections will be used in addition to inspections performed when piping is exposed during excavations in accordance with the GALL and the related operating history pertained to failures of a different material type.

In RAI B.1.25, the staff requested the applicant to clarify that inspections of buried pipe would occur during excavation and that pipe coatings and wraps are considered a program element instead of an enhancement. The applicant confirmed that inspections would occur during, excavations and that coatings and pipe wraps are used. The staff finds the applicants response acceptable because the applicant confirmed these program elements were consistent with the elements of the GALL program.

3.0.3.12.3 Conclusions

On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item B.1.25-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.13 10 CFR Part 50, Appendix J (B.1.28)

3.0.3.13.1 Summary of Technical Information in the Application

The applicant states in LRA Section B.1.28 that the 10 CFR Part 50, Appendix J aging management program is consistent with the ten elements of aging management program XI.S4, "10 CFR Part 50, Appendix J", specified in NUREG-1801.

The 10 CFR Part 50, Appendix J aging management program is credited for aging management of pressure boundary degradation due to loss of material in the primary containment and various systems penetrating primary containment. The program also manages changes in material properties of gaskets, o-rings, and packing materials for the primary containment pressure boundary access points.

The program consists of tests performed in accordance with the regulations and guidance provided in 10 CFR 50 Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," Option B, Regulatory Guide 1.163, "Performance-Based Containment Leak-Testing Program," NEI 94-01, "Industry Guideline for Implementing Performance-Based Options of 10 CFR Part 50, Appendix J," ANSI/ANS 56.8, "Containment System Leakage Testing Requirements," and station procedures. Containment leak rate tests are performed to assure that leakage through the primary containment and systems and components penetrating primary containment does not exceed allowable leakage limits specified in the Technical Specifications. An integrated leak rate test (ILRT) is performed during a period of reactor shutdown at the frequency specified in 10 CFR Part 50, Appendix J, Option B. Local leak rate tests (LLRT) are performed on isolation valves and containment access penetrations at frequencies that comply with the requirements of 10 CFR 50 Appendix J, Option B.

Under "Operating Experience", the applicant indicates that the industry has found that 10 CFR Part 50, Appendix J testing has been effective in maintaining the pressure integrity of the containment boundaries, including identification of leakage within the various systems' pressure boundaries. The Dresden and Quad Cities facilities have demonstrated experience in effectively maintaining the integrity of the containment boundaries as evidenced by the selection of Option B of 10 CFR 50 Appendix J leakage testing requirements. Both stations have experienced "as found" LLRT results in excess of individual containment penetration administrative limits. Evaluations were performed and corrective actions were taken to restore the individual penetration leakage rates to within the established administrative leakage limits in accordance with the Appendix J testing program.

The applicant concludes that the 10 CFR Part 50, Appendix J aging management program provides reasonable assurance that the loss of material and changes in material properties aging effects are adequately managed so that the intended functions of primary containment components within the scope of license renewal are maintained during the period of extended operation.

3.0.3.13.2 Staff Evaluation

In LRA Section B.1.28, “10 CFR Part 50, Appendix J”, the applicant described its AMP to manage containment leak-tight integrity. The LRA stated that this AMP is consistent with GALL AMP XI.S4, "10 CFR Part 50, Appendix J". The staff confirmed the applicant’s claim of consistency during the AMR inspection. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for both Dresden and Quad Cities to determine whether they provide an adequate description of the program.

3.0.3.13.3 Conclusions

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

3.0.3.14 Structures Monitoring Program (B.1.30)

3.0.3.14.1 Summary of Technical Information in the Application

The applicant states in LRA Section B.1.30 that, with enhancements, the structures monitoring aging management program is consistent with the ten elements of aging management program XI.S6, "Structures Monitoring Program," specified in NUREG-1801.

The structures monitoring program is credited for aging management of various structures and external surfaces of mechanical components within the scope of license renewal. The program, which was developed for structures monitoring under 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” is based on the guidance in Regulatory Guide 1.160 Revision 2, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and NUMARC 93-01 Revision 2, “Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and implemented through procedures. The program is not credited for managing protective coatings.

The program will provide for visual inspections of structures and components not included in the ASME Section XI, Subsection IWF (B.1.27) aging management program. For licence renewal, the following enhancements will be made. Enhancements are scheduled for implementation prior to the period of extended operation.

- The program will provide for inspections of structural steel components in secondary containment, flood barriers, electrical panels and racks, junction boxes, instrument racks and panels, offsite power structural components and their foundations, and the Quad Cities discharge canal weir as part of the ultimate heat sink.

- The program will provide for periodic reviews of chemistry data on below-grade water to confirm that the environment remains non-aggressive for the license renewal term for the aging mechanisms of corrosion of embedded steel and aggressive chemical attack of concrete.

- The program will provide for inspection of a sample of non-insulated indoor piping external surfaces at locations immediately adjacent to periodically inspected piping supports.

- Program procedures will reference specific insulation inspection criteria for existing cold weather preparation and inspection procedures for outdoor insulation, and establish new inspections for various indoor area piping and equipment insulation.

- The program will provide for inspection parameter specificity for non-structural joints, roofing, grout pads, and isolation gaps.

- The program will extend inspection criteria to the structural steel, concrete, masonry walls, equipment foundations, and component support sections of the program to provide consistency with NUREG-1801 component supports.

In its discussion of operating experience, the applicant states that roof leaks were detected and corrective actions taken for the Dresden turbine building and main control room and for the Quad Cities reactor building and turbine building. Minor degradation of concrete has been detected such as cracks with water stains, pitting, and leaching for various structures including the Dresden reactor building and crib house. Similar degradation has been detected in the Quad Cities reactor building and circulating water intake bays. The degradation was evaluated and dispositioned in accordance with the corrective action process. Cracks and small gaps were detected in elastomer seals at both Dresden and Quad Cities. Most of the degraded conditions were attributed to man-made occurrences. None were determined to be significant. Damage and degradation of insulation has been observed and repaired.

The applicant concludes that the structures monitoring program for aging management provides reasonable assurance that the aging effects are adequately managed so that the intended functions of structures within the scope of license renewal are maintained during the period of extended operation.

3.0.3.14.2 Staff Evaluation

In LRA Section B.1.30, “Structures Monitoring Program”, the applicant described its AMP to manage aging of structures and structural components within the scope of license renewal that are not managed by one of the other structural AMPs. The LRA stated that this AMP, with the enhancements described above in Section 3.0.3.14.1 of this report, is consistent with GALL AMP XI.S6, “Structures Monitoring Program”. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancements to determine whether this AMP, with the enhancements, is adequate to manage the aging effects for which it is credited. In addition the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for both Dresden and Quad Cities to determine whether they provide an adequate description of the revised program.

In its description of the program and the enhancements, the applicant made several statements that needed clarification before the staff could complete its evaluation. Therefore, the applicant was requested by RAI B.1.30 to submit the following additional information:

(a) The LRA states that “The program will provide for visual inspections of structures and components not included in the ASME Section XI, Subsection IWF (B.1.27) aging management program.” Is this statement intended to encompass component supports not covered by IWF? Staff requested the applicant to clearly define the scope of structures and components encompassed by this statement.

(b) The last item under “Enhancement” states that “The program will extend inspection criteria to the structural steel, concrete, masonry walls, equipment foundations, and component support sections of the program to provide consistency with NUREG-1801 component supports.” The staff is unable to interpret the meaning of this enhancement. Staff requested the applicant to describe in detail the structures and structural components included in this enhancement; the associated aging effects in need of aging management; the inspection methods to be used, and the acceptance criteria to be applied.

In its response to RAI B.1.30 dated October 3, 2003, the applicant stated:

> Exelon has reviewed LRA Appendix B.1.30 and the following clarification is provided.
>
> The Structural Monitoring Program is intended to encompass component supports that are not covered by the ASME Section XI, Subsection IWF. The ASME Section XI, Subsection IWF program provides for inspection of ASME Class 1, 2, and 3 supports. It will be enhanced to include ASME Class MC supports. The Structures Monitoring Program consists of defining and performing periodic structural evaluations which will ensure the timely identification, assessment and repair of degraded structural elements. One of the elements to be evaluated includes component supports. Component supports include:
>
> - Pipe Whip Restraint Supports
> - Jet Impingement Shield Supports
> - Instrument Tubing Supports
> - Tube Track Supports
> - HVAC Supports
> - Conduit and Junction Box Supports
> - Cable Tray Supports
> - Instrument Racks, panels and supports

- Electrical panels, racks, MCCs, Switchgears, junction boxes and supports
- Piping Component Supports including immediately adjacent piping/tubing.

A fixed number of supports for each type of component are selected for evaluation. The selection includes representation of supports throughout the plant, considering environmental conditions as well as configuration. Component selection includes sample sizes for each component classifications mentioned above. The component support includes all auxiliary steel members (i.e., all steel plates, shapes, bolts, and anchors) between the supported component and the main structural element (i.e., the concrete slab/beam or the structural steel floor framing). The program does not include standard components such as snubbers, struts and spring cans. Grout pads for support base plates are also in-scope.

The last item under "Enhancement" in LRA Appendix B.1.30 related to consistency with NUREG 1801 component supports is not an enhancement in the sense that new areas of inspection are being added, but it is rather a clarification to NUREG 1801 terminology to ensure that the proper attributes are considered for specific types of installed plant components and structures. The following includes the types of clarifications that were added to in the structural monitoring program implementing procedure for structural steel, concrete, masonry walls, equipment foundations, and component support sections to ensure consistency with NUREG 1801.

- Added several support sub-categories under "Component Supports" for Tube Track Supports, Instrument Tubing Supports, Jet Impingement Shield Supports, and Pipe Whip Restraint Supports
- Added platform support clarification wording under "Structural Steel Elements" examination guidelines.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to bolted connection inspection.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to wall support inspection.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to anchorage and welds inspection.
- Added panels, cabinets and enclosures for electrical equipment.
- Added emergency diesel generators, HVAC system components, and other miscellaneous equipment under "Equipment Foundations."
- Added aging mechanism (service induced cracking or other concrete aging degradation) to Grout Pads/Concrete Pedestals examination.

The above clarifications are not enhancements, but rather are clarifications to provide consistency with NUREG 1801 terminology. All associated aging effects in need of aging management for the structures and structural components included in the above clarifications are presently being managed.

The additional information provided by the applicant in its response to RAI B.1.30 sufficiently answers the questions posed by the staff, with (2) exceptions. It is not clear whether the category "Piping Component Supports including immediately adjacent piping/tubing," listed in the response to item (a) of the RAI is meant to include non-ASME piping supports. It is also not clear as to why the Structures Monitoring Program does not include "standard components such as snubbers, struts and spring cans." In order to completely resolve the response to this RAI, the staff requests that the applicant confirm the following:

(a) the B.1.30 program covers non-ASME piping supports
(b) there are no snubbers, struts and spring cans on non-ASME piping and components

This is Confirmatory Item 3.0.3.14.2-1.

3.0.3.14.3 Conclusions

On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item 3.0.3.14.2-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.15 Heat Exchanger Test and Inspection Activities (B.2.6)

3.0.3.15.1 Summary of Technical Information in the Application

The heat exchanger test and inspection activities are a plant specific program, not addressed in the GALL report. In Section B.2.6 of the LRA, the applicant addressed the ten program elements using guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR. The following information was provided in the LRA:

The LRA describes the heat exchanger test and inspection activities as providing condition monitoring, inspection, and performance testing. The activities manage loss of material, cracking, and buildup of deposits in heat exchangers in the scope of license renewal that are not tested and inspected by the Open-Cycle Cooling Water System (B.1.13) and Closed-Cycle Cooling Water System (B.1.14) aging management programs. The augmentation activities identified in the GALL report lines IV.C1.4-a and IV.C1.4-b to manage loss of material and cracking for the Dresden isolation condensers are included in this aging management program. The applicant indicates that the inspection activities are new and will be implemented prior to the period of extended operation.

The applicant utilizes surveillance testing, inspections and in-service nondestructive examinations (ISI, NDE) to verify that heat exchanger performance is adequate and to detect aging effects. Results are trended to confirm that aging effects are managed and that system and component functions are maintained.

Isolation condenser test and inspection augmentation activities detect cracking due to stress corrosion cracking or cyclic loading, and detect loss of material due to pitting and crevice corrosion. These augmentation activities are not part of the ISI program, but are used by the applicant to verify that the ISI program is effective, for ensuring that significant degradation is not occurring, and the intended function of the isolation condenser is maintained during the extended period of operation. These augmentation activities consist of temperature and radioactivity monitoring of the shell-side (cooling) water, and eddy current testing of tubes.

The inservice inspection, water chemistry management and lubricating oil management activities applied to the heat exchangers in the scope of this aging management program are described in other aging management program evaluations.

3.0.3.15.2 Staff Evaluation

Because the Heat Exchanger Test and Inspection Activities program is not included in the GALL, The staff review was performed against the 10 elements of the Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled Quality Assurance Program. The staff's evaluation of the Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program. The staff identified a need for additional information which was requested in the staff letter to the applicant of August 7, 2003. The applicant responded by letter dated October 3, 2003.

[Program Scope] The LRA identified the following heat exchangers as being subject to these test and inspection activities:

- Dresden Unit 2 and 3 HPCI lubricating oil coolers
- Dresden Unit 2 and 3 HPCI gland seal condensers
- Dresden main control room air handling unit hear exchanger
- Dresden Unit 2 and 3 isolation condensers
- Quad Cities Unit 1 and 2 HPCI lubricating oil coolers
- Quad Cities Unit 1 and 2 HPCI gland seal condensers
- Quad Cities main control room air handling unit heat exchanger
- Quad Cities Unit 1 and 2 battery/station blackout room HVAC heat exchangers

The staff finds the scope to be appropriate for the AMP.

[Preventive Actions] The LRA stated that these heat exchanger test and inspection activities do not provide any preventive actions. These activities provide condition monitoring to detect degradation prior to a loss of function. The staff finds this acceptable and notes that preventive actions are not required.

[Parameters Monitored/Inspected] The LRA stated that performance tests verify system operability by verifying proper fluid flows, temperatures, or differential pressures during system operation under load. Wall loss and surface condition of heat exchanger tubes will be monitored by eddy current inspection. Radioactivity monitoring of the Dresden isolation condenser is monitored through periodic sampling. The staff finds that the parameters monitored will identify loss of material or loss of heat transfer and therefore, are acceptable.

[Detection of Aging Effects] Loss of material, cracking, or build up of deposits would result in degradation of heat exchanger or system performance. Inspection activities monitor the effects of corrosion and buildup of deposits. Periodic inspections and NDE tests may consist of visual inspections, eddy-current testing, and ultrasonic tests or radiography to detect loss of material, cracking, or buildup of deposits. System performance testing will be used to detect loss of heat transfer in heat exchangers. The staff requested additional information in RAI B.2.6 a, regarding detection of local corrosion mechanisms affecting the battery station blackout room heat exchangers and the HPCI lube oil coolers and gland seal condensers. The applicant's response stated that periodic inspections (visual and eddy current) of accessible tube internal surfaces for the HPCI lubricating oil coolers and gland seal condenser tubes will be used to identify galvanic, crevice and pitting corrosion and MIC and FAC. One-time visual inspections will be used to identify the potential for selective leaching in a component with similar material environment combination as the HPCI lubricating oil coolers and gland seal condenser tube internal surfaces. The applicant stated that visual inspections of accessible internal surfaces of the Quad Cities battery/station blackout room heat exchanger will identify loss of material in that component. The staff finds that the applicant's program will detect aging effects within the program scope through the use of system performance testing, visual inspection and other NDE methods such as eddy current testing. Further, the applicant's related operating experience in response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," illustrates that the program will be capable of detecting aging.

[Monitoring and Trending] Heat transfer testing results are documented in plant test procedures, and are trended and reviewed by the appropriate plant personnel. Isolation condenser temperatures are recorded in surveillance logs and radiation monitoring of the isolation condensers is conducted by procedure. The applicant has established the frequency and extent of inspections and testing to ensure detection of aging effects before the loss of intended function of the heat exchanger or associated system. The applicant relies on system operability testing to verify heat removal capabilities. Inspections are generally conducted at 10-year intervals or less, with shorter intervals being based on industry guidelines or plant operating experience. Eddy current testing is to be performed at least once every 10 years, and the procedure provides for increasing the inspection frequency based on the results.

After initial inspection, subsequent inspection frequencies will be based on the as-found condition of the equipment. The inspection and testing intervals may be adjusted on the basis of the results of the reliability analysis, type of service, frequency of operation, or age of components and systems.

The applicant was requested in RAI B.2.6d, to provide additional details describing the methods that will be used to evaluate inspection results and assess remaining component life predications for material loss and cracking mechanisms. The applicant's response stated that cracking and loss of material are documented in plant procedures and evaluations are performed for inspection results that do not satisfy the acceptance criteria. Condition reports are initiated to document concerns and the resolution of the condition reports includes engineering evaluations including an assessment of remaining component life and the need for additional aging management activities.

The staff finds the applicant's monitoring and trending is acceptable because system performance testing and NDE results are documented and the frequency of tests and inspections are established with provisions to reevaluate the frequency to ensure aging is managed in the future. Further, the staff finds the program acceptable because corrective action reports will be used to document aging concerns and ensure evaluations are performed to evaluate degradation and remaining life evaluations.

[Acceptance Criteria] The LRA states that specific acceptance criteria are provided in the inspection or test procedures, as required to ensure continued system and component operability. The applicant stated system functional testing must confirm the system's ability to meet minimum Technical Specification requirements and EPRI guidance is used to determine allowable percent wall loss, plugging criteria, and for projections of remaining life. Indications of degradation are evaluated by the applicant to determine if the material condition will maintain the system intended function prior to returning the system to operable status. The applicant performs engineering evaluations if aging is identified and to determine corrective action. The staff requested that the applicant provide additional details on the evaluation methods and acceptance criteria/standards in RAI B.2.6c. The applicant's response to this RAI noted that EPRI documents are used as a bases to determine allowable wall loss, plugging criteria, and projections of remaining life. The applicant indicated that these documents included the following:

- EPRI TR-106857, Volume 34, Preventive Maintenance Program Basis: Main Condensers, July 1988

- EPRI CS-5235, Recommended Practices for Operating and Maintaining Steam Surface Condensers, July 1987

- EPRI TR-100385, Balance-of-Plant Heat Exchanger Condition Assessment Guidelines, July 1992

- EPRI TR-101772, Electromagnetic NDE Guide for Balance-of-Plant Heat Exchangers, Rev. 2, December 1997

- ERPI TR-110392, Eddy Current Testing of Service Water Heat Exchangers for Engineers Guideline, Final Report, February 1999

Further, the applicant stated that these procedures, governing eddy current testing, contain criteria for establishing inspection timing, inspection interval reduction or expansion, and tube random sampling schemes based on criteria such as:

- Number of tubes plugged
- Rate of tube wall loss
- Evidence of tube cracking
- Wall degradation factors (e.g., flaw growth rate)

Similar acceptance criteria are provided in procedures governing other NDE methods utilized by the program. The applicant stated that acceptance criteria for visual inspection may vary depending on a number of parameters associated with the particular heat exchanger being inspected. The applicant stated that in general the visual acceptance criteria will include ensuring the number of plugged/blocked tubes is less than that allowed by a review of the heat exchanger load calculation or engineering judgement. The applicant stated that the visual acceptance criteria for evidence of tube fouling would be based on operating experience and system performance. The applicant stated that visual acceptance criteria will also include inspection for pitting and general corrosion. The applicant indicated that evaluations will be performed for inspections that do not satisfy acceptance criteria and condition monitoring reports are initiated to document conditions in accordance with corrective action program. The applicant indicated that resolution of the corrective action documents would include engineering evaluations assessing the remaining component life and determine the need for additional aging management activities.

The staff found that the applicant's acceptance criteria were acceptable because the acceptance criteria are based on industry guidelines and current practice that account for frequency of inspection, sample expansion and applicable aging mechanisms as well as incorporation of operating history and system performance criteria.

[Operating Experience] The LRA stated that this is a new aging management program. Therefore, no program operating experience exists at this time. However, the LRA indicated that similar controls implemented for the GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," program have been effective in detecting aging effects in heat exchangers. Instances of loss of material, cracking, and buildup of deposits in heat exchangers have been detected in Dresden and Quad Cities heat exchangers prior to loss of system intended functions. In RAI B.2.6b, the staff requested that the applicant provide additional details regarding these occurrences, including the heat exchanger, type of degradation mechanism, how it was detected, and corrective action taken, etc. The applicant's response to this RAI provided a list of the heat exchangers identified by the GL 89-13 program and provided examples of the types of degradation, methods of detection and associated corrective actions as follows:

> Loss of material for TBCCW tubing identified by eddy current testing as part of periodic inspections. Corrective actions included evaluating inspection results and replacing tubes with minimum wall thicknesses not meeting acceptance criteria.
>
> Buildup of deposits for ECCS room cooler components identified by cooler flow surveillance or operator rounds instrumentation inspections. Corrective actions included cleaning and subsequent inspection of surfaces.
>
> Loss of material of ECCS room cooler tubing identified by eddy current testing. Corrective actions included revising procedures to require periodic eddy current testing and replacing the associated cooling coil.

The staff finds that the applicant's operating experience related to GL 89-13 confirms that the applicant's heat exchanger test and inspection program will adequately manage aging because similar degradation mechanisms have been identified using similar techniques in plant heat exchangers and the applicant has incorporated this experience into this program.

3.0.3.15.3 Conclusions

On the basis of its review of the applicant's program, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.16 Lube Oil Monitoring Activities (B.2.5)

3.0.3.16.1 Summary of Technical Information in the Application

The applicant's Lube Oil Monitoring program is discussed in LRA Section B.2.5, "Lube Oil Monitoring Activities." The applicant states that the program is not consistent with a GALL report program; therefore, the applicant summarized the program in terms of the 10-element program as described in Branch Technical Position, Appendix A of the SRP-LR. The LRA credits this program with managing loss of material and cracking of lubricating oil coolers in the HPCI, emergency diesel generator and station blackout (SBO) diesel generator systems at the D/QCNPS. The applicant stated that the program will use periodic sampling, testing, and trending for maintaining physical and chemical properties in lubricating oil.

The applicant stated that this program manages the physical and chemistry properties in the lubricating oil. The complete aging management for the lubricating oil heat exchangers in the scope of this program also includes activities under the "Closed-Cycle Cooling Water System" and/or "Heat Exchanger Test and Inspection Activities," AMPs B.1.14 and B.2.6, respectively.

The applicant concludes that the Lube Oil Monitoring program will mitigate, detect, monitor, and trend the effects of aging to provide reasonable assurance that the intended functions will be maintained during the period of extended operation.

3.0.3.16.2 Staff Evaluation

In LRA Section B.2.5, "Lube Oil Monitoring Activities," the applicant described its AMP to manage loss of material and cracking in lubricating oil coolers within the scope of license renewal. The staff reviewed this program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled Quality Assurance Program. The staff's evaluation of the Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

In its October 3, 2003, response to RAI B.1.23-2(a), the applicant committed to include the following additional components in the scope of this program: components in the reactor core isolation cooling (RCIC) system, additional components in the high pressure coolant injection (HPCI) system, additional components in the emergency diesel generator and auxiliaries system, and additional components in the station blackout diesel system. In its draft supplemental response dated December 18, 2003, the applicant further committed to add components exposed to EHC oil (main turbine and auxiliary systems) and generator hydrogen seal oil (turbine oil system - Quad Cities only) to the scope of this program. The staff finds that adding the above components to the scope of this program is appropriate, since maintaining oil quality is important for preventing aging effects. However, the applicant has not provided updates to the program elements to address the increased scope of the program. The applicant is requested to provide the appropriate revisions to the 10 elements and the UFSAR summary description of this program. This is Confirmatory Item B.2.5-1.

[Program Scope] The applicant stated that this AMP is applicable to heat exchanger components exposed lubricating oil environment in the HPCI, emergency diesel generator and station blackout (SBO) diesel generator systems. The staff finds that the scope is acceptable because it includes those components that rely on the program for aging management.

[Preventive or Mitigative Actions] The applicant's program monitors and controls the oil properties and impurity levels. When the parameters exceed predefined limits, actions are taken to restore the conditions. The staff finds that maintaining the oil parameters mitigates loss of material and cracking in lubricating oil systems; therefore, the staff finds this acceptable.

[Parameters Monitored or Inspected] The applicant stated that the parameters monitored by the program include viscosity, total acid number, total base number, rotary bomb oxidation test, water demulsability, particle count, fuel and combustion byproducts, sediment, water, anti-foaming characteristics, whole particle counting, air release and emission spectrum. The applicant also stated that the parameters monitored by the program depends on oil type and type of service. The staff notes that loss of material due to general, crevice, and pitting corrosion and cracking are applicable aging effects for lubricating oil cooler components in a lubricating oil environment at locations containing water or contaminants such as chloride ions. By RAI B.2.5(a), the staff asked the applicant to clarify whether water, moisture, and chloride ions are monitored for all type of oil and service. If not, the staff requested the applicant to provide justification for not including these parameters in monitoring. In its response dated October 3, 2003, the applicant stated that water/moisture is monitored as part of the Lubricating Oil Monitoring Activities program. No monitoring for chloride ions is provided in this program. The applicant explained that EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, Appendices C and G were reviewed in the development of the Lubricating Oil Monitoring Activities program. These appendices address oil environments in general and lubricating oil environments for heat exchangers respectively. Appendix C identifies damaging effects associated with chlorides in fuel oil environments, but no similar effects are identified for lubricating oil environments. Appendix G does not identify any applicable aging effects associated with chlorides for lubricating oil environments in heat exchanger components. The applicant also stated that there is no site operating experience of failure or degradation in oil environments attributed to the presence of chlorides. Therefore, the applicant concluded that monitoring for chloride ions is not required for the Lubricating Oil Monitoring Activities program. Based on the applicant's operating experience, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.5(a) is considered closed. The staff concludes that the applicant is monitoring the appropriate oil parameters; therefore, the staff finds this acceptable.

[Detection of Aging Effects] The applicant stated that samples of lubricating oil are taken monthly for emergency diesel generators, and quarterly for HPCI and SBO diesel generators. Sampling frequency is increased if plant and equipment operating conditions indicate a need to do so. The applicant stated that the sampling would reveal aging degradation because increased impurities and degradation of oil properties indicate degradation of material in lubricating oil systems. The staff finds this acceptable because sampling and analyses are performed periodically, and the analysis is capable of detecting aging degradation.

The staff also notes that the aging effects are managed by the “Closed-Cycle Cooling Water System” and/or “Heat Exchanger Test and Inspection Activities,” AMPs B.1.14 and B.2.6, respectively. The inspections and performance testing under these programs provides additional assurance that loss of material and cracking will be detected before the loss of intended function; therefore, the staff finds this acceptable.

[Monitoring and Trending] The Lube Oil Monitoring program monitors the relevant parameters via samples taken monthly for EDGs and quarterly for HPCI and SBO diesel generators. The oil analysis results are trended and evaluated using computer software and a database. The applicant stated that the lubricating oil analysis results are trended and evaluated using computer software and a database. The staff finds that monitoring through sample analysis is appropriate and that the frequency is consistent with industry experience; therefore, the staff finds the monitoring and trending to be acceptable.

[Acceptance Criteria] The applicant stated that normal, alert, and fault levels have been established for the various chemical and physical properties, wear metals, additives, and contaminant levels based on information from oil manufacturers, equipment manufacturers, and industry guidelines, for the specific oil type and application. The applicant also stated that the program maintains contaminant and parameter limits within the application-specific limits. By RAI B.2.5(b), the staff asked the applicant to explain the acceptance criteria of water, moisture, and contaminants. In its response dated October 3, 2003, the applicant provided the acceptable limits for water/moisture and contaminants at normal, alert, and fault levels for emergency diesel generator and SBO diesel components with MOBILGARD 450 NC oil and for HPCI turbine components with MOBIL VAPROTEC LIGHT oil. The applicant stated the acceptable limits are based on EPRI 1003056, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” Revision 3, and that any failures to meet these criteria result in a condition evaluation, an identification of root causes, and correction of the adverse condition. The staff finds that the acceptance criteria are consistent with industry guidelines and that the applicant’s activities in case of failure to meet these acceptance criteria are reasonable; therefore, the staff finds the acceptance criteria acceptable.

[Operating Experience] The applicant stated that oil sampling and analysis have detected particulate or water contamination (or both) in lubricating oil systems. The operating experience has produced procedure and program changes, which have improved the effectiveness of lubricating oil testing and inspection activities. By RAI B.2.5(c), the staff asked the applicant to describe the corrective actions made and the operating experience since these corrective actions were implemented. In its response dated October 3, 2003, the applicant provided four examples of corrective actions made as a result of operating experience involving lube oil sampling and analysis. In one of the examples, the applicant stated that the 10/28/99 oil analysis of the Unit 1A (1B) SBO diesel engine crankcases indicated high percentage volume for sediment of 0.3 % (upper limit of 0.05% volume). All physical parameters other than sediment were found to be suitable for use. A recommendation was made to continue sampling/trending oil sample results on a quarterly frequency. The sampling procedure was revised to include requirements to perform sampling on a quarterly basis, and trend results. In another example, the applicant stated that a number of Quad Cities oil analysis results for RHRSW pump bearings showed high metal levels. It was determined that the high/increased wear level concentrations could have been indications of pump shaft, housing, rolling element bearing or bearing cage clearance wear. It was determined that the pump bearing oil analysis required large amounts of oil to be collected because smaller sample amounts had a tendency to show high/erratic wear levels. The sampling procedure was revised to include requirements to draw a relatively large sample. The applicant stated that no operating experience involving recurrence of heat exchanger degradations since implementation of the associated corrective actions. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.5(c) is considered closed. The staff finds that the applicant's operating experience supports the conclusion that the program will be effective in preventing aging of the components in the scope of this program; therefore, the staff finds this acceptable.

3.0.3.16.3 Conclusions

On the basis of its review of the applicant's program, pending satisfactory resolution of Confirmatory Item B.2.5-1, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.17 Periodic Inspection of Ventilation System Elastomers (B.2.3)

3.0.3.17.1 Summary of Technical Information in the Application

The applicant's periodic inspection of ventilation system elastomers is discussed in LRA Section B.2.3, "Periodic Inspection of Ventilation Elastomers." The applicant noted that this program is not addressed in the GALL Report and therefore summarized the program in terms of the 10-element program described in Branch Technical Position Appendix A-1 of the SRP-LR. The applicant stated that GALL Sections V.B1, V.B2, VII.F1, VII.F3, and VII.F4 state that ventilation system elastomers used for flexible boots, access door seals, and filter seals are susceptible to hardening and loss of strength, and loss of material aging effects and that the GALL aging management program column for these sections states that a plant-specific aging management program is to be evaluated. The applicant claimed that the improved program for periodic inspection of ventilation system elastomers provides routine inspection of certain elastomers in ventilation systems in accordance with plant procedures and predefined tasks.

This AMP is credited with providing condition monitoring to detect degradation prior to a loss of function via inspections for cracking, loss of material, or other evidence of aging of all flexible boots, access door seals and gaskets, filter seals and gaskets, and RTV silicone used as a duct sealant and testing of seals for hardening if evidence of aging is found. This AMP calls for periodic inspection of ventilation system elastomers including those in the standby gas treatment, reactor building ventilation, emergency diesel generator building ventilation, station blackout diesel generator building ventilation, and main control room ventilation systems.

The applicant performed elastomer inspections at intervals sufficient to detect aging prior to the equipment failing a leakage test or filter efficiency test. Review of the plant-specific operating experience indicates that, although Dresden and Quad Cities have experienced leaks in ventilation systems due to deterioration of or damage to elastomers, including flexible boots and access door seals and gaskets, the leaks were found and corrected in a timely manner and did not result in a loss of function of the ventilation system train.

In its LRA, the applicant concludes that implementation of the Periodic Inspection of Ventilation Elastomers program will either verify that there are no aging effects requiring management for the subject components, or ensure that the appropriate corrective actions will be taken so that the component intended functions will be maintained during the period of extended operations.

3.0.3.17.2 Staff Evaluation

In LRA Section B.2.3, “Periodic Inspection of Ventilation Elastomers,” the applicant described its AMP to routinely inspect elastomers for cracking, loss of material, or other evidence of aging of all flexible boots, access door seals and gaskets, and filter seals and gaskets in the components of those systems that are within the scope of license renewal. This AMP is not consistent with a GALL AMP. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in the Branch Technical Position RLSB-1 in Appendix A of the SRP-LR.

The staff reviewed this program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of the following 10 elements: scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff’s evaluation of the applicant’s Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven elements is provided below. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

In the second paragraph of the Description section of AMP B.2.3, the applicant stated, “The improved program for periodic inspection of ventilation system elastomers provides routine inspection of certain elastomers in ventilation systems in accordance with plant procedures and predefined tasks.” Elastomer wear and degradation of elasticity are functions of material composition, dynamic load, environment, and time. All elastomer components with the same material composition/dynamic load/environment will roughly have the same degree of aging. By letter dated August 4, 2003, the staff requested, in RAI B.2.3-a, the applicant to explain what are the certain elastomers and technical basis for selecting these certain elastomers.

In its response dated October 3, 2003, the applicant stated that the scope of the program applies to the elastomer seals in the ventilation systems that are in the scope of license renewal. The in-scope systems for Dresden and Quad Cities are control room ventilation, station blackout diesel generator building ventilation, and standby gas treatment. Additionally, the Dresden reactor building ventilation and the Quad Cities emergency diesel generator building ventilation systems are included. The certain elastomers include flexible boots, access door seals and gaskets, and RTV used as duct sealant. The basis for selecting these certain elastomers was to provide an inspection of the elastomers of in scope ventilation systems. On the basis of its review, the staff finds that the applicant’s response to B.2.3-a adequate and acceptable because the applicant explained the technical basis and the types of elastomers included in the scope of license renewal. The issue is characterized as resolved.

[Program Scope] The applicant stated that this AMP is applicable to elastomers utilized in ventilation systems within the scope of license renewal, including flexible boots, access door seals, filter seals, and RTV used as a duct sealant. Further the applicant stated (LRA Section 3.3.1.1.5) that aging management of control room, emergency diesel generator building, station blackout diesel generator building, and reactor building (using the requirements of the containment ventilation) ventilation system elastomers will be performed by the periodic inspection of elastomers in accordance with the plant-specific aging management program Periodic Inspection of Ventilation System Elastomers. The applicant further states that Exelon may elect to periodically replace certain ventilation system elastomer and RTV seals instead of inspecting them and that periodic replacement will be evaluated on a case-by-case basis. By letter dated August 4, 2003, the staff requested, in RAI B.2.3-b, the applicant to provide specific information such as replacement frequency, replacement criteria and the associated technical basis, including applicable operating experience about the proposed periodic replacement. The staff further requested that the applicant describe how the variable combinations of material composition, dynamic load, and environment will be weighed in determining the frequency of inspection.

In its response dated October 3, 2003, the applicant stated that there are no plans or schedules to perform replacements of ventilation system elastomers at this time and the intent of this statement in the program scope was to provide the opportunity to credit replacement of elastomers in lieu of performing the inspection. By letter dated December 17, 2003, the applicant stated that, upon further evaluation, it does not need to include the flexibility of being able to replace elastomers in lieu of performing the inspection. Therefore, the applicant will revise the AMP to delete the flexibility to replace the elastomers. The Scope of Activity for the Periodic Inspection of Ventilation System Elastomers AMP will be revised as follows:

> The program inspects elastomers utilized in ventilation systems within the scope of license renewal, including flexibility boots, access door seals, filter seals, and RTV used as a duct sealant. These elastomers prevent external leakage and bypass of HEPA and carbon filters. These inspections apply to the standby gas treatment system and ventilation systems within the scope of license renewal; that is, to the main control room ventilation, station blackout diesel generator building ventilation, Dresden reactor building ventilation, and Quad Cities emergency diesel generator building ventilation systems.

This is part of Commitment #41 of Appendix A of this SER. The staff finds the applicant's response acceptable because the replacement of elastomers is no longer an options; therefore, the specific information for replacement of elastomers such as replacement frequency, replacement criteria and the associated technical basis, including applicable operating experience about the proposed periodic replacement is not required.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effect; the inspections provide condition monitoring to detect degradation prior to a loss of function. By letter dated August 4, 2003, the staff noted, in RAI B.2.3-e, that elastomers may crack, harden, or lose strength due to relative motion between vibrating equipment, exposure to warm moist air, temperature changes, oxygen, and/or radiation and requested the applicant to clarify if the elastomer components are also used at Dresden and Quad Cities as vibration isolators to prevent transmission of vibration and dynamic loading to the rest of the system. If these isolators degrade, vibration and subsequent dynamic loads applied to the ductwork and fasteners cannot be eliminated. The staff further requested that the applicant provide the frequency of the subject inspection for the applicable elastomer components, including a discussion of the operating history to demonstrate that the applicable aging degradations will be detected prior to the loss of their intended function.

In its response dated October 3, 2003, the applicant stated that elastomer components are not used in Dresden or Quad Cities HVAC systems as vibration isolators to prevent transmission of vibration or dynamic loading to the rest of the system. On the basis of its review, the staff finds that the applicant's response to B.2.3-e adequate and acceptable because the applicant explained how, since there are no elastomeric isolators, their degradation is not an aging management issue. The issue is characterized as resolved.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include elastomers used in ventilation system; flexible boots, access door seals and gaskets, filter seals and gaskets, and RTV used as a duct sealant are inspected to ensure they are free of cracking, loss of material, and damage. The seals will be tested for hardening if cracking or loss of material is noted. This is part of Commitment #41 of Appendix A of this SER. For the standby gas treatment and main control room ventilation systems, the results of the elastomer inspections are verified by the performance of system leakage tests and filter efficiency tests. Since the applicant stated that the condition of elastomers used in ventilation systems will be determined by visual inspection, by letter dated August 4, 2003, the staff requested, in RAI B.2.3-f, the applicant to explain how this visual inspection will be conducted in the inaccessible areas.

In its response dated October 3, 2003, the applicant stated that all elastomer components with the same material composition/dynamic load/environment would roughly have the same degree of aging. Therefore, the inspections of the accessible areas bound the inaccessible areas. When unacceptable age related degradation is found, the impact of the degradation will be evaluated for the remaining (inaccessible) portions of that system. On the basis of its review, the staff finds that the applicant's response to RAI B.2.3-f adequate and acceptable because the applicant explained how information from accessible areas would be extrapolated to inaccessible areas. The issue is characterized as resolved.

[Detection of Aging Effects] The applicant stated that the AMP will rely on inspections of elastomers performed at intervals sufficient to detect aging prior to the equipment failing a leakage test or filter efficiency test and that seals will be inspected for hardening if cracking or loss of material is observed. The applicant further states, in LRA Section 3.3.1.1.5, that the AMP will manage the aging of elastomeric components due to hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear for the period of extended operation. Since the AMP does not contain a statement that the inspection will be conducted by qualified personnel, or reference to authoritative criteria to detect hardening or cracking due to elastomer degradation or loss of material due to wear, by letter dated August 4, 2003, the staff requested, in RAI B.2.3-c, the applicant to address this issue.

In its response dated October 3, 2003, the applicant stated that personnel that have been trained and qualified in accordance with station procedures perform these examinations. The inspections visually look for evidence of cracking and loss of material. When indications are found, additional examinations are performed for hardening of the material. On the basis of its review, the staff finds that the applicant's response to B.2.3-c adequate and acceptable because the applicant verified that qualified personnel would conduct the inspection. The issue is characterized as resolved.

[Monitoring and Trending] The applicant stated that the conditions of the elastomers used in ventilation systems are monitored, but not trended and that flexible boots, filter seals, and access door seals and gaskets are repaired or replaced if damage or deterioration is detected. The staff finds the above monitoring acceptable; the staff did not identify the need for trending in this AMP.

[Acceptance Criteria] The applicant stated that the acceptance criteria are no unacceptable cracking, loss of material, and damage. The seals will be inspected for hardening if cracking or loss of material is observed and repaired or replaced if a degraded condition is found. Surveillance tests of the standby gas treatment and main control room ventilation systems ensure that system leakage meets the requirements of the current licensing basis. Since the AMP does not specifically refer to an acceptance criterion to evaluate indications related to hardening or cracking due to elastomer degradation or loss of material due to wear, by letter dated August 4, 2003, the staff requested, in RAI B.2.3-d, the applicant to address this issue.

In its response dated October 3, 2003, the applicant stated that the elastomers are inspected for signs of cracking, loss of material, damage, or other abnormal conditions. If signs of cracking or loss of material is noted then an inspection for hardness is performed. Discrepant conditions are recorded in the corrective action program for further evaluation and disposition. On the basis of its review, the staff finds that the applicant's response to B.2.3-d adequate and acceptable because the applicant explained its procedure for identifying and recording discrepant conditions in the corrective action program for further evaluation and disposition. The issue is characterized as resolved.

[Operating Experience] The applicant stated that Dresden and Quad Cities have experienced leaks in ventilation systems due to deterioration of or damage to elastomers, including flexible boots and access door seals and gaskets. The leaks were found and corrected in a timely manner and did not result in a loss of function of the ventilation system train. By letter dated August 4, 2003, the staff requested, in RAI B.2.3-g, the applicant to discuss how the program has been modified to avoid seepage or leakage through boots, seals, and gaskets.

In its response dated October 3, 2003, the applicant stated that the operating experiences summarized in element 10 of B.2.3 are indicative of an effective program identifying age related degradation prior to loss of intended function of a component and taking appropriate and timely corrective action. As such, there were no program enhancements made. However, the applicant noted that some of the specific examples cited include:

- In 1987, Dresden identified minor leakage in the reactor building ventilation access doors. The door seals were replaced and stiffeners were added to the door.

- In 1988, Dresden identified cracking in some HVAC system piping flexible boot seal. All of the HVAC system piping flexible boot seals were replaced.

- In 1988, Dresden identified minor leakage in the reactor building ventilation inspection doors. The door seals were replaced and new latches were installed.

- In 1994, Quad Cities identified a high efficiency particulate air (HEPA) filter door leak. The damaged door and seal were replaced.

- In 1996, Quad Cities identified minor leakage in the standby gas treatment access doors. The doors were re-adjusted and the seals were replaced.

On the basis of its review, the staff finds that the applicant's response to B.2.3-g adequate and acceptable because the applicant explained and provided examples of how the program adequately provides remediation to any seepage or leakage through boots, seals, and gaskets. The issue is characterized as resolved.

The staff reviewed the UFSAR supplement in LRA Appendix A.2.3 and found that the description of the periodic inspection of ventilation system elastomers is consistent with Section B.2.3 of the LRA. The staff finds that the information provided in the UFSAR supplement provides an adequate summary of the program activities as required by 10 CFR 54.21 (d).

3.0.3.17.3 Conclusions

On the basis of its review of the applicant's program, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 Quality Assurance For Aging Management Programs

Pursuant to 10 CFR 54.21(a)(3), a license renewal applicant is required to demonstrate that the effects of aging on structures and components subject to an Aging Management Review (AMR) will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation. NUREG-1800, Branch Technical Position RLSB-1, "Aging Management Review - Generic," describes ten attributes of an acceptable aging management program. Three of these ten attributes are associated with the quality assurance activities of corrective action, confirmation processes, and administrative controls. Table A.1-1, "Elements of an Aging Management Program for License Renewal," of Branch Technical Position RLSB-1 provides the following description of these quality attributes:

- corrective actions, including root cause determination and prevention of recurrence, should be timely

- the confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective

- administrative controls should provide a formal review and approval process

NUREG-1800, Branch Technical Position IQMB-1, "Quality Assurance For Aging Management Programs," noted that those aspects of the aging management program that affect quality of safety-related structures, systems, and components are subject to the quality assurance (QA) requirements of 10 CFR Part 50 Appendix B. Additionally, for non-safety-related structures and components subject to an aging management review, the existing 10 CFR Part 50 Appendix B

QA program may be used by the applicant to address the elements of corrective actions, the confirmation process, and administrative controls. Branch Technical Position IQMB-1 provides the following guidance with regard to the quality assurance attributes of aging management programs:

- Safety-related structures and components are subject to 10 CFR Part 50 Appendix B requirements, which are adequate to address all quality-related aspects of an aging management program consistent with the CLB of the facility for the period of extended operation.

- For non-safety-related structures and components that are subject to an AMR for license renewal, an applicant has an option to expand the scope of its 10 CFR Part 50 Appendix B program to include these structures and components to address corrective actions, the confirmation process, and administrative controls for aging management during the period of extended operation. In this case, the applicant should document such a commitment in the UFSAR supplement in accordance with 10 CFR 54.21(d).

3.0.4.1 Summary of Technical Information in Application

Chapter 3.0, "Aging Management Review Results," of the LRA provides an AMR summary for each unique structure, component, or commodity group at the Dresden and Quad Cities Nuclear Power Stations determined to require aging management during the period of extended operation. This summary includes identification of aging effects requiring management and AMPs utilized to manage these aging effects. Appendix B to the LRA demonstrates how the identified programs manage aging effects using attributes consistent with the industry and NRC guidance. The applicant's programs and activities that are credited with managing the effects of aging can be divided into two types of programs: (1) aging management programs evaluated in NUREG-1801, and (2) plant-specific aging management programs. Aging management program evaluated in NUREG-1801 are described in Appendices A.1 and B.1 of the LRA while plant specific aging management programs are described in Appendices A.2 and B.2 of the LRA.

In Section A.2.1," Corrective Action Program," of the LRA, the applicant describes the quality attributes of the plant specific aging management programs. The applicant stated that the 10 CFR Part 50, Appendix B program provides corrective actions, confirmation processes, and administrative controls for license renewal aging management programs. Additionally, prior to the period of extended operation the scope of the program will be expanded to include non-safety-related structures and components that are subject to an aging management review for license renewal. The applicant stated that the corrective action program applies to all plant systems, structures and components (both safety-related and non-safety-related) within the scope of license renewal. Administrative controls are in place for existing aging management programs and activities. Administrative controls will also be applied to new and enhanced programs and activities as they are implemented.

In Section B.2.1, "Corrective Action Program," of the LRA, the applicant provided the following generic description of the quality attributes common to all the plant specific aging management programs:

- Corrective Actions: Corrective action is initiated following the identification of conditions adverse to quality, and is documented. The corrective action program is described in Chapter 16 of the QAP. The various components of the corrective action program provide for timely actions, including determination of the cause of the condition and corrective action taken to preclude recurrence for significant conditions adverse to quality. Condition reports are analyzed for adverse trends. Identified adverse trends are reported to the appropriate manager and documented on a condition report.

- Confirmation Process: Condition reports are reviewed by supervisors. Operations shift management is contacted as necessary to discuss potential operability or regulatory reportability of the condition. Items determined to be significant conditions adverse to quality are reported to the appropriate levels of management. An effectiveness review is completed for root cause analysis corrective actions to prevent recurrence.

- Administrative Controls: Activities affecting quality are prescribed by documented instructions, procedures, drawings, or specifications of a type appropriate to the circumstances and are accomplished in accordance with these instructions, procedures, drawings or specifications. They contain appropriate acceptance criteria and documentation requirements for determining whether important activities have been satisfactorily accomplished. The document control process is described in Chapter 6 of the QAP.

3.0.4.2 Staff Evaluation

The NRC staff reviewed the applicant's aging management programs described in Appendix A, "Updated Final Safety Analysis Report (UFSAR) Supplement," and Appendix B, "Aging Management Activities," of the Dresden and Quad Cities license renewal application. The purpose of this review was to assure that the aging management activities were consistent with the staff's guidance described in NUREG-1800, Section A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)," regarding quality assurance attributes of aging management programs. Based on the staff's evaluation, the descriptions and applicability of the plant-specific aging management programs and their associated quality attributes provided in Appendix A.2 and Appendix B.2 of the LRA are consistent with the staff's position regarding quality assurance for aging management. However, the applicant did not sufficiently described the use of the quality assurance program and its associated attributes (corrective action, confirmation process, and administrative controls) in the discussions provided for aging management programs described in Appendix A.1 and Appendix B.1. In RAI 2.1-4, the staff requested that the applicant supplement the descriptions in the Appendix A, "Updated Final Safety Analysis Report (UFSAR) Supplement," and Appendix B, "Aging Management Activities" to include a description of the quality assurance program attributes, including references to pertinent implementing guidance as necessary, which are credited for the programs described in Appendix A.1 and Appendix B.1 of the LRA.

In their October 3, 2003, response to RAI 2.1-4, the applicant stated that the LRA Sections A.2.1 and B.2.1, "Corrective Action Program," apply to all of the aging management programs and activities that are credited for license renewal and to all plant systems, structures and components within the scope of license renewal. Based on this response, the staff concluded that the applicant will apply the corrective action program, as described in LRA Sections A.2.1

and B.2.1, to all plant systems, structures and components (both safety-related and non-safety-related) within the scope of license renewal and subject to the AMPs described in Section A.1 and B.1 of the LRA. Therefore, RAI 2.1-4 is resolved.

3.0.4.3 Conclusions

The staff finds that the quality assurance attributes of the applicant's AMPs are consistent with 10 CFR 54.21(a)(3) and the staff's BTP IQMB-1. Specifically, the applicant described the quality attributes of the programs and activities for managing the effects of aging for both safety-related and non-safety-related SSCs within the scope of license renewal and stated that the 10 CFR Part 50 Appendix B Quality Assurance Program provides corrective actions, confirmation processes, and administrative controls. The staff also reviewed the UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4.4 References

1. NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," April 2001

2. NEI 95-10, Rev. 3, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule," March 2001

3. Letter from Exelon Generation Company, LLC, to US NRC, "Additional Information for the Review of the License Renewal Applications for Quad Cities Nuclear Power Station, Units 1 and 2 and Dresden Nuclear Power Station, Units 2 and 3," dated October 3, 2003, [RS-03-178]

3.1 Reactor Vessel, Internals, and Reactor Coolant System

As discussed in Section 3.0.1 of this SER, the components in each of the systems are rolled up into one of two LRA tables. LRA Table 3.1-1 consists of reactor vessel, internals, and reactor coolant system components that are evaluated in the GALL Report and LRA Table 3.1-2 consists of reactor system components that are not evaluated in the GALL Report.

3.1.1 Summary of Technical Information in the Application

In LRA Section 3.1, the applicant described its AMRs for the reactor vessel, internals, and reactor coolant system. The description of this system can be found in Section 2.3.1 of the LRA. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Tables 2.3.1-1 through 2.3.1-9.

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

The applicant's review of industry operating experience included a review of operating experience through 2002. The results of this review concluded that the aging effects requiring management based on industry operating experience were consistent with the aging effects identified in GALL. The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the Exelon Operating Experience Program.

3.1.2 Staff Evaluation

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

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of reactor system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report; this evaluation is presented in Section 3.1.2.2 of this SER. The staff also evaluated aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report; this evaluation is presented in Section 3.1.2.4 of this SER. Finally, the staff reviewed the UFSAR Supplement to ensure that it provided an adequate description of the programs credited with managing aging for the reactor system components.

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

Table 3.1-1. Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA evaluated in accordance with10 CFR 54.21(c)	Evaluated in accordance with 10 CFR 54.21(c)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.1 below.)
Isolation condenser	Loss of material due to general, pitting, and crevice corrosion	Inservice Inspection; Water Chemistry	Inservice Inspection Program (Appendix B.1.1); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.2 below.)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR Part 50 and RG 1.99	Evaluated in accordance with 10 CFR 54.21(c)(1)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.3 below.)
Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor Vessel Surveillance	Reactor Vessel Surveillance Program (Appendix B.1.22)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.3 below.)
Small-bore reactor coolant system and connected systems piping	Crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading	Inservice Inspection; Water Chemistry; One-Time Inspection	Inservice Inspection Program (Appendix B.1.1); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.4(1) below.)
Jet pump sensing line and reactor vessel flange leak detection line	Crack initiation and growth due to SCC, IGSCC, or cyclic loading	Plant specific	Plant specific	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.4(2) below.)
Isolation condenser	Crack initiation and growth due to SCC or cyclic loading	Inservice Inspection; Water Chemistry	Inservice Inspection Program (Appendix B.1.1); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801 which recommends further evaluation. (See Section 3.1.2.2.4(3) below.)
Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor Head Closure Studs	Reactor Head Closure Studs Program (Appendix B.1.3)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice Inspection	Inservice Inspection program (Appendix B.1.1)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
CASS piping	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No AMP (CASS piping does not exist at D/QCNPS)	Not applicable
BWR piping and fittings; steam generator components	Wall thinning due to FAC	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion Program (Appendix B.1.11)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
RCPB valve closure bolting, manway, and holding bolting, and closure bolting in high pressure and high temperature systems	Material loss due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting Integrity	Bolting Integrity Program (Appendix B.1.12)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Feedwater and CRD return line nozzles	Crack initiation and growth due to cyclic loading	Feedwater Nozzle; CRD Return Line Nozzle	Feedwater Nozzle Program (Appendix B.1.5); Control Rod Drive Return Line Nozzle Program (Appendix B.1.6)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Vessel shell attachment welds	Crack initiation and growth due to SCC, IGSCC	BWR Vessel ID Attachment Welds; Water Chemistry	BWR Vessel ID Attachment Welds Program (Appendix B.1.4); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Nozzle safe ends, recirculation pump casing, connected systems piping and fittings, body and bonnet of valves	Crack initiation and growth due to SCC, IGSCC	BWR Stress Corrosion Cracking; Water Chemistry	BWR Stress Corrosion Cracking Program (Appendix B.1.7); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Penetrations	Crack initiation and growth due to SCC, IGSCC, cyclic loading	BWR Penetrations; Water Chemistry	BWR Penetrations Program (Appendix B.1.8); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Core shroud and core plate, support structure, top guide, core spray lines and spargers, jet pump assemblies, CRD housing, nuclear instrumentation guide tubes	Crack initiation and growth due to SCC, IGSCC, IASCC	BWR Vessel Internals; Water Chemistry	BWR Vessel Internals Program (Appendix B.1.9; Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Core shroud and core plate access hole cover (welded and mechanical covers)	Crack initiation and growth due to SCC, IGSCC, IASCC	ASME Section XI Inservice Inspection; Water Chemistry	Inservice Inspection Program (App. B.1.1); Water Chemistry Program (Appendix. B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)
Jet pump assembly castings; orificed fuel support	Loss of fracture toughness due to thermal aging and neutron embrittlement	Thermal Aging and Neutron Irradiation Embrittlement	Thermal Aging and Neutron Irradiation Embrittlement (Appendix B.1.10)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Unclad top head and nozzles	Loss of material due to general, pitting, and crevice corrosion	Inservice Inspection; Water Chemistry	Inservice Inspection Program (Appendix B.1.1); Water Chemistry Program (Appendix B.1.2)	Consistent with NUREG-1801. (See Section 3.1.2.1 below.)

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant’s claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant’s evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

3.1.2.2.1 Cumulative Fatigue Damage (NUREG-1800, Section 3.1.2.2.1)

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

3.1.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion (NUREG-1800, Section 3.1.2.2.2.2)

The GALL Report recommends augmented inspection to manage this aging effect. The staff review verifies that the applicant has proposed a program that will manage loss of material due to pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material and ensure that the component intended function would be maintained during the period of extended operation.

The applicant stated in LRA Table 3.1-1, Reference No. 3.1.1.2, that the program for managing this aging effect is consistent with NUREG-1801 with exceptions, as described in LRA Appendices B.1.1, “ASME Section XI Inservice Inspection Program,” and B.1.2, “Water Chemistry Program.” As discussed in Section 3.1.2.2.4(1) of this SER, these exceptions are acceptable. In addition, the applicant referred to LRA Sections 3.1.1.1.2 and 3.1.1.2.3 for further evaluation of loss of material due to general (carbon steel only), pitting, and crevice corrosion as an aging effect for the isolation condenser components at Dresden Units 2 and 3. LRA Section 3.1.1.1.2 states that LRA Appendix B.1.1, “ASME Section XI Inservice Inspection Program,” will be augmented by a plant-specific AMPs described in LRA Appendix B.2.6, “Heat Exchanger Test and Inspection Activities.” This plant-specific AMP includes temperature and radioactivity monitoring of the shell-side water and eddy current testing of the tubes as recommended by NUREG-1801. However, LRA Section 3.1.1.1.2 does not identify any augmented inspection to detect loss of material in the isolation condenser tubesheet, channel head, and shell as recommended by Item C1.4-b, Chapter IV.C1, of NUREG-1801. LRA Appendix B.1.1 requires VT-2 examinations of the reactor coolant pressure boundary of isolation condenser components during system pressure testing. This is not adequate for detecting loss of material in the isolation condenser components before their intended function (pressure boundary) is compromised. Therefore, the staff issued RAI 3.1-11 requesting the applicant to provide augmented inspection for detecting loss of material in the isolation condenser tubesheet, channel head, and shell.

In response to RAI 3.1-11, in a letter dated October 3, 2003, the applicant stated that the aging management activities identified in LRA Sections 3.1.1.1.2 and 3.1.1.1.7 are consistent with the augmented activities recommended by NUREG-1801, Items IV.C.1.4-a and b and implied that no additional inspection program is needed. The staff finds this response unacceptable because the activities identified in LRA Sections 3.1.1.1.2 and 3.1.1.1.7 do not include augmented inspections for detecting loss of material and cracking in the tubesheet, channel head, and shell of the isolation condenser as recommended by NUREG-1801, Items IV.C.1.4-a and b. Therefore, in Supplemental RAI 3.1-11, the staff requested the applicant to provide augmented inspection of the Dresden isolation condenser (i.e.. VT or UT) to manage loss of material and crack initiation and growth in the isolation condenser tubesheet, channel head, and shell, as required by NUREG-1801.

In response to Supplemental RAI 3.1-11, in a letter dated November 21, 2003, the applicant stated that AMP B.2.6, “Heat Exchanger Test and Inspection Program,” is a 10-element program that was developed to address heat exchangers within the scope of license renewal that are not inspected under other AMPs. The intent of AMP B.2.6, as originally developed and described in the LRA, is to require a visual inspection of the isolation condenser channel head, tubesheet, and shell, in addition to performing eddy current testing of the tubes and temperature and radiation monitoring of the shell-side water. These new activities will be implemented prior to the period of extended operation. This is Commitment #44 of Appendix A of this SER.

The applicant further stated that AMP B.2.6 did not clearly describe the visual inspection of the isolation condenser tubesheet, channel head, and shell in the description of the isolation condenser augmented activities. In addition to identifying the augmented isolation condenser inspection activities of temperature and radiation monitoring of the shell-side water and eddy current testing of the tubes, AMP B.2.6 provides for condition monitoring, inspection, and performance testing of heat exchangers in scope of license renewal that are not inspected under other AMPs, including the isolation condensers.

The applicant further stated that AMP B.2.6 requires the following two inspections of the isolation condenser by qualified inspectors:

(a) In conjunction with the periodic eddy current testing of the tubes, a visual inspection to detect cracking and loss of material of the channel head and tubesheets will be performed on the tube side of the isolation condenser in accordance with the station's Heat Exchanger Inspection Program as an augmented inspection to manage loss of material and crack initiation and growth in the isolation condenser tubesheet and channel head.

(b) Shell-side visual inspections are presently periodically performed to verify the integrity of shell-side internal structural components. These inspections will be expanded in accordance with the station's Heat Exchanger Inspection Program to visually inspect the shell to detect cracking and loss of material of the shell as an augmented inspection to manage loss of material and crack initiation and growth in the isolation condenser shell.

The staff finds the applicant's response to Supplemental RAI 3.1-11 acceptable because it ensures that the isolation condenser tubesheet, channel head, and shell will be visually inspected during the extended period of operation for detecting loss of material and crack initiation and growth, as recommended by NUREG-1801.

However the applicant's update to the UFSAR does not provide a complete description of the inspection program, including VT of the isolation condenser tubesheet, channel head , and shell. In a letter dated December 22, 2003, the applicant revised their response to RAI 3.1-11 to specify that the UFSAR Supplement, Section A.2.6 of the LRA includes visual inspections of the channel head, tube sheets and internal surfaces of the shell.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to pitting and crevice corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement (NUREG-1800, Section 3.1.2.2.3)

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

Loss of fracture toughness due to neutron irradiation embrittlement could occur in the reactor vessel. A reactor vessel materials surveillance program monitors neutron irradiation embrittlement of the reactor vessel. Reactor vessel surveillance programs are plant-specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Thus, further staff evaluation is required for license renewal. The GALL Report recommends further evaluation of a plant's reactor vessel materials surveillance program for the period of extended operation. The staff verified that the applicant has proposed an adequate reactor vessel materials surveillance program for the period of extended operation.

D/QCNPS has an existing program, the Reactor Vessel Surveillance Program, described in LRA Appendix B.1.22, for managing loss of fracture toughness in reactor vessel beltline shell and welds due to neutron irradiation embrittlement. The applicant had submitted its license amendment to implement a program consistent with Boiling Water Reactor Vessel and Internals Project (BWRVIP)-78, "Integrated Surveillance Program," and BWRVIP-86, "BWR Integrated Surveillance Program Implementation Plan." The staff has reviewed the license amendment and approved it in SERs to John Skolds, Exelon, from the NRC, dated September 29, 2003, and August 28, 2003, for Dresden and Quad Cities, respectively. Therefore, the applicant has committed to and implemented the BWRVIP Integrated Surveillance Program, consistent with GALL Program XI.M31, "Reactor Vessel Surveillance," described in NUREG-1801. The evaluation of the enhanced program is presented in Section 3.1.2.3.8 of the SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of fracture toughness due to neutron irradiation embrittlement, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.1.2.2.4 Crack Initiation and Growth Due to Thermal and Mechanical Loading or Stress-Corrosion Cracking (NUREG-1800, Section 3.1.2.2.4)

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

The GALL Report recommends that the inspection include a representative sample of the system population, and, where practical and prudent, focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. For small-bore piping, actual inspection locations should be based on physical accessibility, exposure levels, NDE examination techniques, and locations identified in IN 97-46, "Unisolable Crack in High-Pressure Injection Piping." Combinations of NDE, including visual, ultrasonic, and surface techniques, are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. For small-bore piping less than NPS 4, including pipe, fittings, and branch connections, a plant-specific destructive examination or NDE that permits inspection of the inside surfaces of the piping should be conducted to ensure that cracking has not occurred. Follow up of unacceptable inspection findings should include expansion of the inspection sample size and locations. The inspection and test techniques prescribed by the program should verify any aging effects because these techniques, used by qualified personnel, have been proven effective and consistent with staff expectations. The staff's review confirms that the program includes measures to verify that unacceptable degradation is not occurring, thereby validating the effectiveness of existing programs, or confirming that there is no need to manage aging-related degradation for the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the proposed inspection will be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques, to ensure that the component's intended function will be maintained during the period of extended operation.

The applicant stated in LRA Table 3.1-1 that the program for managing this aging effect is consistent with NUREG-1801, with exceptions, as described in LRA Sections B.1.1 for the Inservice Inspection Program and B.1.2 for the Water Chemistry Program. These exceptions are described in the following paragraphs.

Inservice Inspection

NUREG-1801 indicates that the Inservice Inspection Program is to use the 1995 Edition through the 1996 Addenda of ASME Section XI. The applicant stated that the current code of record for Dresden and Quad Cities is the 1989 Edition of ASME Section XI. The applicant's program will be enhanced to be consistent with the requirements of the 1995 Edition through the 1996 Addenda of ASME Section XI. This enhancement is scheduled for implementation prior to the beginning of the period of extended operation. The evaluation of the Inservice Inspection Program is presented in Section 3.0.3.1 of this SER.

Water Chemistry

NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The D/QCNPS Water Chemistry Programs are based on EPRI TR-103515-R2, which is the 2000 revision of "BWR Water Chemistry Guidelines." As an enhancement to the applicant's Water Chemistry Program, the applicant stated that procedures will be revised to provide for increased sampling to verify corrective actions taken to address abnormal chemistry conditions. The evaluation of the Water Chemistry Program is presented in Section 3.0.3.2 of this SER.

The staff finds the applicant's exception to the GALL Inservice Inspection Program to be acceptable because the applicant has committed to meeting the requirements of the 1995 Edition through the 1996 Addenda of ASME Section XI, which the staff has endorsed in 10 CFR 50.55a, prior to the period of extended operation. This is Commitment #1 in Appendix A of this SER. The staff finds the applicant's exceptions to the GALL water chemistry program to be acceptable because it is based on updated industry experience (EPRI TR-103515).

In LRA Section 3.1.1.1.5, the applicant stated that an inspection of small-bore reactor coolant piping is to be conducted in accordance with its One-Time Inspection Program to verify that service-induced weld cracking is not occurring in the small-bore piping less than 4 NPS, including pipe, fittings, and branch connections. The applicant's One-Time Inspection Program is described in LRA Section B.1.23, and the applicant stated that it is consistent with NUREG-1801, Chapter XI.M32, "One-Time Inspection." In Section 3.1.1.1.5 of the LRA, the applicant further stated that thermal stratification, thermal cycling and thermal stripping, thermal transients, and flow-accelerated corrosion are potential aging mechanisms for small-bore piping. The LRA also states that a review of the Dresden and Quad Cities risk informed inservice inspection (RI-ISI) evaluations on degradation mechanism assessment demonstrated that only Dresden had a high failure potential on a small-bore pipe due to thermal fatigue. Therefore, one-time inspection will consist of an ultrasonic exam on one of the 2-inch drain lines off the Dresden main steam header. These lines are Class 1 and within the scope of license renewal.

The staff issued RAI 3.1-9(a) requesting information related to one-time inspection of small diameter piping. In RAI 3.1-9(a)(1), the staff requested the applicant: to identify all Class 1, small-bore piping in all units (Dresden, Units 2 and 3, and Quad Cities, Units 1 and 2), including the pipe sizes, material, and type of weld (i.e., butt or socket). If there are no UT-inspectable full penetration butt welds within scope, then the applicant should destructively test the socket welds that are replaced due to modifications to confirm the effectiveness of the existing AMPs. This is consistent with NUREG-1801, Chapter XI.M32, which allows a plant-specific destructive examination of replaced piping in lieu of NDE that permits inspection of the inside surfaces of the piping. In response to RAI 3.1-9(a)(1), in a letter dated October 15, 2003, the applicant provided a listing of the ASME Class 1, NPS less than 4 in. piping. including pipe sizes, material, and type of weld for Dresden Units 2 and 3 and Quad Cities Units 1 and 2. The applicant stated that no destructive examination will be performed of the socket welds because there are full penetration butt welds that can be UT-inspected at Dresden and Quad Cities. The staff agrees with the applicant that it does not have to perform destructive testing of the socket welds because Dresden/Quad Cities have UT-inspectable full penetration butt welds in the small diameter piping.

In RAI 3.1-9(a)(2), the staff provided the following comments to the applicant on the use of risk-informed inservice inspection and requests for additional information. As currently written, 10 CFR Part 54 does not allow the staff to accept the elimination of SSCs from aging management based on risk-informed arguments. Therefore, RI-ISI evaluations can be used to select susceptible SSCs locations, but cannot eliminate SSCs from being inspected for a one-time inspection program. A sampling of butt welds from each unit should be developed that is consistent with the ASME Code and is sufficient to confirm the effectiveness of existing AMPs and/or to confirm that there is no need to manage aging-related degradation for the period of extended operation. Inspecting one weld in one unit is not a sufficient sample size. The applicant must provide a sampling plan with a suitable sample size and an explanation of the selection process. This plan should also include a discussion regarding expansion of the inspection sample size and locations for follow up of unacceptable inspection findings as required by NUREG-1801, Chapter XI.M32. This plan is to be reviewed by the staff on a plant-specific basis, as required by NUREG-1801, Chapter XI.M32.

In response to RAI 3.1-9(a)(2), in a letter dated October 15, 2003, the applicant stated that the butt welds identified in the response to RAI 3.1-9(a)(1) will be evaluated based on risk and placed into high, medium, and low risk categories consistent with the currently approved RI-ISI program. The applicant further stated that a sample of 10 percent of the high and medium risk butt welds from each of the four Dresden/Quad Cities units will be selected for volumetric examination. The sample expansion will be consistent with that described in Code Case N-578-1, Section 2430. This is part of Commitment #23 of Appendix A in this SER. The staff finds the sample size acceptable because it includes the most susceptible sites, and the sample expansion guideline acceptable because it follows the recommendation of NUREG-1801, Chapter XI.M32. Thus, the staff finds the sample size and sample expansion acceptable for the one-time inspection to verify that SCC is not occurring in the small-bore piping.

In RAI 3.1-9(a)(3), the staff noted that Section 3.1.1.1.5 of the LRA does not specify an inspection program for SCC as an aging mechanism in small-bore piping. Therefore, the staff requested the applicant to identify the AMPs that will be used for managing cracking due SCC in small-bore piping. In response to RAI 3.1-9(a)(3), in a letter dated October 15, 2003, the applicant stated that the following two programs are credited with managing cracking due to SCC in small-bore piping—(1) LRA Section B.1.2, ”Water Chemistry,” and (2) LRA Section B.1.23, ”One-Time Inspection,” as amended in response to RAI 3.1-9(a)(2) above. The staff finds the response acceptable because the applicant has identified the One-Time Inspection Program for verifying the effectiveness of the Water Chemistry Program in mitigating cracking due to SCC.

As mentioned above, the applicant stated that the One-Time Inspection Program for small-bore Class 1 piping less than 4 inches will consist of a volumetric examination of 10 percent of high and medium risk butt welds from each of the four units. These lines were identified as part of a review of the Dresden and Quad Cities RI-ISI evaluations on degradation mechanism assessments on Class 1 piping. The aging mechanisms cited by the report for these lines are thermal stratification, cycling, and stripping (TASCS), thermal transients (TT), and flow-accelerated corrosion. Nuclear industry service experience, documented in several industry and NRC reports, has shown that the majority of reported piping leaks occur in small-bore piping less than 4-NPS. A significant number of these failures have been reported in the reactor coolant system, main steam system, feedwater system, and auxiliary systems in BWR plants. Also, a large portion of the reported Class 1 small-bore piping failures occurred in piping 1inch NPS and less that were caused primarily by mechanical vibration, thermal fatigue/turbulent penetration, SCC, and erosion-corrosion aging mechanisms. Since Class 1 small-bore piping 1inch NPS and less is exempt from NDE examinations in ASME Section XI, these lines will typically receive only periodic VT-2 visual examination. In addition, many RI-ISI evaluations do not include Class 1 piping 1inch NPS and less in their evaluation scope and specific degradation mechanism assessments are not performed for these lines. Therefore, it is not clear that the applicant's proposed One-Time Inspection Program for small-bore piping will be representative of all Class 1 piping 1inch NPS and less with full penetration butt welds (socket welds are excluded).

In RAI 3.1-9(b), the applicant was requested to clarify whether the Dresden and Quad Cities RI-ISI degradation mechanism assessments included Class 1 piping 1inch NPS and less with full penetration butt welds. The applicant is also requested to describe how the proposed One-Time Inspection Program will confirm that the aging mechanisms associated with the Class 1 small-bore piping 1-inch NPS and less with full penetration butt welds at Dresden and Quad Cites are either not occurring and/or there is no need to manage age-related degradation for the period of extended operation. In response to RAI 3.1-9(b), in a letter dated October 3, 2003, the applicant stated that neither Dresden nor Quad Cities have butt welds in ASME Class 1 piping 1 inch NPS and less. Therefore, the One-Time Inspection Program does not apply to the 1 inch NPS and less piping. The staff agrees with the applicant's response that the proposed One-Time Inspection Program does not apply to the piping 1 inch NPS and less because, at Dresden and Quad Cities, this piping does not include full penetration butt welds.

Crack initiation and growth due to thermal and mechanical loading or SCC (including IGSCC) could also occur in the BWR reactor vessel flange leak detection line and BWR jet pump sensing line. The GALL Report recommends that a plant-specific AMP be evaluated for the management of crack initiation and growth due to thermal and mechanical loading or SCC (including IGSCC) in the BWR reactor vessel flange leak detection line and BWR jet pump sensing line. The staff reviewed the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

The applicant stated that the Dresden reactor vessel flange leak detection line is fabricated of carbon steel, rather than stainless steel or a nickel-based alloy, as given in NUREG-1801, and it is therefore evaluated as a non-NUREG-1801 item. The AMR results for the carbon steel leak detection line are presented in Section 3.1.2.4.5 of the SER.

In LRA Section 3.1.1.1.6, the applicant stated that the reactor vessel flange leak detection line at Quad Cities is a Class 2 stainless steel component, and is susceptible to cracking due to SCC. The Quad Cities ASME Section XI Inservice Inspection Program, Relief Request PR-02 (relief granted per SER dated September 15, 1995), provides for an alternate inspection of the reactor vessel flange leak detection line. This alternate examination utilizes a VT-2 visual examination on the line during vessel floodup during a refueling outage. Future relief requests may be submitted by the applicant in accordance with 10 CFR 50.55a. Otherwise, the applicant must comply with the appropriate requirements of ASME Section XI. The staff issued RAI 3.1-25 requesting the applicant to confirm that cracking of the reactor vessel flange leak detection line at Quad Cities will be managed in accordance with the requirements of ASME Section XI, Table IWC-2500-1, for license renewal. In response to RAI 3.1-25, in a letter dated October 3, 2003, the applicant confirmed that Quad Cities will manage the aging effects for the reactor vessel flange detection lines in accordance with the requirements of ASME Section XI, Table IWC-2500-1, as amended by NRC-approved relief requests in accordance with 10 CFR 50.55a. The staff finds this response acceptable because the applicant committed to follow the requirements of ASME Section XI, Table IWC-2500-1. This is Commitment #1 in Appendix A of this SER.

The applicant stated in its LRA that the jet pump sensing lines at Dresden and Quad Cities are not within the scope for license renewal, but provided no explanation. The staff issued RAI

2.3.1.2-5 requesting the applicant to provide a technical basis to support this determination. In response to RAI 2.3.1.2-5, in a letter dated October 3, 2003, the applicant submitted the following explanation. The main function of the jetpump sensing line is to monitor jet pump integrity. If a sensing line fails, the Dresden/Quad Cities Plant Technical Specifications require either a plant shut down or safety assessment to justify continued operation. Therefore, the applicant concluded that a sensing line failure has no adverse safety consequences and no inspection is required. The applicant supported its conclusion by pointing out that BWRVIP-41, “BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines,” Section 2.3.12.7, also concludes that inspection of sensing lines is essentially occurring continuously by plant operations. The staff finds the applicant's decision of not including the jet pump sensing line within the scope of license renewal acceptable because plant operation essentially provides for continuous monitoring of the sensing line integrity and, if a line fails, Plant Technical Specifications require either a plant shut down or safety assessment to justify continued operation. Therefore, the failure of the sensing line has no adverse safety consequences and does not need to be included within the scope of license renewal.

Crack initiation and growth due to thermal and mechanical loading or SCC (including IGSCC) could also occur in BWR isolation condenser components. The existing program relies on control of reactor water chemistry to mitigate SCC and on ASME Section XI inservice inspection. However, the existing program should be augmented to detect cracking due to SCC or cyclic loading. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to ensure that the component’s intended function will be maintained during the period of extended operation. The staff reviewed the applicant’s proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

The applicant stated in LRA Table 3.1-1, Reference No. 3.1.1.7, that the program for managing this aging effect is consistent with NUREG-1801 with exceptions, as described in LRA Appendices B.1.1, “ASME Section XI Inservice Inspection Program,” and B.1.2, “Water Chemistry Program.” As discussed in Section 3.1.2.2.4.1 of this SER, these exceptions are acceptable. In addition, the applicant referred to LRA Sections 3.1.1.1.7 and 3.1.1.2.3 for further evaluation of crack initiation and growth due to SCC and cyclic loading as an aging effect for the isolation condenser components at Dresden Units 2 and 3. LRA Section 3.1.1.1.7 states that LRA Appendix B.1.1, “ASME Section XI Inservice Inspection Program,” will be augmented by a plant-specific AMP described in LRA Appendix B.2.6, “Heat Exchanger Test and Inspection Activities.” This plant-specific AMP includes temperature and radioactivity monitoring of the shell-side water and eddy current testing of the tubes, as recommended by NUREG-1801. However, LRA Section 3.1.1.1.7 does not identify any augmented inspection to detect crack initiation and growth in the isolation condenser tubesheet, channel head, and shell, as recommended by Item C1.4-a, Chapter IV.C1, of NUREG-1801. LRA Appendix B.1.1 requires VT-2 examinations of the reactor coolant pressure boundary during system pressure testing. This is not adequate for detecting crack initiation and growth in the isolation condenser components before their intended function (pressure boundary) is compromised. Therefore, the staff issued RAI 3.1-11 and Supplemental RAI 3.1-11 requesting the applicant to provide augmented inspection for detecting loss of material in the isolation condenser tubesheet, channel head, and shell. The staff’s evaluation of the applicant’s responses to RAI 3.1-11 and Supplemental RAI 3.1-11 is presented in Section 3.1.2.2.2 of this SER. The staff finds the applicant's responses acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of crack initiation and growth due to thermal and mechanical loading or SCC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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 Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Components

The applicant credits 17 AMPs to manage the aging effects associated with components in the reactor coolant systems as listed below. Nine of the AMPs are credited to manage aging for components in other system groups (common AMPs) while eight AMPs are credited with managing aging only for reactor system components. The staff's evaluation of the common AMPs that are credited with managing aging in reactor system components are provided in Section 3.0.3 of this SER.

- ASME Section XI Inservice Inspection Program (B.1.1)
- Water Chemistry Program (B.1.2)
- Reactor Head Closure Studs Program (B.1.3)
- BWR Vessel ID Attachment Welds Program (B.1.4)
- Feedwater Nozzle Program (B.1.5)
- Control Rod Drive Return Line Nozzle Program (B.1.6)
- BWR Stress Corrosion Cracking Program (B.1.7)
- BWR Penetrations Program (B.1.8)
- BWR Vessel Internals Program (B.1.9)
- Thermal Aging and Neutron Irradiation Embrittlement Program (B.1.10)
- Flow-Accelerated Corrosion Program (B.1.11)
- Bolting Integrity Program (B.1.12)
- Compressed Air Monitoring Program (B.1.16)
- Reactor Vessel Surveillance Program (B.1.22)
- One-Time Inspection Program (B.1.23)
- Structures Monitoring Program (B.1.30)
- Heat Exchanger Test and Inspection Activities Program (B.2.6)

The staff's evaluation of the eight AMPs for the reactor vessel, internals, and reactor coolant system is provided in the following sections.

3.1.2.3.1 Reactor Head Closure Studs Program

Summary of Technical Information in the Application. The applicant's Reactor Head Closure Studs Program is discussed in LRA Section B.1.3, "Reactor Head Closure Studs." The applicant stated that the program is consistent with GALL Program XI.M3, "Reactor Head Closure Studs" with two exceptions. These exceptions are with respect to the NUREG-1801 requirement that the inspections be carried out in accordance with the requirements of ASME

Section XI, Subsection IWB, Table IWB 2500-1. Table IWB 2500-1 specifies volumetric (radiographic, ultrasonic, or eddy current) inspection for studs in place and both surface (magnetic particle, liquid penetration, or eddy current) and volumetric examination of studs when removed. Instead of a surface examination, the Dresden and Quad Cities plants utilize a VT-1 visual inspection, as granted under relief requests CR-13 and CR-11, respectively. Likewise, instead of a volumetric examination with a conventional UT, the Dresden and Quad Cities reactor closure head studs are examined by end-shot UT, as approved in relief request CR-12.

The LRA also indicates that the current code of record for the Dresden and Quad Cities inspection programs is the 1989 Edition of ASME Section XI, rather than the 1995 Edition through the 1996 Addenda, as specified in NUREG-1801. The applicant stated that its inspection program will be revised to be consistent with these NUREG-1801 requirements prior to the period of extended operation.

This AMP is credited with managing aging-related cracking and loss of material in reactor head closure bolts. The applicant stated in the LRA that the Dresden and Quad Cities reactor head closure studs AMP activities have detected aging degradation and have implemented appropriate corrective actions to maintain system and component intended functions, including prompt repair or replacement of degraded components prior to failure.

The applicant concluded in its LRA that the Reactor Head Closure Studs Program provides reasonable assurance that loss of material and cracking aging effects in the reactor head closure studs are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Appendix B.1.3, “Reactor Head Closure Studs,” the applicant described its AMP to manage aging-related cracking and loss of material in the reactor head closure studs. The applicant stated that this AMP is consistent with GALL AMP XI.M3, “Reactor Head Closure Studs,” with exceptions to the NUREG-1801 requirements regarding inspection for studs in place and when removed. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviations and their justifications to determine whether the AMP, with the deviations, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the revised program. In addition, the staff determined whether the applicant properly applied the GALL program (NUREG-1801) to its facility.

The staff notes that NUREG-1801, in accordance with the requirements of ASME Section XI, Subsection IWB, Table IWB 2500-1, specifies volumetric inspection for studs in place and both surface and volumetric examination of studs when removed. The applicant stated in the LRA that, instead of a surface inspection, Dresden and Quad Cities employ a VT-1 visual inspection, as granted under relief requests CR-13 and CR-11, respectively. Likewise, instead of a volumetric examination, the Dresden and Quad Cities reactor closure head studs are examined by end-shot UT, as approved in relief request CR-12. Use of VT-1 visual inspection when the studs are removed is acceptable based on current revisions of the ASME Code. However, use of the end-shot UT inspection procedure was not approved per relief request CR-12 since it does not provide the required sensitivity (see Section 3.1.1.3 of the staff’s safety evaluation

(SE) dated September 15, 1995). The staff's SE did approve the use of the bore probe inspection procedure through the third ISI interval.

Future relief requests may be submitted by the applicant in accordance with 10 CFR 50.55a. Otherwise, the applicant must comply with the requirements of ASME Section XI, Subsection IWB, Table IWB 2500-1, which specifies volumetric inspection for studs in place and both surface and volumetric examination of studs when removed. In RAI B.1.3-a, the staff requested the applicant to confirm that aging effects for the reactor closure head studs will be monitored/managed in accordance with the requirements of ASME Section XI, Subsection IWB, Table IWB 2500-1, during the period of extended operation. The applicant provided the following response to RAI B.1.3-a in a letter dated October 3, 2003. The applicant stated that since submittal of the LRA, Dresden and Quad Cities have updated their ISI programs to be consistent with the 1995 Edition through the 1996 Addenda of ASME Section XI. The applicant further stated that the requirements of ASME Section XI, Subsection IWB, Table IWB 2500-1, will be augmented by Code Case N-307-2, "Revised Ultrasonic Examination Volume for Class 1 Bolting, Table IWB-2500-1, Examination Category B-G-1, When the Examinations Are Conducted From the End of the Bolt or Stud or From the Center-Drilled Hole," as endorsed by NRC RG 1.147, Revision 13. Thus, with this update of its ISI programs as augmented by Code Case N-307-2, Dresden and Quad Cities removed the exception noted as Relief Request CR-12. The staff finds the response acceptable because the applicant has confirmed that cracking and loss of material in the reactor closure head studs will be managed during the license renewal period in accordance with ASME Section XI, Subsection IWB, Table IWB 2500-1, as augmented by Code Case N-307-2, as required by the staff in accordance with 10 CFR 50.55a.

In LRA Appendix B.1.3, "Reactor Head Closure Studs," the applicant stated that the Reactor Head Closure Studs Program provides for condition monitoring and preventive actions to manage stud cracking and loss of material. However, loss of material is not identified as an aging effect for reactor head closure studs in LRA Tables 3.1-1 or 3.1-2. In RAI B.1.3-c, the staff requested the applicant to clarify this discrepancy and discuss D/QCNPS operating experience with respect to loss of material for the reactor head closure studs. In response to RAI B.1.3-c ,in a letter dated October 3, 2003, the applicant states that the loss of material was inadvertently added to LRA Appendix B.1.3, "Reactor Head Closure Studs," and should have been deleted. The applicant further stated that Dresden and Quad Cities do not have any operating experience that would indicate that loss of material is an applicable aging effect for reactor head closure studs. The staff finds the applicant's clarification acceptable because it is consistent with the operating experience of Dresden and Quad Cities and is consistent with NUREG-1801, Table IV.A1, Item A1.1-c.

The applicant stated in LRA Appendix B.1.3, "Reactor Head Closure Studs," that the reactor head studs at Dresden and Quad Cities are not metal-plated and have had manganese phosphate coatings applied. These preventative actions are consistent with those recommended in Chapter XI.M3 of NUREG-1801 which recommends use of manganese phosphate coatings for reducing SCC and IGSCC of closure studs. NUREG-1801 does not recommend use of metal-plated studs because metal plating can result in corrosion and hydrogen embrittlement. In RAI B.1.3-b, the staff requested the applicant to submit the operating experience with manganese phosphate coatings. Specifically, the staff requested the applicant to describe the experience related to any cracking of the reactor head closure studs since the application of the manganese phosphate coatings. In response to RAI B.1.3-b, in a letter dated October 3, 2003, the applicant stated that four studs at Dresden Unit 2 were found to have cracking during refuel outages. These studs were replaced. The applicant further stated that no other recordable indications have been identified on the Dresden or Quad Cities reactor vessel closure head studs. The applicant has not identified the cause of cracking, when the cracking was found, and mitigation actions to prevent cracking. The applicant needs to provide this information. In a letter dated December 22, 2003, the applicant supplemented its response to RAI B.1.3(b). The response stated that the Reactor Head Closure Stud Program for Dresden and Quad Cities provides inspections in accordance with NUREG-1801, Program XI.M3 requirements, which has been proven effective in detecting the aging effects (cracking and loss of material). The four studs at Dresden, Unit 2 were found to have cracking during refueling outages D2R11 and D2R15 and were subsequently replaced. The cracking was the result of stress corrosion cracking (SCC) and the probable cause determined to be exposure of the studs to oxygenated water during outages while in the tensioned condition. No other recordable indications have been identified on the Dresden or Quad Cities reactor head closure studs. The reactor vessel studs normally remain in the reactor vessel flange during refueling activities and are exposed to water during reactor vessel flood up. Water collected in these small areas can not be removed following a refueling outage. As part of the re-assembly, studs are tensioned. The combination of oxygenated water and tensioning resulted in the SCC. Due to the nature of the installation, the only possible corrective actions are stud inspections and replacement. The staff finds this response acceptable because the operating experience demonstrates the ability of the AMP to identify and replace degraded studs prior to a loss of function, which is consistent with the aging effect of cracking managed by Reactor Head Closure Studs Program (LRA Appendix B.1.3).

The staff reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program. In RAI B.1.3-d, the staff requested the applicant to revise the UFSAR Supplement by mentioning the use of VT-1 visual and bore-probe UT inspection procedures for detecting cracking in the reactor head closure studs. In response to RAI B.1.3-d, in a letter dated October 3, 2003, the applicant stated that the UFSAR Supplement described in LRA Appendix A, Section A.1.3, provides a level of detail consistent with that provided in NUREG-1800, Table 3.1-2. The applicant further stated that identifying specific examinations required by ASME Section XI is redundant to the stated information and is not required. The staff finds the applicant's response unacceptable because, as stated in the response to RAI B.1.3-a, the applicant plans to augment the requirements of ASME Section XI by Code Case N-307-2, so that it can use end-shot UT and bore probe UT inspection procedures for detecting cracking in the reactor head closure studs. Therefore, in Supplemental RAI B.1.3(a), the staff requested the applicant to include ASME Section XI Code Case N-307-2 in the UFSAR Supplement for the Reactor Head Closure Studs Program. In response to Supplemental RAI B.1.3(a), in a letter dated November 21, 2003, the applicant stated that Exelon will update the UFSAR Supplement to indicate that the requirements of ASME Section XI will be implemented in accordance with 10 CFR 50.55a. The staff finds the response acceptable because 10 CFR 50.55a allows the use of ASME Section XI Code Cases, including Code Case N-307-2, that are accepted by the staff. These code cases are listed in RG 1.147, "Inservice Inspection Code Case Acceptability—ASME Section XI Division 1."

Conclusions. On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.2 BWR Vessel ID Attachment Welds Program

Summary of Technical Information in the Application. The applicant's BWR Vessel ID Attachment Welds Program is discussed in LRA Appendix B.1.4, "BWR Vessel ID Attachment Welds." The applicant stated that the program incorporates the inspection and evaluation recommendations of BWRVIP-48, "Vessel ID Attachment Weld Inspection and Evaluation Guidelines," as well as the water chemistry recommendations of EPRI TR-103515-R2, "BWR Water Chemistry Guidelines." The applicant further stated that because of the incorporation of these recommendations, the program is consistent with GALL Program XI.M4, "BWR Vessel ID Attachment Welds."

The applicant identified one exception to NUREG-1801. GALL Program XI.M4 indicates that the BWR water chemistry control is in accordance with BWRVIP-29, which references the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." However, the D/QCNPS Water Chemistry Programs are based on the 2000 revision of EPRI TR-103515-R2.

LRA Appendix B.1.4 also indicates that the current code of record for the D/QCNPS inspection programs is the 1989 Edition of ASME Section XI, rather than the 1995 Edition through the 1996 Addenda, as specified in NUREG-1801. The applicant stated that its inspection program will be revised to be consistent with these NUREG-1801 requirements prior to the period of extended operation.

This AMP is credited with managing crack initiation and growth due to SCC and IGSCC in the vessel ID attachment welds. The applicant stated that the D/QCNPS inspection and testing methodologies have not detected cracking in the attachment welds. The applicant concluded that the BWR Vessel ID Attachment Welds Program provides reasonable assurance that cracking aging effects in the ID attachment welds are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Appendix B.1.4, "BWR Vessel ID Attachment Welds," the applicant described its AMP to manage crack initiation and growth in the vessel ID attachment welds due to SCC and IGSCC. The LRA stated that this AMP is consistent with GALL AMP XI.M4, "BWR Vessel ID Attachment Welds" with an exception regarding water chemistry. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program.

The staff finds the applicant's exception to the GALL water chemistry program to be acceptable because it is based on updated industry experience. The evaluation of the applicant's Water Chemistry Program (LRA Appendix B.1.2) is presented in Section 3.0.3.2 of this SER.

The applicant stated that the inspection guidelines for the BWR Vessel ID Attachment Welds Program (LRA Appendix B.1.4) are consistent with BWRVIP-48, which has been approved by the NRC staff. The letter dated January 17, 2001, from C.I. Grimes, NRC, to C. Terry, BWRVIP Chairman, lists required license renewal applicant action items, in accordance with 10 CFR Part 54, when incorporating the BWRVIP-48 report in a renewal application. These license renewal applicant action items are also required for the other applicable BWRVIP reports, which are approved by the staff. These action items are listed below:

- The license renewal applicant is to verify that its plant is bounded by the report. Further, the renewal applicant is to commit to programs described as necessary in the BWRVIP reports to manage the effects of aging during the period of extended operation. Applicants for license renewal will be responsible for describing any such commitments and identifying how such commitments will be controlled. Any deviations from the AMPs within these BWRVIP reports described as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the components or other information presented in the report, such as materials of construction, will have to be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1).

- Section 54.21(d) of Title 10 of the *Code of Federal Regulations* requires that an FSAR Supplement for the facility contain a summary description of the programs and activities for managing the effects of aging and the evaluation of TLAAs for the period of extended operation. Those applicants for license renewal referencing the applicable BWRVIP report shall ensure that the programs and activities specified as necessary in the applicable BWRVIP reports are summarily described in the FSAR Supplement.

- As required by 10 CFR 54.22, each application for license renewal must include any technical specification changes (and the justification for the changes) or additions necessary to manage the effects of aging during the period of extended operation as part of the renewal application. The applicable BWRVIP reports may state that there are no generic changes or additions to technical specifications associated with the report as a result of its AMR, and that the applicant will provide the justification for plant-specific changes or additions. Those applicants for license renewal referencing the applicable BWRVIP reports shall ensure that the inspection strategy described in the reports does not conflict with or result in any changes to their technical specifications. If changes in technical specifications do result, then the applicant must ensure that those changes are included in its application for license renewal.

- If required by the applicable BWRVIP report, the applicant referencing a particular report for licensing renewal should identify and evaluate any potential TLAA issues and/or commitments to perform future inspections when inspection tooling is made available.

In RAI 4.2-BWRVIPs, the staff requested the applicant to submit the necessary commitments, information, and changes as described above for each of the following applicable BWRVIP reports:

- BWRVIP-05
- BWRVIP-18

- BWRVIP-25
- BWRVIP-26
- BWRVIP-27
- BWRVIP-38
- BWRVIP-41
- BWRVIP-42
- BWRVIP-47
- BWRVIP-48
- BWRVIP-49
- BWRVIP-74
- BWRVIP-75
- BWRVIP-76
- BWRVIP-78
- BWRVIP-86
- Other BWRVIP reports applicable to license renewal

In response to RAI 4.2-BWRVIPS, in a letter dated October 3, 2003, the applicant summarized the NRC's request for information in the seven elements listed below and presented its response to each of those elements.

(1) Verify that Dresden and Quad Cities are bounded by the conditions (materials configuration and inspection methodologies) specified in the applicable BWRVIP documents.

Response: The BWRVIP documents were assembled with participation from the NSSS supplier and a wide representation from the BWR Owners Group, providing a level of confidence in accuracy and bounding conditions of these documents. However, during a preliminary review when preparing this response, some material differences were noted. Exelon will perform a detailed review of the applicable BWRVIP documents and verify that Dresden and Quad Cities are bounded by the conditions specified or identify and evaluate any exceptions noted.

(2) Provide a commitment to implement programs consistent with the applicable BWRVIP documents or identify the applicable exceptions.

Response: At the completion of the review noted in item 1 above, Exelon will provide a list of commitments to the applicable BWRVIP documents or identify specific exceptions taken. This is Commitment #3 in Appendix A of this SER.

(3) Describe how the commitments will be tracked.

Response: The commitments, once identified, will be placed in the site implementing procedures with traceability back to the license renewal commitment being made. This is part of Commitment #3 in Appendix A of this SER.

(4) Summarize a program description of the applicable BWRVIP documents in the LRA Appendix A, UFSAR Supplement.

Response: Several of the BWRVIP programs are identified in the LRA Appendix A, such as

BWRVIP-75, A.1.7; BWRVIP-27, A.1.8; BWRVIP-48, A.1.4; BWRVIP-49, A.1.8; BWRVIP-78, A.1.22; and BWRVIP-86, A.1.22. Once the comprehensive list of commitments is identified in item 2 above, Exelon will update the LRA Appendix A to provide a summary program description to address each applicable BWRVIP document.

(5) Verify that technical specification changes needed to support implementation of the applicable BWRVIP documents have been identified and processed.

Response: There are no additional technical specification changes anticipated. However, once the detailed review summarized in item 1 above is complete, Exelon will confirm that no technical specification changes are needed or identify the needed changes to be processed prior to the start of the extended term of operation.

(6) Identify and evaluate any potential TLAA issue identified by the applicable BWRVIP documents and/or commitments to perform future inspections when inspection tooling is made available.

Response: All applicable TLAAs are discussed in Section 4 of the LRA.

(7) Address items 1 through 6 above for the 16 specific BWRVIP documents listed in the RAI and identify and address other BWRVIP documents applicable to license renewal.

Response: Based on a preliminary review, there appears to be several other BWRVIP documents applicable to license renewal, such as BWRVIP-07 and BWRVIP-63 for core shroud repairs, and BWRVIP-26 for Water Chemistry. Once the detailed review is completed, Exelon will provide an amended response addressing items 1 through 6 for all BWRVIP documents applicable to license renewal.

The staff finds the applicant's response is incomplete. The response commits to perform a detailed review of the BWRVIP documents applicable to license renewal, prepare an amended response addressing items 1 through 7 for all of those documents applicable to license renewal, and submit it to the staff for review and approval (Confirmatory Item 3.1.2.3.2-1). The response is incomplete because it does not address the request of RAI 4.2-BWRVIPS for commitments to perform future inspections when inspection tooling is made available, as discussed in element 6 of RAI 4.2-BWRVIPS. In Supplemental RAI 4.2-BWRVIPS, the staff requested the applicant to commit to perform future inspections when inspection tooling is made available. In response to Supplemental RAI 4.2-BWRVIPS, the applicant stated that Dresden and Quad Cities will perform the additional inspections when new inspection techniques and tooling are developed, incorporated into the applicable BWRVIP document(s), and approved by NRC SER. The staff finds the response acceptable because, as recommended by an applicable BWRVIP report, the applicant has committed to perform future inspections when inspection tooling is made available. This is Commitment #9 in Appendix A of this SER.

The staff-approved version of BWRVIP-48 recommends enhanced VT-1 (EVT-1) for furnace-sensitized (from PWHT) welds, Alloy 182 welds, and the welds attaching certain components to the vessel. To facilitate its review, the staff issued RAI B.1.4 requesting the applicant to identify the D/QCNPS vessel ID attachment welds, weld materials, and the welds that are furnace sensitized. The staff also requested the applicant to identify the attachment welds that will be inspected with enhanced VT-1. In response to RAI B.1.4, in a letter dated October 3, 2003, the applicant identified the vessel ID attachment welds at the Dresden and Quad Cities plants. However, it did not include the steam dryer holddown bracket attachment welds at Dresden Unit 3. However, Table 2-2 in BWRVIP-48 states that Dresden Unit 3 does have these welds. The applicant has identified all other vessel ID attachment welds. Some of these welds are furnace sensitized, whereas others are not. None of these welds are Alloy 182 welds. The applicant examines all of these welds, except the surveillance sample holder attachment welds, by enhanced VT-1 examination, as recommended by BWRVIP-48. The surveillance sample holder attachment welds are non-safety-related welds, and the applicant examines them with VT-1 visual examination as part of its ASME Section XI program.

In Supplementary RAI B.1.4, the staff requested the applicant to confirm whether the steam dryer holddown bracket attachment weld at Dresden 3 is a furnace-sensitized weld that requires enhanced VT-1 in accordance with BWRVIP-48. In its response to Supplemental RAI B.1.4, in a letter dated December 12, 2003, the applicant stated that the steam dryer support brackets discussed in the response to RAI B.1.4 include the configuration for Dresden Unit 3. The applicant further stated that the steam dryer holddown bracket attachment weld described in Table 2-2 of BWRVIP-48 does not exist at Dresden Unit 3, and Dresden Unit 3 is the same configuration as Dresden Unit 2 and Quad Cities Units 1 and 2. The staff finds the response acceptable because the steam dryer holddown bracket attachment weld does not exist at Dresden Unit 3, and therefore, the applicant does not have to provide for its inspection. The applicant's response to RAI B.1.4 is acceptable because it is consistent with the recommendations of BWRVIP-48.

Conclusions. On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item 3.1.2.3.2-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exception to the GALL program and 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). The staff also reviewed the UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.3 BWR Feedwater Nozzle Program

Summary of Technical Information in the Application. The applicant's Feedwater Nozzle Program is discussed in LRA Appendix B.1.5, "BWR Feedwater Nozzle." The applicant stated that the program is consistent with GALL Program XI.M5, "BWR Feedwater Nozzle" with no exceptions. The applicant also stated that the program enhances the inservice inspections specified in ASME Code Section XI with the recommendations of General Electric (GE) NE-523-A71-0594, "Alternate BWR Feedwater Nozzle Inspection Requirements."

This AMP is credited with managing aging-related cracking in reactor feedwater nozzles. The applicant stated in the LRA that the Dresden and Quad Cities BWR Feedwater Nozzle Program activities have detected indications of cracking due to cyclic loading on feedwater nozzles prior to loss of their intended function. The indications were repaired by grinding and reexamination or the thermal sleeve was replaced. The applicant also stated that the Dresden and Quad Cities feedwater nozzles have been modified to mitigate cracking by removing the stainless steel cladding.

The applicant concluded that the BWR Feedwater Nozzle Program provides reasonable assurance that cracking aging effects in the feedwater nozzles are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.5, "BWR Feedwater Nozzle," the applicant described its AMP to manage crack initiation and growth in the feedwater nozzles due to cyclic loading. The LRA states that this AMP is consistent with GALL AMP XI.M5, "BWR Feedwater Nozzle," with no deviations. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program.

The applicant credited the GE report, GE-NE-523-A71-0594, "Alternate BWR Feedwater Nozzle Inspection Requirements," for managing crack initiation and growth in the feedwater nozzle. However, the report number does not imply a version of the report that is approved by the staff. The report number for the version of the report that is approved by the staff is GE-NE-523-A71-0594-A, Revision 1, published in May 2000; the designation "A" indicates the staff-accepted version. This report specifies UT of specific regions of the feedwater nozzle inner blend radius and bore, and provides guidelines for the UT examination techniques and personnel qualifications. In Supplemental RAI B.1.5, the staff requested the applicant to confirm whether it has implemented these guidelines as described in GE-NE-523-A71-0594-A, Revision 1. In response to Supplemental RAI B.1.5, in a letter dated November 21, 2003, the applicant stated that Exelon will implement the recommendations of Revision 1, Version A of the report (GE - NE-523-A71-0594-A, Revision 1), which was approved by the NRC staff. The staff finds the response acceptable because the applicant's commitment to implement the recommendations of the staff-approved version of the GE report would ensure that the feedwater nozzles will be inspected as recommended in NUREG-1801. This is Commitment #5 in Appendix A of this SER.

Conclusions. On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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 UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.4 BWR Control Rod Drive Return Line Nozzle Program

Summary of Technical Information in the Application. The applicant's Control Rod Drive Return Line Nozzle Program is discussed in LRA Section B.1.5, "BWR Control Rod Drive Return Line Nozzle." The applicant stated that the program is consistent with GALL Program XI.M6, "BWR Control Rod Drive Return Line Nozzle," with one exception. This exception is related to the NUREG-1801 requirement that the program include enhanced inservice inspections in conformance with ASME Code Section XI, Subsection IWB, Table IWB 2500-1, and the recommendations of NUREG-0619, "BWR Feedwater Nozzle and Control Rod Return Line Nozzle Cracking." The applicant stated that because the Dresden and Quad Cities CRD return line nozzles are capped, the augmented inspections called out in NUREG-0619 are not required. Instead, the applicant's inspections are consistent with the ASME Section XI requirements.

The LRA also indicated that the current code of record for the Dresden and Quad Cities inspection programs is the 1989 Edition of ASME Section XI, rather than the 1995 Edition through the 1996 Addenda, as specified in NUREG-1801. The applicant stated that its inspection program will be revised to be consistent with these NUREG-1801 requirements prior to the period of extended operation.

This AMP is credited with managing aging-related cracking in the CRD return line nozzles. The applicant stated in the LRA that the Dresden and Quad Cities BWR Control Rod Drive Return Line Nozzle Program activities have detected indications of cracking aging effects on CRD return line nozzles prior to loss of their intended function. The indications were repaired by flaw removal or weld overlay.

The applicant concluded in its LRA that the BWR Control Rod Drive Return Line Nozzle Program provides reasonable assurance that cracking in the CRD return line nozzles is adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.5, "BWR Control Rod Drive Return Line Nozzle," the applicant described its AMP to manage cracking due to cyclic loading in the CRD return line nozzles. The LRA states that this AMP is consistent with GALL AMP XI.M6, "BWR Control Rod Drive Return Line Nozzle," with one exception concerning the implementation of augmented ISI procedures described in NUREG-0619. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the deviation and its justification to determine whether the AMP, with the deviation, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the revised program. In addition, the staff determined whether the applicant properly applied the GALL program to its facility.

The applicant stated that because the Dresden and Quad Cities CRD return line nozzles are capped, the augmented inspections called out in NUREG-0619 are not required, and the applicant's inspections are instead consistent with the requirements of ASME Section XI, Subsection IWB, Table IWB 2500-1. The staff finds this exception acceptable because the capped CRD line nozzles are not subject to cyclic loads due to thermal stratification and striping, and, therefore, not susceptible to cracking due to cyclic loading. However, the capped end of a CRD line nozzle could experience cracking due to SCC and it is evaluated in Section 3.1.2.4.1 of this SER.

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

3.1.2.3.5 BWR Penetrations Program

Summary of Technical Information in the Application. The applicant's BWR Penetrations Program is discussed in LRA Appendix B.1.8, "BWR Penetrations." The applicant stated that the program incorporates the inspection and evaluation recommendations of BWRVIP-27, "BWR Standby Liquid Control System/Core Plate ΔP/SLC Inspection and Flaw Evaluation Guidelines," and BWRVIP-49, "Instrument Penetration Inspection and Flaw Evaluation Guidelines." The program also incorporates the water chemistry recommendations of EPRI TR-103515-R2, "BWR Water Chemistry Guidelines." The applicant further stated that because of the incorporation of these recommendations, the program is consistent with GALL Program XI.M8, "BWR Penetrations."

The applicant identified one exception to NUREG-1801. GALL Program XI.M8 indicates that the BWR water chemistry control is in accordance with BWRVIP-29, which references the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines," whereas the D/QCNPS Water Chemistry Programs are based on the 2000 revision of EPRI TR-103515-R2.

LRA Appendix B.1.8 also indicates that the current code of record for the D/QCNPS inspection programs is the 1989 Edition of ASME Section XI, rather than the 1995 Edition through the 1996 Addenda, as specified in NUREG-1801. The applicant stated that its inspection program will be revised to be consistent with these NUREG-1801 requirements prior to the period of extended operation.

The applicant stated that the program uses relief request ISI CR-01 that provides for inspection of the inner radius of the D/QCNPS standby liquid control system nozzles by a VT-2 examination, instead of the normal volumetric inspection required by the ASME Code.

This AMP is credited with managing crack initiation and growth due to SCC, including IGSCC, in the BWR instrument penetrations and standby liquid control nozzles. The applicant stated that the D/QCNPS inspection and testing methodologies have not detected cracking in these penetrations or nozzles.

The applicant concluded that the BWR Penetrations Program provides reasonable assurance that the aging effect of crack initiation and growth in the BWR penetrations are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Appendix B.1.8, "BWR Penetrations," the applicant described its AMP to manage crack initiation and growth in the BWR penetrations due to SCC and IGSCC. The LRA stated that this AMP is consistent with GALL AMP XI.M8, "BWR Penetrations," with an exception regarding water chemistry. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program.

The staff finds the applicant's exception to the GALL Water Chemistry Program to be acceptable because it is based on updated industry experience. The evaluation of the applicant's Water Chemistry Program (LRA Appendix B.1.2) is presented in Section 3.0.3.2 of this SER.

Two memoranda dated July 8 and August 10, 1999, from W.H. Bateman, Division of Engineering (NRC), to C.I. Grimes, Division of Reactor Program Management (NRC), list several license renewal applicant action items to be addressed in the plant-specific LRA when incorporating, respectively, the BWRVIP-27 and BWRVIP-49 reports in a renewal application. The staff has issued a similar list of license renewal applicant action items for other BWRVIP reports. The staff has issued a generic RAI, RAI 4.2-BWRVIPS, requesting the applicant to submit the necessary commitments, information, and changes, as described in the license renewal applicant action items, including an item related to UFSAR Supplement, for each of the BWRVIP reports that are incorporated in the LRA. The details of the license renewal applicant's action items and applicant's response to RAI 4.2-BWRVIPS is presented in Section 3.1.2.3.2 of this SER. The staff finds the applicant's response acceptable, but incomplete. The response is acceptable, pending satisfactory resolution of Confirmatory Item 3.1.2.3.2-1, because it commits to perform a detailed review of the BWRVIP documents applicable to license renewal, prepare an amended response addressing all the items requested in the RAI for each of those documents, and submit it to the staff for review and approval.

The response to RAI 4.2-BWRVIPS is incomplete because it does not address the request for commitments to perform future inspections of currently inaccessible sites ,such as the ΔP/SLC nozzle weld, when inspection tooling is made available. The ΔP/SLC nozzle at D/QCNPS is welded to a stainless steel safe end. The nozzle-to-safe-end weld is susceptible to cracking due to IGSCC. Therefore, though the ASME Code requires surface examination of this weld because the ΔP/SLC line is less than 4inches in diameter, BWRVIP-27 recommends a more stringent inspection requirement (volumetric inspection) for this weld, if accessible, when inspection tooling is available. In Supplemental RAI 4.2-BWRVIPS, the staff requested the applicant to commit to perform future inspections when inspection tooling is made available. The applicant's response to Supplemental RAI 4.2-BWRVIPS is evaluated in Section 3.1.2.3.2 of this SER. The staff has found the response acceptable, pending satisfactory resolution of Confirmatory Item 3.1.2.3.2-1.

According to BWRVIP-27, D/QCNPS have ΔP/SLC nozzles made of low-alloy steel instead of ΔP/SLC penetrations made of Alloy 600. BWRVIP-27 describes an inspection strategy for these nozzles that recommends the inspection requirements of ASME Section XI, IWB-2500, Category B–D, which essentially includes volumetric examination for the nozzle-to-shell weld and the nozzle inner blend radius at each inspection interval. NUREG-1801, Chapter XI.M8, also recommends the same inspection requirements for the ΔP/SLC nozzles. In Appendix B.1.8 of the LRA, the applicant stated that the Dresden and Quad Cities programs utilize relief request ISI CR-01 (relief granted per SER dated September 15, 1995) that provides for inspection of the inner blend radius by a VT-2 examination instead of the normal volumetric examination. Future relief requests may be submitted by the applicant in accordance with 10 CFR 50.55a. Otherwise, the applicant must comply with the appropriate requirements of the ASME Code. In RAI B.1.8, the staff requested the applicant to confirm that the aforementioned aging effects for the ΔP/SLC nozzles at D/QCNPS will be inspected in accordance with the requirements of ASME Section XI, Subsection IWB, for license renewal. In response to RAI B.1.8, in a letter dated October 3, 2003, the applicant stated that D/QCNPS will inspect the ΔP/SLC nozzles in accordance with the requirements of ASME Section XI, Subsection IWB, during the license renewal period, as part of the NRC-approved ISI plan in accordance with 10 CFR 50.55a. The staff finds the response acceptable because the applicant will follow the inspection of the ΔP/SLC nozzles according to ASME Section XI requirements as approved by the staff.

Conclusions. On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item 3.1.2.3.2-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately manage 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 UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.6 BWR Vessel Internals Program

Summary of Technical Information in the Application. The applicant's BWR Vessel Internals Program is discussed in LRA Appendix B.1.9, "BWR Vessel Internals." The applicant stated that the program incorporates the inspection and evaluation recommendations of BWRVIP guidelines. The program also incorporates the water chemistry recommendations of EPRI TR-103515-R2, "BWR Water Chemistry Guidelines." The applicant further stated that because of the incorporation of these recommendations, the program is consistent with GALL Program XI.M9, "BWR Vessel Internals."

The applicant identified one exception to NUREG-1801. GALL Program XI.M9 indicates that the BWR water chemistry control is in accordance with BWRVIP-29, which references the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines," whereas the D/QCNPS Water Chemistry Programs are based on the 2000 revision of EPRI TR-103515-R2.

The LRA Appendix B.1.8 also indicates that the current code of record for the D/QCNPS inspection programs is the 1989 Edition of ASME Section XI, rather than the 1995 Edition through the 1996 Addenda, as specified in NUREG-1801. The applicant stated that its inspection program will be revised to be consistent with these NUREG-1801 requirements prior to the period of extended operation.

This AMP is credited with managing crack initiation and growth due to SCC, including IGSCC, in the BWR vessel internals. The applicant stated that the BWR vessel internals aging management activities have detected cracking in several vessel internals including Quad Cities access hole covers and core spray piping at Dresden Unit 3. The applicant also reported that a jet pump beam assembly failed at Quad Cities Unit 1 in January 2002. All similar beams at D/QCNPS have been replaced with beams fabricated with an improved heat treatment in accordance with BWRVIP-41 to increase the resistance to IGSCC.

The applicant concluded that the BWR Vessel Internals Program provides reasonable assurance that the aging effect of crack initiation and growth in the BWR vessel internals are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Appendix B.1.9, "BWR Vessel Internals," the applicant described its AMP to manage crack initiation and growth in the vessel internals due to SCC, including IGSCC. The applicant stated that this AMP is consistent with GALL AMP XI.M9, "BWR Vessel Internals" with an exception regarding water chemistry. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program.

The staff finds the applicant's exception to the GALL water chemistry program to be acceptable because it is based on updated industry experience. The evaluation of the applicant's Water Chemistry Program (LRA Appendix B.1.2) is presented in Section 3.0.3.2 of this SER.

The following letters from C.I. Grimes, NRC, to C. Terry, BWRVIP Chairman, identify several license renewal applicant action items to be addressed in the plant-specific LRA when incorporating the following BWRVIP reactor vessel internals guidelines in a renewal application; dates of the letters are given in parentheses—BWRVIP-18, BWRVIP-25, BWRVIP-26, BWRVIP-47 (December 7, 2000); BWRVIP-38 (March 1, 2001); and BWRVIP-41 (June 5, 2001). The staff has issued a generic RAI, RAI 4.2-BWRVIPS, requesting the applicant to submit the necessary commitments, information, and changes as described in the license renewal applicant action items, including an item related to the UFSAR Supplement for each of the BWRVIP reports that are incorporated in the LRA. The details of the license renewal applicant's action items and applicant's response to RAI 4.2-BWRVIPS is presented in Section 3.1.2.3.2 of this SER. The staff finds the applicant's response acceptable, pending satisfactory resolution of Confirmatory Item 3.1.2.3.2-1, but incomplete. The response is acceptable because it commits to perform a detailed review of the BWRVIP documents applicable to license renewal, prepare an amended response addressing all the items requested in the RAI for each of those documents, and submit it to the staff for review and approval.

The response to RAI 4.2-BWRVIPS is incomplete because it does not address the request for commitments to perform future inspections of sites with limited access when inspection tooling is made available. One such limited access site is in the BWR vessel internals. The D/QCNPS shroud support consists of the shroud support plate with legs. It is difficult to inspect the welds on the legs which are in the vessel lower plenum where the access is limited. The staff FSER for BWRVIP-38, "BWR Vessel and Internals Project, BWR Shroud Support Inspection and Flaw Evaluation Guidelines," states that when the inspection tooling and methodologies are developed that allow the welds in the lower plenum to be accessible, these welds should be inspected with appropriate NDE methods. In Supplemental RAI 4.2-BWRVIPS, the staff requested the applicant to commit to perform future inspections when inspection tooling is made available. This is Commitment #9 in Appendix A of this SER. The applicant's response to Supplemental RAI 4.2-BWRVIPS is evaluated in Section 3.1.2.3.2.2 of this SER. The staff finds the response acceptable.

BWRVIP-26, "BWR Vessel and Internals Project, BWR Top Guide Inspection and Flaw Evaluation Guidelines," states that the projected minimum end-of-life fluence at the grid beam location after 48 EFPY of operation is approximately 6×10^{20} n/cm^2 (E > 1 MeV), which is higher than the IASCC threshold of 5×10^{20} n/cm^2 (E > 1 MeV). Therefore, according to the staff final SER for BWRVIP-26, one of the license renewal applicant action items is to identify and evaluate the projected accumulated neutron fluence as a potential TLAA issue. In RAI B.1.9(a), the staff requested the applicant to confirm whether D/QCNPS follows the BWRVIP-26 guidelines for managing cracking in the top guide due to IASCC. If so, then D/QCNPS needs to evaluate the projected accumulated neutron fluence as a potential TLAA issue. The applicant also needs to confirm that it will use EVT-1, as recommended by BWRVIP-26, to inspect the sites on the top guide that are likely to receive neutron fluence higher than the

IASCC threshold before the end of extended operation.

In response to RAI B.1.9(a), in a letter dated October 3, 2003, the applicant stated that Dresden and Quad Cities are following the recommendations of BWRVIP-26, “BWR Vessel and Internals Project, BWR Top Guide Inspection and Flaw Evaluation Guidelines,” including the enhanced visual inspection technique, EVT-1, of the top guide. IASCC of the reactor internals was evaluated as a potential TLAA and was determined not to be a TLAA. However, Dresden and Quad Cities agree to perform inspections of the top guide similar to the inspections of the control rod drive housing (CRDH) guide tube. The inspection of the CRDH guide tube is performed in accordance with BWRVIP-47, “BWR Lower Plenum Inspection and Flaw Evaluation Guidelines.” The examination extent and frequency is a 10 percent sample of the total population within 12 years, one-half (5 percent) to be completed within 6 years. The method of examination is EVT-1. LRA Appendix B.1.9, “BWR Vessel Internals Program,” will be enhanced to include inspection of the top guide with an examination extent and frequency similar to the CRDH guide tube. The program enhancements will be implemented prior to the end of the initial operating license term for Dresden and Quad Cities. The staff finds the applicant’s response acceptable because the applicant has proposed an inspection plan that was previously accepted by the staff. The applicant, however, needs to describe how it will identify the sites that belong to the total population that it will consider for inspection. Specifically, the applicant needs to confirm that only those sites where the neutron fluence exceeds the IASCC threshold of 5×10^{20} n/cm^2 (E > 1 MeV) will be included in the total population. In Supplemental RAI B.1-9(a), the staff requested the applicant to identify the locations of the top guide, equivalent to Peach Bottom, that will be included in the total population, and confirm that their fluences exceed the IASCC threshold limit of BWRVIP-26.

In response to Supplemental RAI B.1-9(a), in a letter dated November 21, 2003, the applicant stated that Figures 2-1 and 2-3 of BWRVIP-26 identify 94 potential locations (total population) of failure. The top guide grid beam locations selected for examination will be contingent on the CRDH guide tube locations selected for inspection per BWRVIP-47. This is not necessarily limited to the center or near the center of the core locations. However, the locations selected for examination will be in areas that have surpassed the fluence threshold for IASCC noted in BWRVIP-26. As stated in BWRVIP-26, Section 2.1.1, “based on estimates made in the late 1980’s all BWR/2 through BWR/5’s have reached or surpassed the fluence threshold for IASCC at the top guide grid beam locations.” Dresden and Quad Cities (BWR/3 plants) are consistent with this evaluation. The staff finds the response acceptable because it defines the total population of IASCC-susceptible locations on the top guide, which is consistent with BWRVIP-26, and commits to select those locations for inspection that have reached or surpassed the fluence threshold for IASCC. This is Commitment #9 in Appendix A of this SER.

The rim hold-down bolts are susceptible to stress relaxation. Therefore, the license renewal action item for BWRVIP-25 recommends that the applicant for license renewal should identify and evaluate the projected stress relaxation as a potential TLAA issue if a plant-specific analysis satisfies the six criteria in 10 CFR 54.3 for a TLAA. The staff issued RAI B.1.9-b requesting the applicant to confirm whether D/QCNPS follows the BWRVIP-25 guidelines for managing aging of the rim hold-down bolts and, if so, to identify and evaluate whether the projected stress relaxation in the rim hold-down bolts is a TLAA issue. In response to RAI B.1.9-b, in a letter dated October 3, 2003, the applicant stated that D/QCNPS follows the BWRVIP-25 guidelines for management of the hold-down bolts. However, the D/QCNPS core plates had wedges installed along with the repair of their shrouds with tie rods. The applicant further stated that BWRVIP-25 does not recommend inspection of rim hold-down bolts if wedges are installed. The staff reviewed BWRVIP-25 and confirmed the accuracy of the applicant's statements made in this response. The staff finds the applicant's response acceptable because it follows the recommendations of BWRVIP-25, which is approved by the staff. However, the applicant did not identify whether stress relaxation in the rim hold-down bolts is a TLAA. In response to the staff's followup question, the applicant stated that the stress relaxation of the rim hold-down bolts is not a TLAA for Dresden or Quad Cities. Dresden and Quad Cities have installed wedge retainers, which structurally replace the lateral load resistance provided by the rim hold-down bolts. As such, the failure of the bolts due to stress relaxation is no longer a concern and inspection of the bolts is not required. Therefore the stress relaxation of the rim hold-down bolts does not meet the TLAA criteria 5 (involve conclusions or provide the basis for conclusion related to the capability of the core plate to perform its intended function). Additionally, neither the rim hold-down bolts, nor the wedges meets TLAA criteria 3 (time-limited assumptions defined by the current operating term). The staff finds this response acceptable because the rim hold-down bolts no longer provide structural load and do meet the definition of a TLAA as defined in 10 CFR 54.3(a)(3) and (5). This is a confirmatory item pending formal submittal from the applicant. (Confirmatory Item 3.1.2.3.6-1).

The applicant stated that the BWR vessel internals aging management activities at D/QCNPS have detected cracking in several vessel internals, including core spray piping at Dresden Unit 3 and access hole covers at Quad Cities, Units 1 and 2. In RAI B.1.9-c, the staff requested the applicant to identify the specific BWRVIP guidelines upon which the BWR vessel internals aging management activities at D/QCNPS are based. The applicant was also requested to identify specific BWRVIP guidelines used to support the aging activities mentioned in LRA, Appendix B.1.9. In its response to RAI B.1.9-c, in a letter dated October 3, 2003, the applicant stated that the aging management activities associated with detecting these cracks in the core spray piping were based on BWRVIP-18, "BWR Core Spray Internals Inspection and Evaluation Guidelines." The examination methods included EVT-1. The staff finds the applicant's use of the BWRVIP-18 recommendations acceptable for detecting cracks in the core spray piping because BWRVIP-18 has been reviewed and approved by the staff. With respect to the access hole covers, the applicant stated that the covers were inspected by VT-1 and VT-3 based on the recommendations of GE SIL 462 and Supplement 1, "Shroud Access Hole Cover Cracks." As a result of these inspections, cracks were found in the welded access hole covers for Dresden 2 and Quad Cities 1 and 2 and all access hole covers at these three units were subsequently replaced with mechanical bolted covers. The applicant further stated that future inspections of the Dresden 3 welded access hole covers will continue to be based on the SIL guidance (GE SIL 462, Revision 1), as discussed in its response to RAI 3.1-8, which is evaluated in Section 3.1.2.4.2.2 of this SER. The inspection requirements of GE SIL 462, Revision 1, include visual and ultrasonic examination of the welded access hole covers. The staff finds the applicant's use of GE SIL 462, Revision 1, for inspecting welded access hole covers acceptable because it is consistent with the recommendations of NUREG-1801, Item IV.B1.1.4.

In LRA Appendix B.1.9, the applicant reported that a jet pump beam assembly failed at Quad Cities Unit 1 in January 2002, and all similar beams have been replaced with ones with improved heat treatment. Section 2.3.2.4 of BWRVIP-41 details mitigation processes that include a specific heat treatment that improves on the old heat treatment of the jet pump beams. Section 2.3.2.7 of BWRVIP-41 also recommends, for the improved heat-treated beams along with reduced preload, inspections consisting of no inspection during the first 10 years of service and inspection of these beams every following 10-year period at the same frequency as the old heat-treated beams with reduced preload. The staff issued RAI B.1.9(d) requesting the applicant to submit information about how the new jet pump beams meet these BWRVIP-41 heat treatment guidelines and how they will be inspected accordingly. The RAI also requested the applicant to describe the beam assembly failure or provide a reference, and confirm whether all the beams at all four D/QCNPS units have been replaced with ones with improved heat treatment. In response to RAI B.1.9(d), in a letter dated October 3, 2003, the applicant stated that on January 9, 2002, jet pump beam 20 for Quad Cities Unit 1 failed due to an IGSCC crack in the transition area, which was a low stress area. The applicant referred to Quad Cities Licensee Event Report (LER) 1-02-001 for a more detailed explanation. Subsequent to this failure, Dresden and Quad Cities replaced all of the jet pump beams with ones having improved heat treatment. The new beams are inspected based on the guidelines in BWRVIP-03 and BWRVIP-41. The review of the referenced LER, LER 1-02-001, indicates that all of the original-style BWR/3 jet pump holddown beams were replaced with BWR/4 beams. The staff finds this corrective action acceptable because it follows the recommendations of BWRVIP-41 (Section 2.3.2). Further review of the LER has raised the following concern related to inspection of the jet pump beam.

LER 1-02-001 states that the crack was located in an area of the jet pump holddown beam (transition area of the beam) that is not covered by the inspection requirements of BWRVIP-41, “BWR Jet Pump Assembly Inspection and Flow Evaluation Guidelines.” The applicant therefore stated that, although the Quad Cities Nuclear Power Station implemented the requirements of BWRVIP-41, including periodic inspections of the required areas of the jet pump holddown beams, the transition area of the beam was not required to be inspected and the crack was not identified prior to failure. However, a review of Table 3.3-1, “Matrix of Inspection Options,” of BWRVIP-41 includes inspection requirements for the jet pump beam transition arm region. In Supplemental RAI B.1.9(d), the staff requested the applicant to clarify this apparently conflicting information about inspection of the beam transition arm region.

In response to Supplemental RAI B.1.9(d), in a letter dated November 21, 2003, the applicant stated that the information it has provided is not contradictory and described the inspection of the holddown beam as recommended by BWRVIP-41. The inspections recommended in BWRVIP-41 are divided into both baseline and reinspection recommendations based on an inspection cycle of 6 years. Baseline inspection required UT or another NDE technique of all beams during the next inspection cycle. Fifty percent of the inspections were to be performed in the next refueling outage. Reinspection requirements are 50 percent per inspection cycle for the first 20 years of service and 100 percent per inspection cycle beyond 20 years of service.

The applicant further stated that both Dresden and Quad Cities have performed 100 percent UT inspections of area BB-1 (the area surrounding the bolt hole) and area BB-2 (the machined radius or ear) during each refueling outage since 1995, which exceeds BWRVIP-41 recommendations. The beam regions that are required to be inspected per BWRVIP-41 are location BB-1 and location BB-2, and not the transition area of the beam. However, the cracking occurred in the transition area of the beam, located between BB-1 (the area surrounding the bolt hole) and BB-2 (the machined radius or ear). The transition area is a low stress location, outside the area of interest specified by the BWRVIP-41.

As part of the corrective actions from the LER root cause investigation, Exelon has requested the BWRVIP committee to provide further evaluations of the adequacy of the examinations performed on the holddown beams. Exelon will continue to perform the inspections required by BWRVIP-41 (BB-1 and BB-2) and will incorporate the additional changes in inspection methodology when incorporated into BWRVIP-41. The staff finds the response acceptable because all of the jet pump beams have been replaced with beams fabricated with an improved heat treatment in accordance with BWRVIP-41. This heat treatment improves the resistance to SCC. Also, the applicant follows the BWRVIP-41 recommendations regarding inspection of the holddown beams and commits to perform any additional inspections, such as inspection of the transition area, when recommended by BWRVIP-41.

Conclusions. On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item 3.1.2.3.6-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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). The staff also reviewed the UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.7 Thermal Aging and Neutron Irradiation Embrittlement Program

Summary of Technical Information in the Application. The applicant's Thermal Aging and Neutron Irradiation Embrittlement Program is discussed in LRA Appendix B.1.10, "Thermal Aging and Neutron Irradiation Embrittlement." This is a new program for managing loss of fracture toughness in CASS reactor internals within the scope of license renewal. The program will be implemented prior to the period of extended operation.

The applicant stated that the program will include a component-specific evaluation of the loss of fracture toughness. For those components where loss of fracture toughness may affect function of the component, an inspection will be performed as part of the station ISI program. The applicant stated that this program, when implemented, will be consistent with GALL Program XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement."

Staff Evaluation. In LRA Appendix B.1.10, "Thermal Aging and Neutron Irradiation Embrittlement," the applicant described its AMP to manage loss of fracture toughness in the CASS reactor internals due to thermal aging and neutron irradiation embrittlement. This is a new program and will be implemented prior to the period of extended operation. This is Commitment #10 in Appendix A of this SER. The applicant stated that this AMP, when implemented, will be consistent with GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement." The staff reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program.

In LRA Appendix B.1.10, the applicant stated that the component-specific evaluation for loss of fracture toughness in CASS components will be performed. The applicant further stated that if loss of fracture toughness affects the function of a given component, that component will be inspected as part of the D/QCNPS ISI program. In RAI B.1.10, the staff requested the applicant to confirm that the criteria given in GALL AMP XI.M13 will be applied to determine whether loss of fracture toughness affects the function of the CASS vessel internals and that a supplemental inspection program, qualified for detecting the critical flaw size with adequate margin, will be provided for the CASS vessel internals whose function is affected.

In response to RAI B.1.10, in a letter dated October 3, 2003, the applicant submitted the following information. AMP B.1.10 has been developed to evaluate thermal aging/neutron embrittlement of CASS reactor internals components that are included within the scope of license renewal. When implemented, the AMP will be consistent with the program described in NUREG- 1801, AMP XI.M13. For each component, the ferrite content will be determined based on Hull's equivalent factors (described in NUREG/CR-4513, Revision 1," Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems," U.S. Nuclear Regulatory Commission). Molybdenum content will be obtained from certified material test reports. Based on these factors, the potentially susceptible components will be identified. For these components, a mechanical loading assessment will be performed to determine maximum tensile loading on the component during ASME Code Level A, B, C, and D conditions.

For components that do not satisfy the acceptance criteria, an inspection will be performed as part of the ISI program. If any criteria are not met, a condition report will be generated for engineering evaluation. The ISI program includes an enhanced visual inspection program for detecting critical flaw size and is in accordance with BWRVIP-03, which has the ability to achieve a 0.0005-in. resolution, as specified in NUREG-1801, AMP XI.M13. The staff finds the applicant's response acceptable because it will apply the acceptance criteria given in GALL AMP XI.M13 to determine whether loss of fracture toughness affects function of the CASS vessel internals, and will perform enhanced visual inspection (as recommended by GALL AMP XI.13) of components that do not satisfy these criteria.

<u>Conclusions</u>. On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program.   Since the GALL program is acceptable to the staff, 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 UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.8 Reactor Vessel Surveillance Program

<u>Summary of Technical Information in the Application</u>. The applicant's Reactor Vessel Surveillance Program is discussed in LRA Appendix B.1.22, "Reactor Vessel Surveillance." The program is implemented through station procedures that conform to the requirements of 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements." Neutron embrittlement for the period of extended operation is predicted using the chemistry tables and Position 1.3, "Limitations," as described in RG 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials."

The applicant has enhanced the program by making it consistent with BWRVIP-78, "BWR Vessel and Internals Project: BWR Integrated Surveillance Program Plan": BWRVIP-86, "BWR Vessel and Internals Project: BWR Integrated Surveillance Program Implementation Plan:" and the corresponding NRC safety evaluation reports and the associated RAIs. The enhanced program provides for capsule testing consistent with BWRVIP-78 and BWRVIP-86 saving the withdrawn capsules for future reconstitution. Existing capsules not included in the integrated surveillance program will be maintained in the vessels as a contingency for the future. The applicant stated that the enhanced program will be consistent with GALL AMP XI.M31, “Reactor Vessel Surveillance.”

The applicant indicated that the Reactor Vessel Surveillance Program provides that the aging effects of irradiation embrittlement for the D/QCNPS reactor vessel components are adequately managed so that their intended functions, consistent with the CLB, are maintained during the period of extended operation.

Staff Evaluation. In LRA Appendix B.1.22, “Reactor Vessel Surveillance,” the applicant described its AMP to manage irradiation embrittlement of the reactor pressure vessel through testing that monitors reactor vessel beltline materials. The LRA states that the Reactor Vessel Surveillance Program will be enhanced by making it consistent with BWRVIP-78 and BWRVIP-86 prior to the period of extended operation. The LRA further states that the enhanced program will be consistent with GALL AMP XI.M31, “Reactor Vessel Surveillance,” described in NUREG-1801. For this AMP, GALL recommends further evaluation. The staff confirmed the applicant’s claim of consistency during the AMR inspection. The staff also reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program. Furthermore, the staff reviewed the applicant’s evaluation to determine whether it addressed the additional issues recommended in the GALL Report, as well as in the final SERs for the related BWRVIP documents, and confirmed that the AMP would adequately address these issues. Finally, for D/QCNPS, the staff determined whether the applicant properly applied the GALL program to its facility.

The applicant had submitted its license amendment to implement a program consistent with BWRVIP-78, “Integrated Surveillance Program,” and BWRVIP-86, “BWR Integrated Surveillance Program Implementation Plan.” The staff has reviewed the license amendment and approved it in SERs to John Skolds, Exelon, from the NRC, dated September 29, 2003, and August 28, 2003, for Dresden and Quad Cities, respectively. Therefore, the applicant has committed and implemented the BWRVIP Integrated Surveillance Program, consistent with the AMP XI.M31, “Reactor Vessel Surveillance,” described in NUREG-1801 for the current license period of 40 years. The staff has concluded that the final proposed BWRVIP integrated surveillance program (ISP) was acceptable for BWR licensee implementation, provided that all participating licensees use one or more compatible neutron fluence methodologies acceptable to the NRC staff for determining surveillance capsule and RPV neutron fluences. The NRC acceptance of these reports for the current term is documented in the SER dated February 1, 2002, from Bill Bateman of the NRC to Carl Terry, BWRVIP Chairman. One of the provisions of the ISP is for surveillance capsule material withdrawal and testing during the license renewal period. In RAI B.1.22, the staff requested the applicant to commit that it will incorporate the Reactor Vessel Surveillance Program consistent with the staff-approved versions of the revised BWRVIP-78 and BWRVIP-86 documents and include this commitment in the UFSAR Supplement for this program. This is part of Commitment #22 in Appendix A of this SER.

In response to RAI B.1.22, in a letter dated October 3, 2003, the applicant mentioned that Section B.1.22 of the LRA states that the Exelon Reactor Vessel Surveillance Program will be enhanced to incorporate the reactor vessel surveillance program consistent with the staff-approved versions of BWRVIP-78 and BWRVIP-86. The applicant further stated that this commitment is already included in Section A.1.22 of the Dresden and Quad Cities UFSAR

Supplement. The staff finds the applicant's response not acceptable because it has not committed to the revised versions of BWRVIP-78 and BWRVIP-86 that are prepared for the extended period of operation. The staff also notes that the BWRVIP has combined these revised versions of BWRVIP-78 and BWRVIP-86 into BWRVIP-116 for the extended period of operation, which is being reviewed by the staff. The staff issued Supplemental RAI B.1.22 requesting from the applicant additional information about the Reactor Vessel Surveillance Program.

This RAI and the evaluation of the applicant's response to it are presented here in three parts. In Part 1 of Supplemental RAI B.1.22, the staff requested the applicant to commit to BWRVIP-116, "BWRVIP Integrated Surveillance Program Implementation for License Renewal," July 2003, upon approval by the staff. In response to Part 1 of Supplemental RAI B.1.22, in a letter dated November 21, 2003, the applicant stated that the Reactor Vessel Surveillance Program (LRA Appendix B.1.22) will be consistent with BWRVIP-116, "BWR Vessel and Internals Project, Integrated Surveillance Program (ISP) Implementation for License Renewal," upon approval by the NRC staff. This is part of Commitment #22 of Appendix A of this SER. The staff finds the applicant's response acceptable because it has committed to make its Reactor Vessel Surveillance Program (LRA Appendix B.1.22) consistent with BWRVIP-116, which includes recommendations for implementing ISPs during license renewal, upon approval by the staff.

In Part 2 of Supplemental RAI B.1.22, the staff requested the applicant to submit plant-specific reactor vessel surveillance programs for all four units of D/QCNPS, if the ISP program for license renewal as described in BWRVIP-116 is not approved by the NRC, or if it is modified such that D/QCNPS is not covered by the ISP. The staff also stated that these plant-specific programs, if needed, should include the following actions:

- Capsules must be removed periodically to determine the rate of embrittlement and at least one capsule with neutron fluence not less than once or greater than twice the peak beltline neutron fluence must be removed before the expiration of the license renewal period.

- Capsules must contain material to monitor the impact of irradiation on the limiting beltline materials and must contain dosimetry to monitor neutron fluence.

- If capsules are not being removed from Dresden and Quad Cities plants during the license renewal period, the applicant must supply operating restrictions (i.e., inlet temperature, neutron spectrum and flux) to ensure that the RPV is operating within the environment of the surveillance capsules, and must supply ex-vessel dosimetry for monitoring neutron fluence.

In response to Part 2 of Supplemental RAI B.1.22, in a letter dated November 21, 2003, the applicant stated that if staff does not approve the proposed BWRVIP-116, Exelon will provide a plant-specific surveillance plan for the license renewal period in accordance with 10 CFR Part 50, Appendices G and H, prior to entering the renewed license period (Confirmatory Item 3.1.2.3.8-1). This is part of Commitment #22 of Appendix A of this SER. The staff finds the response acceptable because the applicant commits to provide a plant-specific surveillance program for the license renewal period in accordance with 10 CFR Part 50, Appendices G and H, if the staff does not approve the proposed BWRVIP-116.

The staff reviewed the UFSAR Supplement to determine whether it provides an adequate description of the program. In Part 3 of Supplemental RAI B.1.22, the staff requested the applicant to revise the UFSAR Supplement to reference the ISP for the license renewal period (proposed BWRVIP-116) when approved by the NRC staff. In response to Part 3 of Supplemental RAI B.1.22, in a letter dated November 21, 2003, the applicant revised the UFSAR Supplements for Dresden and Quad Cities (LRA Appendix A.1.22) by including its commitment that the Reactor Vessel Surveillance Program will be consistent with BWRVIP-116 upon approval by the NRC staff. This is part of Commitment #22 in Appendix A of this SER. The staff finds the response acceptable because the revised UFSAR Supplements include the applicant's commitment that the Reactor Vessel Surveillance Program will be consistent with BWRVIP-116 upon approval by the NRC staff.

Conclusions. On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Confirmatory Item 3.1.2.3.8-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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 UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.9 Metal Fatigue of Reactor Coolant Pressure Boundary

Summary of Technical Information in the Application. The applicant's aging management program (AMP) for metal fatigue of the reactor coolant pressure boundary is described in LRA section B.1.34, "Metal Fatigue of Reactor Coolant Pressure Boundary" (Metal Fatigue AMP). It provides means for monitoring fatigue stress cycles to ensure that the ASME Section III design fatigue cumulative usage factor (CUF) limit is not exceeded during the period of extended operation.

The applicant stated that, with enhancements, the program is consistent with the ten elements of the NUREG 1801 AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." The enhancements consist in the implementation of the EPRI-licensed "FatiguePro" cycle counting and fatigue usage factor tracking computer program. The computer program provides the capability for automated counting of fatigue stress cycles and automated calculation and tracking of fatigue CUFs at various locations. The program will permit calculating and tracking the cumulative usage factors for the reactor pressure vessel, Class 1 piping, the torus, torus vents, and torus attached piping and penetrations, at the monitoring locations stated in Sections 4.3 and 4.6 of the LRA. The program will also provide for tracking of fatigue stress cycles for the Dresden isolation condenser.

Under Element 10, "Operating Experience," of NUREG 1801 AMP X.M1, the applicant stated that the reactor vessel cycle counting programs have been revised to incorporate changes in design basis analysis cycles, because certain types of events were found to be more frequent than anticipated in the original design, while others were found to be less frequent. The applicant stated that the FatiguePro computer program was developed by the industry as a result of NRC concerns that early-life operating cycles at some units had caused fatigue usage factors to increase at a greater rate than anticipated in the design analysis. The program is designed to ensure that the code limits are not exceeded for the remainder of each unit's licensed life and provides for incorporation of operating experience.

The applicant concludes that the aging management program for metal fatigue of reactor coolant pressure boundary provides reasonable assurance that the thermal and pressure transients aging effects are adequately managed so that the intended functions of pressure boundary components within the scope of license renewal that are covered by this program are maintained during the period of extended operation.

Staff Evaluation. In RAI B.1.34(a), the staff requested that the applicant explain how the "FatiguePro" program and the AMP will account for CUFs at the selected monitoring locations prior to the implementation for the period of extended operations. The applicant stated in his response that FatiguePro has the capability of estimating the fatigue usage in one of two ways: 1) stress-based fatigue (SBF) monitoring, in which a real time stress history is determined by the program at a given location on a given component. The program calculates the CUF at the location from the computed stress history using appropriate cycle counting techniques and appropriate ASME Code Section III fatigue analysis methodology. SBF monitoring duplicates the methodology in the ASME Section III stress report for the component in question, but uses actual transient severity in place of design transient severity. 2) Cycle-based fatigue (CBF) monitoring, which consists of automated cycle counting and CUF computation based on the counted cycles. The CUF is computed via a design-basis fatigue calculation where the design basis transient severity in the fatigue table from the governing stress report is used as a basis, but actual numbers of cycles are substituted for assumed design basis numbers of cycles. This is Commitment #34 of Appendix A of this SER. For the time period prior to the implementation of FatiguePro, the fatigue usage will be estimated in one of two ways. For the locations for which SBF is specified, the initial CUF will be determined based on a linear projection of the design basis CUF. For the locations for which CBF is specified, the initial CUF estimate will be determined based on the cycle counts to-date since initial startup and the design basis fatigue CUF calculation methodology. The staff finds these procedures acceptable since they conform with accepted industry practice.

In RAI B.1.34(b), the staff requested that the applicant verify that fatigue stress cycles will be tracked for both Dresden isolation condensers. The applicant stated that all thermal events that have a significant impact on fatigue of critical isolation condenser components will be monitored for both Dresden units. The staff finds this acceptable, since it states clearly that this enhancement of the Metal Fatigue AMP will be applicable to both Dresden units.

In RAI B.1.34(c), the staff requested that the applicant provide a list, or a reference in the Dresden/Quad Cities UFSARs, of the transients that will be monitored in the Metal Fatigue AMP. In its response, the applicant provided the requested list of transients, which includes the transients listed in Table 3.9-1 of the Dresden/Quad Cities UFSARs. The staff finds that this list is acceptable since it contains the transients listed in the UFSARs and other representative transients usually associated with BWR plant operation.

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

3.1.2.4 Aging Management Review of Reactor Vessel, Vessel Internals, and Reactor Coolant System

In SER Sections 3.1.2.1 through 3.1.2.3, the staff determined that, subject to satisfactory resolution of Confirmatory Item 3.1.2.3.6.2-1, the applicant's AMPs will adequately manage component aging in the reactor systems. The staff then reviewed specific components in the reactor systems to ensure that they were properly evaluated in the applicant's AMR. This evaluation included systems and components (LRA Table 3.1-1) that are covered by GALL, as well as systems and components (LRA Table 3.1-2) not addressed by GALL.

To perform this evaluation, the staff reviewed the components listed in LRA Tables 2.3.1-1 through 2.3.1-9 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below. The staff also reviewed the UFSAR Supplements for the AMPs credited with managing aging in reactor system components to determine whether the program description adequately describes the program.

The following sections provide the results of the staff's evaluation of the adequacy of aging management for components in each of the reactor vessel, vessel internals, and the reactor coolant system.

3.1.2.4.1 Reactor Vessel

Summary of Technical Information in the Application. The description of the reactor pressure vessel can be found in Section 2.3.1.1 of this SER. The passive, long-lived components in this system that are subject to AMR are identified in LRA Table 2.3.1-1. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2.

Aging Effects

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the D/QCNPS operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the aging effects, component intended functions, environment, and materials for each group of components of the reactor pressure vessel in Tables 3.1-1 and 3.1-2 of the LRA.

The long-lived, passive pressure boundary components in this system that are subject to AMR are fabricated of low-alloy steel with stainless steel cladding (vessel bottom heads, vessel shells, top heads, nozzles); low-alloy steel without stainless steel cladding (top head enclosure head flanges); Alloy 600 (penetrations including CRD stub tubes penetrations); stainless steel (nozzle safe ends, penetrations, vessel shell attachment welds); Alloy 82/182 (nozzle safe ends); high-strength, low-alloy steel (top head enclosure studs and nuts, closure bolting);

carbon steel (nozzle safe ends, penetrations); and low-alloy steel (support skirts and attachment welds).

The operating environments are reactor coolant water up to 288 °C (550 °F); steam at 288 °C (550 °F); leaking reactor coolant water and/or steam at 288 °C (550 °F); ambient air and humidity at metal temperatures up to 288 °C (550 °F); and containment nitrogen.

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

- crack initiation and growth due to SCC, IGSSC, and cyclic loading
- cumulative fatigue damage
- loss of fracture toughness due to neutron embrittlement of beltline materials
- loss of material due to wear

In LRA Table 3.1-2 and Aging Management Review Aid Table 2.3.1-1, the applicant also listed the following reactor vessel system components for which no aging effect (except cumulative fatigue damage and loss of fracture toughness in the beltline region) is identified:

- external surfaces of carbon steel reactor vessel components exposed to containment nitrogen environment

- carbon steel drain line penetrations exposed to reactor coolant water up to 288 °C (550 °F)

- low-alloy steel nozzles, head flanges, and vessel shells with or without stainless steel cladding exposed to 288 °C (550 °F) steam

- Low-alloy steel nozzles, vessel shells and penetrations, and vessel bottom heads exposed to reactor coolant water at 288 °C (550 °F)

Aging Management Programs

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

- Bolting Integrity Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- Feedwater Nozzle Program
- Control Rod Drive Return Line Nozzle Program
- BWR Penetrations Program
- Reactor Head Closure Studs Program
- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
- BWR Vessel ID Attachment Welds Program
- Reactor Vessel Surveillance Program

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

Aging Effects

The aging effects for the reactor pressure vessel follow:

- crack initiation and growth due to SCC, IGSCC, and cyclic loading
- cumulative fatigue damage
- loss of fracture toughness due to neutron embrittlement of beltline materials
- loss of material due to wear

The applicant identified cracking due to SCC, IGSCC, and cyclic loading as an applicable aging effect for the closure bolting, reactor vessel nozzle safe ends, vessel penetrations including CRD stub tubes, feedwater nozzle, reactor head closure studs and nuts, and vessel shell attachment welds. This identification of cracking as an applicable aging effect is consistent with Sections IV.A1 and IV.C1 in NUREG-1801, as well as with the BWRVIP reports (BWRVIP-27, BWRVIP-48, BWRVIP-74, and BWRVIP-75).

LRA Table 3.1-1 (Reference Nos. 3.1.2.37 and 3.1.2.59) identifies cracking as an applicable aging effect for a vessel head enclosure cladded with austenitic stainless steel, but NUREG-1801 does not. In RAI 3.1-1, the staff requested the applicant to submit industry-wide and plant-specific operating experience with the cladded vessel head enclosures and identify the locations where cracking had occurred (cladding, weld metal, base metal). The staff also requested the applicant to describe the methodology for detecting cracking and monitoring crack growth and, if cracking is not planned to be repaired prior to the end of the current license, provide an analysis or inspection program that will monitor the crack and provide a basis for concluding that the ISI program will detect cracks. The staff further requested that the applicant evaluate the cracking of the vessel head enclosure in accordance with the 10 CFR Part 54.3, TLAA criteria. In response to RAI 3.1-1, in a letter dated October 3, 2003, the applicant provided the following information:

- In 1990, Quad Cites Unit 2 visually detected defects (stain patches) at various points on the RPV head cladding. Dye penetrant and UT examinations were performed to determine the extent of the defects. The defects (cracks) were a maximum depth of approximately 6 mm in the base material. The cracking was attributed to IGSCC and possibly hot cracking. Subsequent examinations in 1990, 1992, and 1995, using ultrasonic through-wall sizing and VT-1 and VT-3 methods, have indicated no change (no evidence of growth, increased severity, or decrease in component integrity).

- In 1992, Vermont Yankee observed rust patches in the RPV head. This inspection was performed to address the Quad Cites Unit 2 operating experience. The indications were located primarily in the area of the flange, which had been clad by manual welding. There was no evidence of cracking in the base material. The indications were fine, branched cracks in the cladding, which is consistent with IGSCC.

The applicant further stated that Dresden and Quad Cities will continue to monitor the RPV head cladding using the VT methods (VT-3) described in ASME Section XI, IWB-2500-1, Item B13.10. Once cracking occurs in the cladding, the ferritic material under the cladding becomes exposed to the reactor water and steam environment and begins to oxidize or rust. The rust seeps back through the cracked surface providing a readily detectable stain. The visual examination required by ASME Section XI was the method used to detect the evidence of cracking (stain patches) at both Quad Cities and Vermont Yankee. The staff finds the use of the VT-3 method to detect cracking in the cladding acceptable because this method can easily detect stain patches resulting from rusting of ferritic material under the cracked cladding, which allows the reactor water and steam environment to penetrate to the ferritic base metal and oxidize it. However, the VT-3 method cannot monitor the growth of the existing cracks. Therefore, the applicant needs to provide a method for sizing the flaws identified in the vessel head enclosure cladded with stainless steel during the period of license renewal. This program must satisfy the 10 elements of Branch Technical Position RLSB-1, and include, at a minimum, the frequency, acceptance criteria, and qualifications of the inspection method. In response to Supplemental RAI 3.1-1 in a letter dated December 17, 2003, the applicant stated that one additional ultrasonic examination of the Quad Cities, Unit 2 reactor vessel head cladding will be performed in 2018 (plus or minus 2 years), to verify that the relevant indication has remained essentially unchanged. This is Commitment #7 in Appendix A of this SER. Previously, the cracking was inspected using Ultrasonic-Through-Wall Sizing, with the last inspection completed in 2000. The initial indication, 1990, was evaluated in accordance with ASME Code, Section XI, IWB-3142, which allows "Acceptance by Analytical Evaluation," proved subsequent examinations of IWB 2420(b) and (c) were performed. IWB-2420(c) states that if the reexaminations required by IWB-2420(b) reveal that the relevant indication remains essentially unchanged for the three consecutive examinations, the component examination schedule may revert to the original schedule for successive examinations. Since the three successive examinations confirmed that the indication remained essentially unchanged, the original VT-3 examination in accordance with ASME Code, Section XI was rescheduled for successive examinations. This one time volumetric inspection, in addition to the scheduled VT-3 examinations, is acceptable because IGSSC of the low alloy steel head is not considered a significant aging effect, the design is robust, and operating experience is benign as previous years have shown. Therefore, this is a confirmatory inspection (Confirmatory Item #7), and the one time inspection is considered to be acceptable and appropriate to confirm that the cracking is not growing.

The applicant evaluated cracking as a potential TLAA in accordance with 10 CFR Part 54.3 and concluded that this was not a TLAA because the analysis did not involve time-limited assumptions defined by the current operating term at Dresden. In addition, the analysis was not contained or incorporated by reference in the CLB at Quad Cities. The staff accepts the applicant's conclusion that the cracking of RPV head cladding is not a TLAA because it does not satisfy the definition of a TLAA according to 10 CFR 54.3.

The applicant stated that the CRD return line nozzles at D/QCNPS are capped, and therefore, are not susceptible to cracking due to cyclic loading. The staff finds this acceptable because the capped nozzle will not be subjected to cyclic loading due to thermal stratification and striping. However, the cap and applicable weld may experience cracking due to SCC and the applicant must provide a program to manage this cracking. The staff needs the following information from the applicant so that it can evaluate the aging management of the capped CRD nozzles—(1) description of the configuration and location of the capped nozzle including the existing base material for the nozzle, piping (if piping remnants exist) and cap material, and any welds and material type (i.e., 82/182), (2) description of how these welds and caps are managed (e.g., the applicability of the BWRVIP-75 inspection requirements); and (3) discussion on whether the event at Pilgrim (leaking weld at capped nozzle, September 30, 2003) is applicable to Dresden and Quad Cities. A description of the Pilgrim event is discussed in LER 2003-006-00, dated November 24, 2003, which states that the cracking was in an 82/182 weld metal that was repaired extensively. The applicant also needs to include in the discussion the past inspection techniques applied, the results obtained, mitigative strategies followed, weld repairs carried out, and any other relevant information (Confirmatory Item 2.3.4.2-3).

In LRA Table 3.1-1, the applicant identified cumulative fatigue damage as an applicable aging effect for nozzles and their safe ends, vessel penetrations, support skirts and attachment welds, top head flanges, vessel flanges, vessel shells, including upper shell, intermediate nozzle shell, intermediate beltline shell, and lower shell, and vessel bottom heads. However, it is not clear whether this identification of cumulative fatigue damage as an aging effect applies to all four units (Dresden Units 2 and 3 and Quad Cities Units 1 and 2). Table 2.3.1-1 of the Aging Management Review Aid provided by the applicant identifies cumulative fatigue damage as an aging effect for support skirts exposed to ambient temperature air, but not for the ones exposed to containment nitrogen. In RAI 3.1-2, the staff requested the applicant to confirm whether the identification of cumulative fatigue damage as an aging effect applies to all four units. If not, the applicant was requested to provide a technical explanation. The staff also requested the applicant to identify the containment environment in each unit. In response to RAI 3.1-2, in a letter dated October 3, 2003, the applicant stated that the aging effect of cumulative fatigue damage does apply to all four units (Dresden Units 2 and 3 and Quad Cities Units 1 and 2). The applicant further stated that at all four units, the primary containment (drywell and suppression pool) atmosphere is made inert with nitrogen to render the primary containment atmosphere nonflammable by maintaining the oxygen content below 4 percent by volume during normal operation. The drywell has an average temperature of 57 °C (135 °F) during normal operations. The relative humidity in the drywell ranges between 20 percent and 90 percent. The staff finds the applicant's identification of cumulative fatigue damage as an applicable aging effect for the vessel components at all four D/QCNPS units acceptable because it is consistent with NUREG-1801, Chapter IV.A1, as well as with BWRVIP-74.

The applicant, however, did not identify cumulative fatigue damage as an applicable aging effect for stabilizer brackets, the external attachment weld between reactor pressure vessel and refueling bellows, and the reactor vessel closure studs, although BWRVIP-74 does identify such aging effects. In addition, the applicant does not identify cumulative fatigue damage as an applicable aging effect for closure bolting, but NUREG-1801 (Item C1.2-f, Chapter IV.C1) does. In RAI 3.1-3, the staff requested the applicant to submit an explanation of why cumulative fatigue damage is not identified as an applicable aging effect for stabilizer brackets, the external attachment weld between reactor pressure vessel and refueling bellows, the reactor vessel closure studs, and closure bolting. The staff further requested the applicant to provide an appropriate program for managing cumulative fatigue damage, if this effect is identified as an applicable aging effect for these components.

In response to RAI 3.1-3, in a letter dated October 3, 2003, the applicant stated that for Dresden and Quad Cities there are no CLB TLAAs that evaluate cumulative fatigue of the RPV stabilizer brackets or of the external attachment weld between reactor pressure vessel and refueling bellows. The applicant provided the following additional explanation about the weld between the reactor pressure vessel and refueling bellows. The refueling bellows attached to the reactor pressure vessel prevent leakage from the flooded reactor cavity into the drywell during refueling operations. However, the function of preventing leakage into the drywell during refueling operations is not a safety related function and failure of the vessel-to-bellows weld cannot cause failure of a safety related function. Therefore, the refueling bellows are not within the scope of license renewal. Consequently, the external attachment weld between the reactor pressure vessel and the refueling bellows is not within the scope of license renewal. The staff finds the applicant's explanation for not identifying cumulative fatigue damage as an aging effect for the RPV stabilizer brackets and the external attachment weld between the RPV and refueling bellows acceptable because they are not in scope of license renewal.

Regarding the reactor vessel closure studs, the applicant stated that LRA Table 2.3.1-1, "Component Groups Requiring Aging Management Review —Reactor Vessel," should have included Aging Management Reference 3.1.1.1 in the Top Head Enclosure (Closure Studs and Nuts) line. The applicant further pointed out that LRA Section 4.3.1, "Reactor Fatigue Analysis," identifies the reactor vessel closure studs as components that may experience cumulative fatigue damage. The reactor vessel closure studs are included in the Fatigue Monitoring Program that is described in Section 4.3.1 of the LRA. The staff finds the applicant's response acceptable because LRA Section 4.3.1 does identify the RPV studs as components that experience cumulative fatigue damage. This evaluation is presented in Section 4.3.1 of this SER.

Regarding closure bolting, the applicant stated that Item C1.2-f, Chapter IV.C1, of NUREG-1801 is the closure bolting for the recirculation pump. The aging effect of cumulative fatigue for the recirculation pumps' closure bolting is shown in LRA Table 3.1-1, Aging Management Reference 3.1.1.1, which links to the Closure Bolting line of LRA Table 2.3.1-5, "Component Groups Requiring Aging Management Review—Recirculation System." The staff finds the applicant's response acceptable because the LRA does identify cumulative fatigue damage as an applicable aging effect for closure bolting.

The applicant identified loss of fracture toughness as an applicable aging effect for the reactor pressure vessel flange, intermediate beltline shell, beltline welds, intermediate nozzle shell, lower shell, and upper shell. NUREG-1801, however, identifies this aging effect only for the intermediate beltline shell and beltline welds. In RAI 3.1-4, the staff requested the applicant to identify the components that are expected to have neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV) by the end of the extended period of operation. In response to RAI 3.1-4, in a letter dated October 3, 2003, the applicant identified the following four components that are expected to have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV) by the end of the extended period of operation—lower shell, intermediate beltline shell, axial welds in these two shells, and girth weld between these two shells. The applicant identified LRA Appendix B.1.22, "Reactor Vessel Surveillance," as an AMP for managing loss of fracture toughness in these components. The staff finds the response acceptable because the identification of an AMP to manage loss of fracture toughness is consistent with NUREG-1801. However, it is not clear to the staff whether the applicant has taken into account the increased fluence on the RPV wall due to power uprates that have been implemented at D/QCNPS. In Supplemental RAI 3.1-4, the staff requested the applicant to clarify whether the fluence calculations for the reactor vessel included the effects of power uprates when determining which components are susceptible to loss of fracture toughness. In response to Supplemental RAI 3.1-4, in a letter dated November 21, 2003, the applicant stated that the fluence calculations for the reactor vessel did include the effects of power uprates when determining the components that are susceptible to loss of fracture toughness. The staff finds the response acceptable because it facilitates the proper identification of reactor vessel beltline shell and welds that are susceptible to loss of fracture toughness due to neutron irradiation embrittlement.

The applicant identified loss of material due to wear as an applicable aging effect for closure bolting. This is consistent with NUREG-1801 Chapter IV.C1. However, the applicant did not identify loss of preload as an aging effect for closure bolting in the reactor vessel system. In LRA Section 3.1.1.2.2, the applicant referred to EPRI 1003056, Revision 3, which states that loss of preload mechanisms are typically addressed during installation and subsequent maintenance of closure bolting. The EPRI report further states that as the loss of preload is a design driven effect, it is not an applicable aging effect and does not require aging management. Loss of preload, however, may take place during operation when closure bolting is subject to stress relaxation, cyclic loads, and differential thermal expansion. NUREG-1801, Chapter XI.M18, "Bolting Integrity," requires this program to include periodic inspection of closure bolting for indication of loss of preload. In RAI 3.1-13, the staff requested the applicant to explain why periodic inspection of the closure bolting for indication of loss of preload due to the aforementioned mechanisms is not required. The staff further requested the applicant, if periodic inspection is required, to reference the appropriate AMP and include the appropriate inspection in the AMP.

In response to RAI 3.1-13, in a letter dated October 3, 2003, the applicant stated that Exelon will manage the loss of preload for closure bolting in the reactor vessel system and other systems, such as recirculation pumps, reactor recirculation valves, and reactor vessel head vent valves, and the reactor pressure boundary portion of all other systems. This is part of Commitment #12 of Appendix A in this SER. The applicant further stated that AMP, LRA Appendix B.1.12, "Bolting Integrity," will be enhanced to include periodic inspections of the closure bolting in accordance with the ASME Code Section XI requirements. This part of Commitment #12 of Appendix A in this SER. Closure bolting will be periodically inspected for signs of leakage. The enhanced Bolting Integrity Program will be comprised of periodic ISI and piping and component preventive maintenance inspections. These activities will detect early leakage and material degradation of closure bolting (that may be caused by loss of material or cracking) prior to loss of system or component intended functions.

The staff finds the response not completely acceptable because LRA Section 3.1.1.2.1 does not address loss of preload as an aging effect, and states that loss of preload mechanisms is typically addressed during installation and subsequent maintenance of closure bolting. However, the applicant's response to RAI 3.1-13 stated that loss of preload will be managed, and that the enhanced Bolting Integrity Program will be comprised of periodic ISI and piping and components preventative maintenance inspections.

In Supplemental RAI 3.1-13, the staff requested the applicant to describe the maintenance program activities that are performed on the bolts so that loss of preload is significantly reduced or eliminated, and to identify whether retorquing of the bolts to the design preload values is performed after the component is reassembled. In response to Supplemental RAI 3.1-13, in a letter dated November 21, 2003, the applicant stated that the Exelon procedure governing "Torquing and Tightening of Bolted Connections" requires the inspection and documentation of closure bolting connections prior to disassembly for signs of leakage; missing, cracked, degraded or loose bolts or nuts; misalignment of connection; gasket condition; and corrosion. When closure bolting connections are disassembled for maintenance, bolts are loosened in two increments using a crossing sequence to prevent distortion of the mating surfaces. Bolts, studs, and washers are cleaned of corrosion, grit, and dried lubricant. They are also inspected for galling of threads or nut facing, dings and dents in threads, cracks, pits, erosion, corrosion, bent bolts, dished or galled washers, and elongation. If damaged bolts, studs, nuts or washers are found, they are replaced or repaired. Prior to reassembly, the correct torque value is determined from history that has been validated by successful performance, design drawings, vendor prints, plant design specification, or procedures. When required by design drawings, vendor prints, plant design specifications, or procedures, approved lubricant is applied to the bolts, studs, and nuts. Bolts or nuts are first hand tightened using a crossing sequence and then torque tightened using a diametrically opposed pattern in three passes (ALARA areas) or four passes (non-ALARA areas). This is part of Commitment #12 of Appendix A of this SER.

Conditions that involve leakage, insufficient gasket compression, or other situations that require torque values to be increased require engineering review. All torque values are documented. The staff finds the applicant's response acceptable because the applicant's procedure governing torquing and tightening of bolted connections ensures that the loss of preload will be eliminated or reduced when the bolted connections are reassembled.

The staff finds that the applicant's identification of no aging effect (except cumulative fatigue damage and loss of fracture toughness in the beltline region) for the low-alloy steel vessel shells, nozzles, and flanges internally exposed to 288 °C (550 °F) steam or reactor coolant water is acceptable because it is supported by the industry operating experience and it is consistent with GALL. However, the applicant's identification of no aging effect for the external surface of carbon steel reactor vessel components exposed to a containment nitrogen environment is not acceptable because the BWR containment environment typically has high humidity. The carbon steel components exposed to this environment may experience loss of material due to corrosion. In RAI 3.1-5, the staff requested the applicant to explain why loss of material is not identified as an aging effect for these components, or provide a program for managing that effect. In response to RAI 3.1-5, in a letter dated October 3, 2003, the applicant first described the environment of the drywell and then explained why loss of material is not an applicable aging effect for the carbon steel RPV components exposed to the containment environment. The drywell is made inert with nitrogen to render the primary containment atmosphere nonflammable by maintaining the oxygen content below 4 percent by volume during normal operation. The drywell has an average temperature of 135 °F during normal operations. The relative humidity in the drywell ranges between 20 percent and 90 percent.

According to EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," loss of material due to corrosion is not considered a credible aging effect for carbon steel components in a containment nitrogen environment because of the negligible amounts of free oxygen (less than 4 percent). Both oxygen and moisture must be present for general corrosion to occur because oxygen alone or water free of dissolved oxygen (high humidity in a nitrogen atmosphere) does not corrode carbon steel to any practical extent. The staff finds the applicant's identification of no loss of material for the carbon steel components exposed to a containment nitrogen environment acceptable because, with the negligible amounts of free oxygen, anodic reactions do not take place and the corrosion cell does not form. Therefore, no loss of material due to corrosion takes place.

The applicant's identification of no aging effect for the carbon steel drain line penetrations exposed to reactor coolant water up to 288 °C (550 °F) is not acceptable because the drain line is likely to experience loss of material due to corrosion. This assessment is consistent with Item D2.1-a, Chapter V.D2, of NUREG-1801. In RAI 3.1-6, the staff requested the applicant to explain why loss of material is not an applicable aging effect for the drain line, or provide a program for managing such effect. In response to RAI 3.1-6, in a letter dated October 3, 2003, the applicant states that the drain line penetration is an unclad hole drilled into the reactor vessel bottom head with an unclad carbon steel nozzle welded to the outside of the vessel bottom head. The applicant further stated that Aging Management Reference 3.1.2.58 should have shown loss of material/general, pitting, and crevice corrosion as an applicable aging effect. The applicant identified the ASME Section XI Inservice Inspection (LRA Appendix B.1.1) and Water Chemistry (LRA Appendix B.1.2) Programs for managing this aging effect. The staff finds the response acceptable because the applicant has identified loss of material as an applicable aging effect and provided the AMPs that are consistent with GALL to manage the applicable aging effects.

The aging effects identified in the LRA for the reactor vessel, pending satisfactory resolution of Confirmatory Item 2.3.4.2-3, are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credits the following programs for managing aging in the reactor pressure vessels. The staff reviewed these programs in the sections of the SER listed in the parentheses.

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program(Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- Reactor Head Closure Studs Program (Section 3.1.2.3.1)
- BWR Vessel ID Attachment Welds Program (Section 3.1.2.3.2)
- Feedwater Nozzle Program (Section 3.1.2.3.3)
- Control Rod Drive Return Line Nozzle Program (Section 3.1.2.3.4)
- BWR Penetrations Program (Section 3.1.2.3.5)
- Reactor Vessel Surveillance Program (Section 3.1.2.3.8)

The first four AMPs (ASME Section XI Inservice Inspection, Water Chemistry, BWR Stress Corrosion Cracking, and Bolting Integrity) are credited with managing the aging effects in several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and, pending satisfactory resolution of the associated RAIs, found them to be acceptable for managing the aging effects identified for reactor pressure vessels. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The remaining six AMPs are credited with managing aging effects only in reactor pressure vessels and the staff's evaluation of those AMPs is documented in Section 3.1.2.3 of this SER.

The applicant credited the BWR Stress Corrosion Cracking (LRA Appendix B.1.7) and Water Chemistry (LRA Appendix B.1.2) Programs for managing cracking due to IGSCC in reactor vessel safe ends. The BWR Stress Corrosion Cracking Program is based on BWRVIP-75, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules." In RAI B.1.7-a, the staff requested the applicant to submit information about its plant-specific experience related to IGSCC cracking of the reactor vessel safe ends and reactor coolant pressure boundary piping, mitigative actions taken, and the revised inspection schedules following the

BWRVIP-75 guidelines. The staff also requested the applicant to submit information about whether hydrogen water chemistry (HWC) and noble metal chemical application (NMCA) are implemented at D/QCNPS and how this implementation has affected monitoring of water chemistry parameters. The applicant's response to this RAI is evaluated in Section 3.1.2.4.3 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor vessel will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, pending satisfactory resolution of Confirmatory Item 2.3.4.2-3, 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).

3.1.2.4.2 Reactor Vessel Internals (Including Fuel Assemblies and Control Blades)

Summary of Technical Information in the Application. The description of the reactor pressure vessel internals can be found in Section 2.3.1.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.1-2. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2.

The long-lived, passive reactor internals that are subject to an AMR are fabricated of Alloy 600 and Alloy 82/182 weld metal (welded and mechanical access hole covers, shroud support structures); cast austenitic steel (jet pump assemblies, orificed fuel structural supports); Alloy X750 (jet pump holddown beams); and stainless steel (CRD tubes and housing, core plates and bolts, core shrouds, core spray lines and spargers, incore instrumentation dry tubes and guide tubes, jet pump assemblies, orificed fuel support pieces, orificed fuel structural supports, reactor internal modifications/repair hardware/structural support, top guides). The operating environments are high-purity water at 288 °C (550 °F) and reactor coolant water up to 288 °C (550 °F).

The description of the fuel assemblies and control blades can also be found in Sections 2.3.1.2 of this SER. The applicant stated that fuel assemblies and control blades do not require AMR because they are short-lived.

Aging Effects

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

- crack initiation and growth due to SCC, IGSCC, and IASCC
- cumulative fatigue damage
- loss of fracture toughness due to thermal aging and neutron irradiation embrittlement

Aging Management Programs

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

- ASME Section XI Inservice Inspection Program

- Water Chemistry Program
- BWR Vessel Internals Program
- Thermal Aging and Neutron Irradiation Embrittlement Program

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

The staff accepts the applicant's determination that the D/QCNPS fuel assemblies and control blades do not require aging management because these components are short-lived.

Aging Effects

The aging effects for the reactor vessel internals are as follows:

- crack initiation and growth due to SCC, IGSCC, and IASCC
- cumulative fatigue damage
- loss of fracture toughness due to thermal aging and neutron irradiation embrittlement

The applicant identified cracking due to SCC, IGSCC, and IASCC for all the vessel internals except orificed fuel support pieces. This is consistent with Chapter IV.B1 of NUREG-1801. However, some additional information is needed. The applicant has identified core spray line and spargers and jet pump assemblies as two of the vessel internals. The applicant needs to confirm whether the following subcomponents, which are identified in Appendix C of BWRVIP-18, are included as part of the core spray line and spargers for aging management—junction or tee box connections at the vessel nozzle or shroud penetration, sparger spray nozzle, support bracket, and thermal sleeve. Since the staff needed similar confirmation for the vessel internals addressed by other BWRVIP documents that the applicant has referenced in the LRA, the staff issued a generic request for information, RAI 4.2-BWRVIPS, requesting the applicant to verify that D/QCNPS is bounded by the BWRVIP documents referenced in the LRA. The evaluation of the applicant's response to this RAI is presented in Section 3.1.2.3.2 of this SER and the staff has found the response acceptable pending satisfactory resolution of Confirmatory Item3.1.2.3.2-1.

In RAI 2.3.1.2-5, the staff requested the applicant to identify all the components included in component group, "Jet Pump Assemblies," and explain why jet pump sensing lines are not within the scope of license renewal. In response to RAI 2.3.1.2-5, in a letter dated December 22, 2003, the applicant identified the following components that are included in the jet pump assemblies—thermal sleeve, inlet header, riser brace arm, hold-down beams, inlet elbow, mixing assemblies, and diffuser. The staff compared the applicant's response to the list of BWR jet pump assembly components that are within the scope of license renewal as identified in Appendix A (Section A.2) of BWRVIP-41. The staff finds that the applicant has not identified the transition piece, riser pipe, adapter, and restrainer bracket as within scope. The applicant needs to provide an explanation for not including these four components in component group, "Jet Pump Assemblies." In response to Supplemental RAI 2.3.1.2-5, the applicant stated that the transition piece, riser pipe, adapter, and restrainer bracket are included in the Component Group "Jet Pump Assemblies." The previous response considered the transition piece and riser pipe to be part of the inlet header and the adapter as part of the part of the diffuser. The restrainer bracket was not specifically identified, but is part of the assembly. The staff finds the applicant's response acceptable because it identifies all of the required components addressed in BWRVIP-41. The applicant's explanation for not including jet pump sensing lines within the scope of license renewal is evaluated in Section 3.1.2.2.4(2) of this SER and is found acceptable.

D/QCNPS have used extended power uprates to increase the power output of each of the four units by about 17 to 18 percent (NRC Fact Sheet on Power Uprates for Nuclear Plants, February 2002). Such increase in power may increase the fluence on vessel internals, and the sites on some of the components that were not susceptible to IASCC may become susceptible. The final license renewal SER for BWRVIP-26 states that the threshold fluence level for IASCC is 5×10^{20} n/cm^2 (E > 1 MeV). In RAI 3.1-7(a), the staff requested the applicant to explain whether this increase in power has been accounted for in performing AMR of vessel internals. The staff also requested the applicant to identify the vessel internals whose fluence at the end of the extended period of operation may exceed the threshold level and become susceptible to cracking due to IASCC. In response to RAI 3.1-7(a), in a letter dated October 3, 2003, the applicant stated that the fluence calculations prepared specifically for the Dresden and Quad Cities LRA included the effects of extended power uprate. The top guide, shroud, and the incore instrumentation guide tubes and dry tubes may exceed the threshold fluence value of 5×10^{20} n/cm^2 (E > 1 MeV) by the end of the period of extended operation. As such, these components will require aging management. The AMPs used to manage the IASCC aging effect are LRA Appendices B.1.2, "Water Chemistry," and B.1.9, "BWR Vessel Internals." The staff finds the response acceptable because LRA Appendix B.1.9 indicates that the applicant will follow the recommendations of the related BWRVIP documents, and the applicant's inspection program considers the effects of IASCC as discussed in this section and Section 3.1.2.3.6.

The applicant identified cumulative fatigue damage as an applicable aging effect for core plates; core spray line and spargers; jet pump assemblies; orificed fuel supports; top guides; and incore instrumentation dry tubes and guide tubes. This identification of the aging effect is consistent with Chapter IV.B1 of NUREG-1801.

The applicant identified loss of fracture toughness due to thermal aging and neutron irradiation embrittlement as an applicable aging effect for castings in jet pump assemblies and CASS orificed fuel supports. This identification of the aging effect is consistent with Items B1.4-c and B1.5-b, Chapter IV.B1, of NUREG-1801.

The aging effects identified in the LRA for the reactor vessel internals are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs to manage the aging effects described above for the reactor vessel internals. The staff reviewed these programs in the sections of the SER listed in parentheses:

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)

- Water Chemistry Program (Section 3.0.3.2)
- BWR Vessel Internals Program (Section 3.1.2.3.6)
- Thermal Aging and Neutron Irradiation Embrittlement Program (Section 3.1.2.3.7)

The first two AMPs (ASME Section XI Inservice Inspection and Water Chemistry) are credited with managing the aging effects in several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and, pending satisfactory resolution of the associated RAIs, found them acceptable for managing the aging effects identified for the reactor vessel internals. The staff's evaluation of these AMPs is documented in Section 3.0 of the SER. The remaining two AMPs are credited with managing aging effects only in the reactor vessel internals and the staff's evaluation of those AMPs is documented in Section 3.1.2.3.6 and 3.1.2.3.7 of the SER.

The reactor vessel internals that may receive neutron fluence greater than the threshold fluence for IASCC (5×10^{20} n/cm^2 [E > 1 MeV]) by the end of the extended period of operation are susceptible to cracking due to IASCC. Per license renewal SER for BWRVIP-26, the accumulated neutron fluence is a TLAA issue for these vessel internals. The SER for BWRVIP-26 further states that the applicant must identify and evaluate this TLAA issue. In RAI 3.1-7b, the staff requested the applicant to submit identification and evaluation of the accumulated neutron fluence received by the D/QCNPS vessel internals at the end of license period as a TLAA issue.

In response to RAI 3.1-7b, in a letter dated October 3, 2003, the applicant stated that as mentioned in the response to RAI 3.1-7a above, fluence calculations were prepared for the reactor vessel and internals, including the effects of extended power uprate. Three components have been identified as being susceptible to IASCC for the period of extended operation—(1) top guide, (2) shroud, and (3) incore instrumentation dry tubes and guide tubes. As such, these components will require aging management as discussed above.

However, contrary to the direction contained in the SER for BWRVIP-26, this technical issue does not qualify as a TLAA. Specifically, the analysis is not contained or incorporated by reference in the CLB for either site. As such, it does not satisfy Criterion (6) of 10 CFR 54.3, "Definitions, Time Limited Aging Analyses." Dresden and Quad Cities stations will implement the BWRVIP recommendations and manage the effects of aging of IASCC through AMPs B.1.2 (Water Chemistry) and B.1.9 (BWR Vessel Internals). Therefore, the staff agrees that 10 CFR 54.21(c)(1)(iii) allows the applicant to manage the effects of aging on the intended functions for the period of extended operation in lieu of performing a TLAA evaluation. The response to RAI 3.1.7b states that Dresden and Quad Cities will implement the BWRVIP recommendations and manage the effects of aging of IASCC through AMPs B.1.2 (Water Chemistry) and B.1.9 (BWR Vessel Internals). AMP B.1.9 is consistent with NUREG-1801 which references the use of BWRVIP-26 for the inspection of the reactor vessel internals, including the top guide, and BWRVIP-76 for the inspection of the shroud. However, according to Table 2-1 of BWRVIP-76, when fluences exceed 5×10^{20} n/cm^2, a plant-specific analysis is required to be submitted to the NRC. The applicant needs to submit this analysis to the staff (Confirmatory Item 3.1.2.4.2-1).

BWRVIP-47, which was approved by the staff in an SER dated December 7, 2000, does not require inspections of the incore instrumentation dry tubes and guide tubes because of the service history and minimal safety consequence of the tube failure. However, by letter dated

December 22, 2003, the applicant stated that the program is enhanced by inspecting the incore instrumentation dry tubes every outage in accordance with GE SIL-409, Revision 1, for this specific GE dry tube model. SIL 409 recommends that dry tubes with detected cracks be replaced. Inspection of the SRM and IRM dry tubes/guide tubes to detect the aging effects of IASCC are included in EXELON AMP B.1.9, BWR Vessel Internals. Inspection of the dry tubes that have not been replaced are performed in accordance with the recommendations of SIL-409 during each refueling outage. Exelon has replaced incore dry tubes during refueling outages. When a dry tube is replaced, the inspection interval for the replacement dry tube is extended to 20 years as recommended by SIL-409. After the 20 year inspection has been completed, additional inspections are performed once every 4 years. The staff finds that the applicant exceeds the inspection requirements of NUREG-1801 for the incore instrumentation dry tubes. Inspection of the top guide is discussed in Section 3.1.2.3.6. Therefore, the staff finds that the applicant is managing the IASCC aging effect by inspection programs, in lieu of performing a TLAA evaluation, in accordance with the requirements of 10 CFR 54.21(c)(1)(iii).

The applicant credited ASME Section XI Inservice Inspection Program for managing cracking in the welded access hole covers due to SCC. This program requires visual inspection for detecting cracking. However, a crevice may be present near the weld and visual inspection is not adequate for detecting cracking initiated in the crevice region. Therefore, in RAI 3.1-8, the staff requested the applicant to provide a justification for why an augmented inspection technique that includes UT or another demonstrated acceptable inspection method for the welded access hole cover is not required, or to provide augmented inspection as specified in NUREG-1801, Item IV.B1.1.4. In response to RAI 3.1-8, in a letter dated October 3, 2003, the applicant stated that the augmented inspection technique discussed in NUREG-1801, Item IV.B1.1.4, is applicable to welded access hole covers. Since Dresden Unit 2 and Quad Cities Units 1 and 2 have replaced the welded access hole covers with mechanical covers, the augmented inspections are not required on these units. The Dresden Unit 3 welded access hole covers are inspected visually and augmented by ultrasonic examination consistent with the requirements of GE SIL 462, "Shroud Access Cover Cracking and Radial Cracking," Revision 1, as specified in NUREG-1801, Item IV.B1.1.4. This inspection is specified in LRA Table 3.1-1, Reference No.3.1.1.18. This response is acceptable to the staff because the applicant is inspecting the welded access hole covers with ultrasonic examination as recommended by GE SIL 462, Revision 1, and NUREG-1801, Item IV.B1.1.4.

In RAI 4.2-Flaw Evaluation, the staff requested the applicant to confirm whether there have been any flaws that were left in service based on ASME Code Section XI analysis techniques. If so, the staff requested the applicant to confirm whether it considered such analyses as potential TLAAs. In response to RAI 4.2-Flaw Evaluation, in a letter dated October 3, 2003, the applicant confirmed that flaws have been left in service based on ASME Code Section XI analysis techniques. The applicant further confirmed that the analyses associated with such flaws were reviewed and considered as potential TLAAs. However, none of these flaw analyses were determined to be TLAAs because the analyses did not satisfy Criterion (3) of 10 CFR 54.3, "Definitions, Time Limited Aging Analyses"; that is, the analyses did not involve time-limited assumptions defined by the current operating term.

The staff agrees that this is not a TLAA issue because the VIP program allows flaws to be left in service and defines an inspection interval based on the size and amount of flaws left in service in lieu of a 40-year analysis. For example, BWRVIP-76 defines the inspection interval by percent cracking and does not include an analysis for 40 years. Since there is no 40-year evaluation on the flaw, a TLAA evaluation is not required. The staff finds the response acceptable because the applicant has submitted the requested information. The staff accepts the applicant's determination that the analyses of the flaws left in service are not TLAAs because those analyses do not satisfy the definition of TLAA and are managed by an AMP in accordance with the requirements of 10 CFR 54.21(c)(1)(iii).

On the basis of its review, pending satisfactory resolution of Confirmatory Items 3.1.2.3.2-1 and 3.1.2.4.2-1, the staff finds that the AMPs credited in the LRA for the reactor vessel internals will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, pending satisfactory resolution of Confirmatory Items 3.1.2.3.2-1 and 3.1.2.4.2-1, the staff finds 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).

3.1.2.4.3 Reactor Coolant System—Recirculation System

Summary of Technical Information in the Application. The description of the reactor recirculation system, recirculation flow control, and motor/generator (M/G) sets can be found in Section 2.3.1.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.1-5 and are discussed in LRA Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System." The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2. LRA Table 2.3.1-5 also identifies the intended functions for the components listed and provides aging management reference links to LRA Tables 3.1-1 and 3.1-2. In a letter, dated February 7, 2003, from P.R. Simpson, Exelon, to NRC, D/QCNPS sent corrections to LRA Table 2.3.1-5. The corrections included deletion of aging management reference links that do not apply to certain component groups of the reactor recirculation system and the addition of a few aging management reference links that were found missing for some component groups.

Aging Effects

The system consists of all recirculation piping connected to the reactor vessel, along with associated valves, branch lines, and instrumentation. Also included are the recirculation flow control instrumentation and the recirculation M/G sets, fluid drive couplers, and the M/G set lubrication oil piping subsystem and oil coolers and their associated electrical controls. The system does not include the jet pumps or associated piping and instrument sensing lines that are inside the reactor vessel.

The long-lived, passive components in the recirculation system that are subject to an AMR are fabricated of stainless steel, CASS, low-alloy steel, carbon steel, brass, bronze, or glass (for sight glasses). The operating environments are reactor coolant water or steam at 288 °C (550 °F), oxygenated or demineralized water at temperatures up to 288 °C (550 °F), treated water, lubricating oil with contaminants, ambient air and humidity at metal temperatures up to 288 °C (550 °F), wet gas, saturated air, and containment nitrogen.

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the D/QCNPS operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the following aging effects in Tables 3.1-1 and 3.1-2 for the reactor recirculation system components subject to an AMR:

- cumulative fatigue damage
- crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading
- loss of material due to wear
- loss of material due to general, galvanic, pitting, and crevice corrosion
- loss of fracture toughness due to thermal aging embrittlement

In LRA Tables 2.3.1-5 and 3.1-2, the applicant also listed the following reactor recirculation system components for which no aging effect is identified:

- external surfaces of sight glasses exposed to air, moisture, and humidity (Table 3.1-2, Reference No. 3.1.2.5)

- external surfaces of stainless steel piping and fittings, dampeners, tubing, and valves exposed to air, moisture, and humidity (Table 3.1-2, Reference No. 3.1.2.7)

- external surfaces of stainless steel piping and fittings, flow element pumps, tanks, tubing, restricting orifices, thermowells, and valves exposed to containment nitrogen (Table 3.1-2, Reference No. 3.1.2.8)

- sight glasses exposed to water (Table 3.1-2, Reference No. 3.1.2.30)

- sight glasses exposed to lubricating oil (Table 3.1-2, Reference No. 3.1.2.31)

- sight glasses exposed to wet gas (Table 3.1-2, Reference No. 3.1.2.32)

Aging Management Programs

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following seven AMPs to manage the aging effects associated with the reactor recirculation system components:

- ASME Section XI Inservice Inspection Program
- Water Chemistry Program
- One-Time Inspection Program
- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program
- Structures Monitoring Program
- Compressed Air Monitoring Program

Staff Evaluation. The applicant described its AMR for the reactor recirculation system in Section 3.1 of the LRA. The staff reviewed this section to determine whether the applicant identified all the applicable aging effects for components in these systems and demonstrated that the effects of aging on the components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The applicant identified the following aging effects for the reactor recirculation system:

- cumulative fatigue damage (discussed below and in Section 4.3 of this SER)
- crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading
- loss of material due to wear
- loss of material due to general, galvanic, pitting, and crevice corrosion
- loss of fracture toughness due to thermal aging embrittlement

The applicant identified cumulative fatigue damage as an applicable aging effect for the recirculation system closure bolting, piping and fittings, recirculation pumps, and valves. The staff notes that this assessment is consistent with NUREG-1801. Cumulative fatigue damage is further evaluated in Section 4.3, “Metal Fatigue,” in Chapter 4 of this SER.

The applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for the recirculation system austenitic stainless steel components (piping and fittings, tubing, valve bodies, flow elements, thermowells, restricting orifices, and dampeners) and for the high-strength, low-alloy steel primary pressure closure bolting exposed to reactor coolant water. The applicant also identified this aging effect for cast stainless steel components exposed to reactor coolant water. The applicant identified crack initiation and growth due to thermal and mechanical loading as an applicable aging effect for small-bore stainless steel piping and fittings and low-alloy steel pressure boundary closure bolting in the reactor recirculation system. The staff notes that this assessment is consistent with NUREG-1801.

In LRA Section 3.1.1.1.5, the applicant stated that an inspection of small-bore reactor coolant piping is to be conducted in accordance with its One-Time Inspection Program to verify that service-induced weld cracking is not occurring in the small-bore piping less than 4 inches, including pipe, fittings, and branch connections. The applicant’s One-Time Inspection Program is described in LRA Section B.1.23, and the applicant stated that it is consistent with NUREG-1801, Chapter XI.M32, “One-Time Inspection.”

In Section 3.1.1.1.5 of the LRA, the applicant further stated that thermal stratification, thermal cycling and thermal stripping, thermal transients, and flow-accelerated corrosion are potential aging mechanisms for small-bore piping. The LRA also stated that a review of the Dresden and Quad Cities RI-ISI evaluations on degradation mechanism assessment demonstrated that only Dresden had a high failure potential on a small-bore pipe due to thermal fatigue. Therefore, one-time inspection will consist of an ultrasonic exam on one of the 2-inch drain lines off the Dresden main steam header. These lines are Class 1 and within the scope of license renewal.

The staff issued RAI 3.1-9(a) requesting the applicant to identify all Class 1 small-bore piping, describe a sampling plan based on RI-ISI evaluations, and specify AMPs for managing cracking in this piping due to SCC. This RAI and the staff’s evaluation of the applicant’s response are presented in Section 3.1.2.2.4 of this SER. The staff found the applicant’s response acceptable because the applicant had identified all Class 1 small-bore piping, presented an adequate sampling plan for inspection sites, and provided appropriate AMPs to manage cracking due to SCC.

The applicant identified loss of material due to wear as an aging effect for the reactor recirculation system high-strength, low-alloy steel bolting exposed to air with metal temperatures up to 288 °C (550 °F) and low-alloy steel bolting exposed to containment nitrogen. The staff notes that this assessment is consistent with NUREG-1801.

In LRA Table 3.1-2, the applicant identified loss of material due to various forms of corrosion as an aging effect for several reactor recirculation system components. The AMR results for these components are not presented in NUREG-1801, Chapter IV.C1, “Reactor Coolant Pressure Boundary (BWR).” However, AMR results for components with similar materials and environments can be found in other chapters of NUREG-1801 and are used here to evaluate the AMR results presented in LRA Table 3.1-2.

The applicant identified loss of material due to general corrosion as an applicable aging effect for the recirculation system carbon steel components exposed to moist air and humidity. The staff finds that this identification is consistent with Item E.2-a, Chapter V.E, of NUREG-1801.

The applicant identified loss of material due to general, crevice, pitting, and galvanic corrosion as an applicable aging effect for the recirculation system carbon steel components (piping, fittings, valves, filters/strainers, and restricting orifices) exposed to lubricating oil with contaminants and/or moisture. The staff finds that this identification is consistent with Item G.7-a, Chapter VII.G, of NUREG-1801.

The applicant identified loss of material due to general (carbon steel only), pitting, and crevice corrosion as an applicable aging effect for carbon steel exposed to treated water. The staff finds that this identification is consistent with Item C2.3-a, Chapter VII.C2, of NUREG-1801.

In LRA Table 3.1-2, the applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for stainless steel valves and carbon steel piping, fittings, and valves exposed to wet gas. In RAI 3.1-12, the staff requested that the applicant submit a description of the wet gas environment so that the staff can evaluate this aging effect. In response to RAI 3.1-12, in a letter dated October 3, 2003, the applicant stated that the wet gas environment is an air environment that contains moisture. The applicant referenced EPRI 1003056, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3,” in identifying the role of moisture in promoting various forms of corrosive attack, including loss of material due to general, pitting, and crevice corrosion. The staff finds the applicant’s response acceptable because it provides a description of the wet gas environment. The staff also verified that the reference cited by the applicant identifies the role of moisture in promoting loss of material due to general, pitting, and crevice corrosion.

The applicant identified loss of material due to pitting and crevice corrosion as an applicable aging effect for carbon steel valves and stainless steel tanks, tubing, restricting orifices, and piping and fittings exposed to reactor coolant water or oxygenated water with temperatures up to 288 °C (550 °F). The staff finds this identification of loss of material as an applicable aging effect, acceptable because pitting and crevice corrosion of carbon steel and stainless steel is possible due to a small amount of chloride generally present in the BWR water and saturated air environments.

The applicant identified loss of material due to corrosion as an applicable aging effect for stainless steel, bronze, and brass components exposed to air, moisture, humidity, and leaking fluid. The staff finds this identification of loss of material as an applicable aging effect, acceptable because trace levels of corrosive species (e.g., chlorides) are generally present in moist environments and leaking fluid.

The applicant identified the loss of fracture toughness due to thermal aging embrittlement as an applicable aging effect for CASS pump casings and valve bodies. The staff notes that this assessment is consistent with NUREG-1801. In LRA Table 3.1.1.10, Reference No. 3.1.1.10, the applicant stated that CASS piping does not exist at Dresden or Quad Cities and, therefore, the piping does not experience loss of fracture toughness due to thermal aging. However, fittings (e.g., elbows and tees) in the austenitic stainless steel piping in the BWR recirculation system are typically made of CASS. In NRC Aging Management Inspection Information Request AMI-11, the staff requested the applicant to identify the material for the fittings in the recirculation piping, and if it is CASS, to provide an AMP for managing loss of fracture toughness in those fittings. In response to AMI-11, the applicant stated that as identified on the Reactor Recirculation Piping Design Table (PDT) A of License Renewal Boundary Diagrams LR-DRE-M-26-2 and LR-QDC-M35-2, the fittings in recirculation piping are made of wrought and forged austenitic stainless steel, rather than of CASS. The staff finds the applicant's response acceptable because its review of Piping Design Table A confirmed that none of the fittings in Dresden and Quad Cities recirculation piping are made of CASS.

The applicant did not identify loss of preload as an aging effect for recirculation pump closure bolting and valve closure bolting in the reactor recirculation system. In LRA Section 3.1.1.2.2, the applicant referred to EPRI 1003056, Revision 3, which states that loss of preload mechanisms is typically addressed during installation and subsequent maintenance of closure bolting. In RAI 3.1-13, the staff requested the applicant to explain why periodic inspection of the closure bolting for indication of loss of preload due to the aforementioned mechanisms is not required. The staff further requested the applicant, if periodic inspection is required, to reference the appropriate AMP and include the appropriate inspection in the AMP. The response to RAI 3.1-13 is evaluated in Section 3.1.2.4.1 of this SER. The staff found the response not completely acceptable for the following reason. LRA Section 3.1.1.2.1 does not address loss of preload as an aging effect, and states that loss of preload mechanisms are typically addressed during installation and subsequent maintenance of closure bolting. However, the applicant's response to RAI 3.1-13 states that loss of preload will be managed and that the enhanced Bolting Integrity Program will be comprised of periodic ISIs and piping and components preventative maintenance inspections. In Supplemental RAI 3.1-13, the staff requested the applicant to describe the maintenance program activities that are performed on the bolts so that loss of preload is significantly reduced or eliminated, and identify whether retorquing of the bolts to the design preload values is performed after the component is reassembled. The applicant's response to Supplemental RAI 3.1-13 is evaluated in Section 3.1.2.4.1 of this SER. The staff has found the response acceptable.

The applicant identified no applicable aging effect for sight glasses exposed to air, moisture, and humidity; water; lubricating oil; and wet gas. This is acceptable because sight glass is resistant to loss of material, and the environments to which it is exposed are not aggressive. The applicant identified no applicable aging effect for the external surfaces of stainless steel components exposed to containment nitrogen or air, moisture, and humidity. The staff finds this identification of no applicable aging effect acceptable because stainless steel is resistant to loss of material and cracking at low temperatures when the environments it is exposed to are not aggressive.

The aging effects identified in the LRA for the reactor recirculation system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following programs for managing aging in the reactor recirculation system. These programs, all of which are common AMPs, are reviewed in the different sections of this SER, as indicated in parentheses:

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- One-Time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Structures Monitoring Program (Section 3.0.3.14)
- Compressed Air Monitoring Program (Section 3.0.3.8)

The applicant credited LRA Appendix B.1.1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD, for managing loss of fracture toughness due to thermal aging embrittlement in reactor recirculation and reactor water cleanup valve bodies and reactor recirculation pump casings made of CASS. The Inservice Inspection Program includes visual inspection for detecting surface-breaking cracks in the CASS valve bodies and pump casings. Inspection for cracking is acceptable for managing loss of fracture toughness in CASS valve and pump bodies because loss of fracture toughness in CASS components becomes a concern only if cracks are present. In RAI 3.1-14, the staff requested the applicant to explain how the proposed visual inspection technique is qualified for detecting IGSCC cracks in the CASS valve bodies and pump casings and to confirm whether Code Case N-481 has been used to supplement the ISI requirements of ASME Code Section XI for these pump casings. The staff further requested the applicant to confirm whether a flaw evaluation was performed for this aging effect while implementing this code case, and if not, to present evaluation of this as a TLAA in accordance with 10 CFR Part 54.3. In response to RAI 3.1-14, in a letter dated October 3, 2003, the applicant stated that NUREG-1801 was relied on as an approved topical report in the preparation of the LRA. As such, the recommendations from NUREG-1801, Items IV.C1.2-c and IV.C1.3-b, were considered. These NUREG-1801 items state, “For pump casings (and valve bodies), screening for susceptibility to thermal aging is not required. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS valve bodies.” Therefore, no additional inspections are required. The applicant further stated that Code Case N-481, “Alternative Examination Requirements for Cast Austenitic Pump Casings.” does not supplement the Dresden or Quad Cities ISI requirements. The staff finds the applicant’s response acceptable because it is consistent with the NUREG-1801 position that the Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS.

The applicant credited LRA Appendix B.1.7, “BWR Stress Corrosion Cracking Program,” for managing crack initiation and growth due to SCC in austenitic stainless steel recirculation system piping and related reactor coolant pressure boundary components. The applicant stated that the BWR Stress Corrosion Cracking Program is based on BWRVIP-75, “Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules.” In Inspection Question 3.1.2.4.3-6, the staff requested the NRC Inspection Team to verify that the resolutions to the open items of NRC letter to Terry (BWRVIP), dated May 14, 2002, have been implemented in the program. Inspection Reports 05000237/2003010 (DRS); 05000249/2003010 (DRS); 05000254/2003014 (DRS);and 05000265/2003014 (DRS), dated December 5, 2003, stated that the ISI Program at Dresden and Quad Cities have incorporated BWRVIP-75, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules," including the resolutions to the open items of NRC letter to the industry BWRVIP group, dated May 14, 2002.

In RAI B.1.7-a, the staff requested the applicant to submit information about its plant-specific experience related to IGSCC cracking of the reactor vessel safe ends and reactor coolant pressure boundary piping, mitigative actions taken, and the revised inspection schedules following the BWRVIP-75 guidelines. The staff also requested the applicant to submit information about whether HWC and NMCA are implemented at D/QCNPS and how this implementation has affected monitoring of water chemistry parameters. In RAI 3.1-24, the staff requested the applicant to provide similar information for the reactor coolant pressure boundary systems other than reactor vessel safe ends and reactor recirculation piping. However, in its response to RAI 3.1-24, the applicant addressed reactor recirculation piping, including reactor vessel safe ends. As a result, the applicant has submitted similar responses to RAIs B.1.7-a and RAI 3.1-24 in a letter dated October 3, 2003. Therefore, since the response to RAI 3.1-24 submitted in a letter dated October 3, 2003, provides all of the necessary information for the applicable systems/components, the staff evaluated this response which is presented in four parts as discussed below.

In RAI 3.1-24a, the staff requested that the applicant submit information about its plant-specific experience related to IGSCC cracking of the stainless steel components in the following reactor coolant pressure boundary systems—HPCI, core spray, RCIC, RHR, LPCI, SBLC, SDC, RWCU, MS, and FW systems and the isolation condenser. In response to RAI 3.1-24a, in a letter dated October 3, 2003, the applicant stated that it had reviewed the Dresden and Quad Cities operating experience related to IGSCC of stainless steel components in the systems specified, as well as in the reactor recirculation system. Reactor coolant pressure boundary piping was identified to have flaw indications, such as indications on the reactor vessel safe ends, and IGSCC on recirculation piping. However, there were no flaw indications (IGSCC) identified that affected the component intended function for any components in the above-mentioned systems. The applicant then listed representative examples of IGSCC operating experience related to reactor coolant pressure boundary piping. These examples were intended to demonstrate the effectiveness of the applicant’s AMP. The applicant further noted that the evaluation of the effectiveness of IHSI treatment for susceptible welds resulted in an adjustment of the inspection plan to change all Quad Cities Unit 1 28-in. IHSI treated Category C (non-resistant material, stress improvement after 2 years of unit operation) welds to Category D (non-resistant material, no stress improvement). The staff finds the applicant’s response acceptable because the operating experience demonstrates that AMP B.1.7 has been successful in identifying aging effects. The program has been successful in identifying cracking so that the intended function of the components will be maintained consistent with the CLB through the extended operation, as required by 10 CFR 54.21(a)(3).

In RAI 3.1-24b, the staff requested that the applicant submit information about mitigation actions taken at D/QCNPS with respect to selection of materials that are resistant to sensitization, use of special processes that reduce residual tensile stress, and monitoring of water chemistry as specified by NUREG-1801, Chapter XI.M7. In response to RAI 3.1-24b, in a letter dated October 3, 2003, the applicant listed mitigation actions taken with respect to material selection, use of special process, and monitoring of water chemistry. These included the replacement of stainless steel piping with more resistant grades, the use of IHSI to minimize tensile stresses in weldments, use of noble metal chemical injection systems, and implementation of HWC. As noted in the response to RAI 3.1-24b, the IHSI treatment of the susceptible welds was not effective in mitigating IGSCC. The applicant also stated that no information is yet available on the effectiveness of noble metal chemical injections on IGSCC mitigation, but the use of HWC appears to provide a beneficial effect. The staff finds the applicant's response to be acceptable because it provides the requested information to evaluate whether the inspections are consistent with the ASME Code and/or BWRVIP-75 with the applicable water chemistry, as discussed below.

In RAI 3.1-24c, the staff requested that the applicant confirm whether HWC and NMCA are implemented at D/QCNPS. If so, the staff requested the applicant to explain how this implementation has affected monitoring of water chemistry parameters. In response to RAI 3.1-24c, in a letter dated October 3, 2003, the applicant stated that both Dresden and Quad Cities have implemented HWC and NMCA. As part of the implementation of HWC and NMCA, monitoring of electrochemical corrosion potential (ECP) was added. ECP data and HWC index results are used to calculate crack growth rate factors of improvement. The applicant further stated that the BWRVIP model for BWR crack growth indicates decreasing crack growth rate with decreasing ECP. The staff finds the applicant's response to RAI 3.1-24c acceptable because it is consistent with the recommendations of BWRVIP-62. "BWR Vessel and Internals Project: Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection," however, the meaning of the term "HWC index" is not clear. The applicant is requested to clarify how the "HWC index" is used to determine factor of improvement, and confirm whether this term means the availability of HWC at a certain ECP value. In response to Supplemental RAI 3.1-24d(iv) in a letter dated December 22, 2003, the applicant confirmed that the term is the availability (in percent) of HWC at a certain Electrochemical Corrosion Potential (ECP) value. The availability is calculated as the percentage of time the feedwater hydrogen concentration is sufficient to achieve an ECP value of less than or equal to -230mV when the water temperature exceeds 200 °F. Factors of Improvement (FOI) can be determined using this information. However, Dresden and Quad Cities do not use the FOI approach identified in BWRVIP-75 to determine the effectiveness of HWC. The staff finds this response acceptable, because the applicant is following the requirements of the NRC letter dated May 14, 2002, such as monitoring the ECP, in lieu of using the FOI.

In RAI 3.1-24d, the staff requested that the applicant submit information on the inspection frequency (based on whether HWS and/or NMCA are used) and the corresponding number of welds to be inspected following the BWRVIP-75 guidelines. The applicant submitted its response to RAI 3.1-24d in a letter dated October 3, 2003. In its response, the applicant stated that at Quad Cities, Category C through E welds (Quad Cities currently has no Category B welds) are still being inspected at the frequency specified in BWRVIP-75, "BWR Vessel and Internal Project Technical Basis for Revisions of Generic Letter 88-01 Inspection Schedules," guidelines for normal water chemistry. However, the NRC SER of EPRI Report TR-113932 (BWRVIP-75) dated May 14, 2002, expanded on the guidelines and inspection frequencies for Category C welds to include plants that comply with BWRVIP-61, as well as those plants that do not comply with BWRVIP-61. Therefore, the staff requested the applicant to confirm whether or not the D/QCNPS plants are complying with BWRVIP-61 and that the appropriate inspection frequencies based on the NRC SER are used. The staff also requested the applicant to identify the number of welds in each category of weld that are credited for the use of IHSI, HWC, NMCA, or a combination of these methods, and corresponding inspection frequency. The staff further requested the applicant to provide the number of Category C through E welds and the frequency of their inspections for Quad Cities 1 and 2. In response to Supplemental RAI 3.1-24d(i) in a letter dated December 22, 2003, the applicant confirmed that D/QCNPS do not use IHSI, and therefore BWRVIP-61, "BWR Vessel and Internals Induction Heating Stress Improvement (IHSI) Effectiveness on Crack Growth in Operating Plants" does not apply to D/QCNPS. However, D/QCNPS does meet the conditions of BWRVIP-75 that permit reductions in the frequencies for inspection of Category C welds (non-resistant material with stress improvement after 2 years of operation). The NRC SER of EPRI Report TR-113932 (BWRVIP-75) dated May 14, 2002, imposed restrictions on reduction in inspection frequencies for plants with Category C welds that had been treated with IHSI, but did not fully comply with BWRVIP-61. However, the category C welds at Dresden and Quad Cities were stress improved by the Mechanical Stress Improvement method (MSIP). This process was accepted by the SER on BWRVIP-75 without restrictions. Dresden and Quad Cities are in compliance with the requirements of BWRVIP-75, and therefore apply the reduced inspection frequencies for the Category C welds. The applicant also provided the number of welds in each category of weld that are credited for the use of MSIP, HWC, NMCA or a combination of these methods, and corresponding inspection frequency as requested. The staff confirmed that the inspection frequencies for both Dresden and Quad Cities are in compliance with the requirements of BWRVIP-75 and therefore finds the applicant's response acceptable.

In further response to RAI 3.1-24d, the applicant stated that HWC/NMCA inspection frequencies for Categories C through E welds were reduced for Dresden Unit 2 and only applied to those weld locations where the improved water chemistry is effective. The staff requested the applicant to explain how these locations were identified. The staff further requested the applicant to explain the two different categories for C, D, and E that are identified in the response, and why two different inspection frequencies are listed in the response for each Category C, D, and E welds at Dresden Unit 2. In addition, the staff asked the applicant to confirm whether the information provided meets the requirements of BWRVIP-75, as approved by the NRC SER of EPRI Report TR-113932 (BWRVIP-75), dated May 14, 2002 (i.e., the RAI response states that Category D-HWC welds with a population of 24 received 10 percent inspection every 6 years, whereas BWRVIP-75 requires 100 percent inspection every 10 years for HWC). In response to Supplemental RAI 3.1-24d(ii) in a letter dated December 22, 2003, the applicant stated that there were a number of typographical errors in the Dresden, Unit 2 weld information provided in the original response to RAI 3.1.24-d. These errors resulted in a perception that different frequencies were provided for each weld category and/or that inappropriate frequencies were used. The applicant provided revised information, which are in compliance with the requirements of BWRVIP-75, as approved by NRC SER of EPRI Report TR-113932 (BWRVIP-75), dated May 14, 2002. The locations for which Dresden, Unit 2 Category C through E weld inspection frequencies were reduced are those areas in the reactor coolant flowpath. These portions of piping are continually exposed to circulating reactor coolant and receive the benefits of IGSCC mitigation due to HWC/NMCA. The staff finds the applicant's response acceptable because the inspection frequencies for Category C through E welds meet the requirements of BWRVIP-75, and that reduced weld inspection for Dresden, Unit 2 is consistent with BWRVIP-75 for the locations in the reactor coolant flowpath, that are continually exposed to circulating reactor coolant with HWC/NMCA.

In response to RAI 3.1-24d, the applicant further stated that Category A welds at D/QCNPS are inspected per the RI-ISI guidelines. The staff requested the applicant to confirm that Category A welds at D/QCNPS are inspected to BWRVIP-75 as modified and approved by the NRC SER of EPRI Report TR-113932 (BWRVIP-75) dated May 14, 2002. In response to Supplemental RAI 3.1-24d(iii) in a letter dated December 22, 2003, the applicant stated that IGSCC Category A welds are subsumed under the EPRI Risk-Informed Inservice Inspection (RI-ISI) program. This is consistent with the methodology of EPRI Report TR-112657, Revision B-A, Risk-Informed Inservice Inspection Evaluation Procedure. The staff finds the applicant's response acceptable because it is consistent with the methodology of EPRI Report TR-112657, Revision B-A, as approved by NRC SERs for RI-ISI dated September 5, 2001, and February 5, 2002 for Dresden and Quad Cities, respectively.

The applicant credited LRA Appendix B.1.23, "One-Time Inspection," for managing loss of material due to corrosion in recirculation system carbon steel and stainless steel components. The applicant stated that the One-time Inspection Program is consistent with Chapter XI.M32, "One-Time Inspection," specified in NUREG-1801. The staff finds the use of the One-Time Inspection Program appropriate for managing loss of material in these components because it will identify any loss of material at the inner surface of the component inspected.

However, the applicant credited only LRA Appendix B.1.2, "Water Chemistry," for managing cracking in recirculation system stainless steel components. The AMR for these components is presented in Table 3.1-2, Reference Nos. 3.1.2.23, 3.1.2.24, 3.1.2.26, 3.1.2.29, 3.1.2.40, 3.1.2.49, and 3.1.2.52. In RAI 3.1-15, the staff requested the applicant to explain why it credits the One-Time Inspection Program for managing loss of material, but not cracking. In response to RAI 3.1-15, in a letter dated October 3, 2003, the applicant stated that these piping components do not require a one-time inspection because they are small-bore (2" and under), socket welded components, downstream of the excess flow check valves and located outside primary containment. The normal operating temperature is less than 60 °C (140 °F), the minimum temperature needed to initiate IGSCC. Therefore, the aging management references should have reported an environment of "Reactor Coolant Water (less than 60 °C or 140 °F);" Aging Effect/Mechanism as "None," and the AMP as "None."

The applicant also noted that this environment is neither part of the original LRA, nor is it contained in the response provided to RAI 3.0-1 submitted to the NRC on June 11, 2003. This piping was originally considered to be in the 288 °C (550 °F) reactor water coolant environment, similar to the piping to which it is attached. However, the actual normal operating environment is less than 60 °C (140 °F). The applicant additionally noted that LRA Table 2.3.1-5, "Components Requiring Aging Management Review —Reactor Recirculation System," component group,"NSR Vents and Drains, Piping and Valves (attached support)," should not have indicated Dresden only. The staff finds the applicant's response to be acceptable because SCC is not anticipated in stainless steel components operating at temperatures below 60 °C (140 °F).

All of the AMPs listed above are credited for managing the aging effects of several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor recirculation system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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 54.2(a)(3).

3.1.2.4.4 Reactor Vessel Head Vent System

Summary of Technical Information in the Application. The description of the reactor vessel head vent system can be found in Section 2.3.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are discussed in LRA Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System," and are identified in LRA Table 2.3.1-6. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2. In a letter, dated February 7, 2003, from P R. Simpson, Exelon, to NRC, D/QCNPS sent a correction to LRA Table 2.3.1-6. The correction included a deletion of an aging management reference link that does not apply to certain component groups of the reactor vessel head vent system.

Aging Effects

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the Dresden and Quad Cities operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the components, aging effects, and AMPs in LRA Tables 3.1-1 and 3.1-2.

The long-lived, passive components in the reactor vessel head vent system that are subject to an AMR are fabricated of stainless steel (tubing and valve components), CASS (valve bodies), low-alloy steel (closure bolting), carbon steel (vents, drains, and piping), brass or bronze (vents/drains), and glass (sight glasses). The operating environments are reactor coolant water or steam at 288 °C (550 °F), ambient air and humidity at metal temperatures up to 288 °C (550 °F), wet gas, saturated air, and containment nitrogen.

In Tables 3.1-1 and 3.1-2, the applicant identified the following aging effects for the reactor vessel head vent system components subject to an AMR:

- cumulative fatigue damage
- crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading
- crack initiation and growth due to cyclic loading
- loss of material due to wear
- loss of material due to general, galvanic, pitting, and crevice corrosion
- wall thinning due to flow-accelerated corrosion

In LRA Tables 2.3.1-6 and 3.1-2, the applicant also listed the following reactor vessel head vent system components for which no aging effect is identified:

- external surfaces of carbon steel piping, fittings, and valves exposed to containment nitrogen (Table 3.1-2, Reference No. 3.1.2.4)

- external surfaces of stainless steel tubing and valves exposed to containment nitrogen

(Table 3.1-2, Reference No. 3.1.2.8)

- sight glasses exposed to wet gas (Table 3.1-2, Reference No. 3.1.2.32)

Aging Management Programs

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following eight AMPs to manage the aging effects associated with the reactor vessel head vent system components:

- ASME Section XI Inservice Inspection Program
- Water Chemistry Program
- One-Time Inspection Program
- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Corrosion Program
- Compressed Air Monitoring Program

Staff Evaluation. The applicant described its AMR for the reactor vessel head vent system in Section 3.1 of the LRA. The staff reviewed this section to determine whether the applicant identified all the applicable aging effects for components in these systems and demonstrated that the effects of aging on the components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified by the applicant for the reactor vessel head vent system are as follows:

- cumulative fatigue damage (discussed below and in Section 4.3 of this SER)
- crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading
- crack initiation and growth due to cyclic loading
- loss of material due to wear
- loss of material due to general, galvanic, pitting, and crevice corrosion
- wall thinning due to flow-accelerated corrosion

The applicant identified cumulative fatigue damage as an applicable aging effect only for the reactor head vent system valves. The staff notes that this assessment is consistent with NUREG-1801, Item C1.3-d, Chapter IV.C1) However, in RAI 3.1-16, the staff requested the applicant to explain why cumulative fatigue damage was not identified as an applicable aging effect for the piping and fittings of the reactor vessel head vents. Cumulative fatigue damage is further discussed in Section 4.3 of Chapter 4 of this SER. In response to RAI 3.1-16 ,in a letter dated October 3, 2003, the applicant stated that cumulative fatigue damage is an applicable aging effect for the reactor head vent piping and fittings. The applicant stated that LRA Table 2.3.1-6 should have included Aging Management Reference 3.1.1.1 for component group, “Piping and Fittings.” The staff finds the applicant’s response to be acceptable because it is consistent with the GALL position on the applicability of cumulative fatigue damage as an aging effect for the reactor pressure boundary piping and fittings, including those associated with the reactor vessel head vents.

According to the Aging Management Review Aid for the reactor vessel head vent system (Table 2.3.1-6), the applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for the reactor head vent system austenitic stainless steel valve bodies exposed to reactor coolant water. However, the staff notes that the applicant does not identify crack initiation and growth as an applicable aging effect for the reactor head vent system CASS valve bodies exposed to reactor coolant water. In RAI 3.1-17, the staff requested the applicant to explain why cracking is not an applicable aging effect for CASS valve bodies in the reactor vessel head vent system. In response to RAI 3.1-17, in a letter dated October 3, 2003, the applicant states that neither Dresden nor Quad Cities have CASS valves installed in the reactor vessel head vent system. The applicant further stated that the material for the line in Table 2.3.1-6 of the Aging Management Review Aid that shows valves with material of “Carbon Steel, Cast Austenitic Stainless Steel, Stainless Steel” should have read “Carbon Steel, Stainless Steel.” Cast austenitic stainless steel should have been removed from the list of materials. The staff finds the applicant’s response to be acceptable because the embrittlement aging effect of concern here is applicable only to CASS components.

The applicant does not identify the loss of fracture toughness due to thermal aging embrittlement as an applicable aging effect for CASS valve bodies in the reactor vessel head vent system. In RAI 3.1-19. the staff requested that the applicant explain why loss of fracture toughness due to thermal aging embrittlement is not an applicable aging effect for the CASS valve bodies. If loss of fracture toughness is identified as an applicable aging effect, then the applicant needs to provide a program for managing that effect. In response to RAI 3.1-19, in a letter dated October 3, 2003, the applicant stated that as explained in the response to RAI 3.1-17, Dresden and Quad Cities do not have CASS valves installed in the reactor vessel head vent system. The staff finds the applicant’s response to be acceptable because the embrittlement aging effect of concern here is applicable only to CASS components.

The applicant identified crack initiation and growth due to thermal and mechanical loading as an applicable aging effect for small-bore carbon steel piping and fittings. These AMR results are evaluated in Section 3.1.2.2.4 of this SER and are consistent with NUREG-1801.

The applicant identified crack initiation and growth due to cyclic loading as an applicable aging effect for the low-alloy steel reactor vessel head vent system pressure boundary low-alloy steel closure bolting exposed to containment nitrogen. This AMR result is consistent with Item I.2-b, Chapter VII.I, in NUREG-1801.

The applicant identified loss of material due to wear as an aging effect for the reactor vessel head vent system low-alloy and high-strength, low-alloy steel closure bolting exposed to an air or containment nitrogen environment with metal temperatures up to 288 ºC (550 ºF). The staff notes that this assessment is consistent with NUREG-1801.

In LRA Table 3.1-2, the applicant identified loss of material due to various forms of corrosion as an aging effect for the reactor vessel head vent system stainless steel tubing exposed to saturated air; for carbon steel, stainless steel, brass or bronze vents/drains, piping, and valves exposed to moist air and leaking fluid; and for stainless steel valve components exposed to saturated air. The AMR results for these components are not presented in NUREG-1801, Chapter IV.C1, “Reactor Coolant Pressure Boundary (BWR).” However, AMR results for components with similar materials and environments can be found in other chapters of NUREG-1801 and are used here to evaluate the AMR results presented in LRA Table 3.1-2.

The applicant identified loss of material due to general corrosion as an aging effect for carbon steel, stainless steel, brass or bronze vents or drains, piping, and valves exposed to air, moisture, humidity, and leaking fluid. The staff finds that the identification of the carbon steel components is consistent with Item E.2-a, Chapter V.E, of NUREG-1801. For the stainless steel, brass, or bronze components, the staff agrees that these components are subject to this aging effect in these environments, since trace levels of corrosive species are generally present in moist environments.

The applicant identified loss of material due to pitting and crevice corrosion as an applicable aging effect for stainless steel tubing and valve components exposed to a saturated air environment. The staff agrees that these components are subject to this aging effect in this environment, since trace levels of corrosive species (e.g., chlorides) commonly present on the component surfaces can interact with moisture and condensation from saturated air.
The aging management results for managing flow-accelerated corrosion of the carbon steel components in the reactor vessel head vent system are provided in LRA Table 3.1-1, Aging Management Reference 3.1.1.11, which refers to LRA Section 3.1.1.2.2 for exceptions to flow-accelerated corrosion.

The applicant identified wall thinning due to flow-accelerated corrosion as an applicable aging effect for carbon steel piping and fittings in the reactor vessel head vent system exposed to flowing reactor coolant water at temperatures up to 225 °C (437 °F). However, in LRA Section 3.1.1.2.2, the applicant stated that the carbon steel components in the reactor vessel head vent system are not susceptible to flow-accelerated corrosion and do not require aging management for this effect. This determination is based on the fact that these components operate less than 2 percent of the plant operating time or at flow rates less than 1.8 m/s (6 ft/s). The applicant referenced the EPRI reports NSAC-202L-R2 and TR-114882 as the bases for these criteria. However, Chapter XI.M17, “Flow-Accelerated Corrosion,” of NUREG-1801 only relies on EPRI report NSAC-202L-R2 for an effective flow-accelerated corrosion program. In RAI 3.1-18, the staff asked the applicant whether EPRI report NSAC-202L-R2 states that carbon steel components are not susceptible to flow-accelerated corrosion, and do not require aging management when these components are operated at flow rates less than 1.8m/s (6ft/s). If not, the applicant needs to specify the applicable AMP, as required by NUREG-1801.

In response to RAI 3.1-18, in a letter dated October 3, 2003, the applicant stated that it has reevaluated the use of EPRI TR-114882 and NSAC-202L-R2 and has decided not to take an exception to NUREG-1801 for aging management of the reactor vessel head vent system. As a result, the applicant stated that the reactor vessel head vent system will be included in the Dresden and Quad Cities Flow Accelerated Corrosion Program, and LRA Section 3.1.1.2.2 should not have included the reactor vessel head vent system in the exception described in Section 3.1.1.2.2 of the LRA.

The applicant stated that LRA Section 3.1.1.2.2 should have read as follows:

> Flow-accelerated corrosion is an applicable aging mechanism for the main steam lines, feedwater lines, reactor vessel head vent lines, and reactor vessel bottom head drain lines (evaluated with the nuclear boiler instrumentation system). However, carbon steel components in the core spray, shutdown cooling (Dresden only), HPCI, RCIC (Quad Cities only), and nuclear boiler instrumentation

(except for the reactor vessel bottom head drain lines) are not susceptible to flow-accelerated corrosion and do not require aging management. This exception is based on the following:

- EPRI NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," allows an exclusion from flow-accelerated corrosion for systems with no flow or those that operate less than 2 percent of plant operating time.

- NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal.", states that erosion/corrosion in HPCI and RCIC turbine steam supply piping is nonsignificant due to the low flow range.

- Dresden and Quad Cities operate these systems less than 2 percent of plant operating time. Additionally, plant experience has not revealed flow-accelerated corrosion in these lines.

The staff finds the applicant's response to be acceptable because the applicant's AMP for managing wall thinning due to flow-accelerated corrosion for carbon steel piping and fittings in the reactor vessel head vent system exposed to flowing reactor coolant water at temperatures up to 225 °C (437 °F) is now consistent with GALL.

The applicant does not identify loss of preload as an aging effect for high-strength, low-alloy steel closure bolting in reactor vessel head vent system. In LRA Section 3.1.1.2.2, the applicant refers to EPRI 1003056, Revision 3, which states that loss of preload mechanisms are typically addressed during installation and subsequent maintenance of closure bolting. In RAI 3.1-13, the staff requested the applicant to explain why periodic inspection of the closure bolting for indication of loss of preload due to the aforementioned mechanisms is not required. The staff further requested the applicant, if periodic inspection is required, to reference the appropriate AMP and include the appropriate inspection in the AMP. The response to RAI 3.1-13 is evaluated in Section 3.1.2.4.1 of this SER.

The staff finds the response not completely acceptable for the following reason. LRA Section 3.1.1.2.1 does not address loss of preload as an aging effect, and states that loss of preload mechanisms are typically addressed during installation and subsequent maintenance of closure bolting. However, the applicant's response to RAI 3.1-13 stated that loss of preload will be managed, and that the enhanced Bolting Integrity Program will be comprised of periodic ISIs and piping and components preventative maintenance inspections. In Supplemental RAI 3.1-13, the staff requested the applicant to describe the maintenance program activities that are performed on the bolts so that loss of preload is significantly reduced or eliminated, and to identify whether retorquing of the bolts to the design preload values is performed after the component is reassembled. The applicant's response to Supplemental RAI 3.1-13 is evaluated in Section 3.1.2.4.1 of this SER. The staff has found the response acceptable.

The applicant identified no applicable aging effect for external surfaces of carbon steel piping, fittings, and valves exposed to a containment nitrogen environment. This identification of no aging effect is not acceptable because the environment in BWR containment is likely to have high humidity, and this humid environment can cause corrosion of the external surface of carbon steel components. In RAI 3.1-5, the staff requested the applicant to explain why loss of material is not identified as an aging effect for these components, or provide a program for managing that aging effect. The staff evaluates the response to this RAI in Section 3.1.2.4.1.2 of this SER and finds it acceptable. The staff agrees with the applicant that there are no applicable aging effects for external surfaces of carbon components exposed to a containment nitrogen environment because the low oxygen level present in the primary containment atmosphere precludes loss of material due to corrosion as a credible aging effect for the external surface of carbon steel components exposed to containment environment.

The applicant identified no applicable aging effect for external surfaces of stainless steel tubing and valves exposed to containment nitrogen and sight glasses exposed to wet gas. This identification of no aging effect is acceptable because these environments are not aggressive.

The aging effects identified in the LRA for the reactor vessel head vent system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The AMPs for the reactor vessel head vent system are identified in Section 3.1.2.4.4 of this SER. These programs are common AMPs, and are reviewed in different sections of this SER, as indicated in parentheses.

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- One-Time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Structures Monitoring Program (Section 3.0.3.14)
- Compressed Air Monitoring (Section 3.0.3.8)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)

All of the AMPs listed above are credited for managing the aging effects of several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor vessel head vent system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.1.2.4.5 Nuclear Boiler Instrumentation System

Summary of Technical Information in the Application. The description of the nuclear boiler instrumentation system can be found in Section 2.3.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are discussed in LRA Section 3.1, “Aging Management of Reactor Vessel, Internals, and Reactor Coolant System,” and are identified in LRA Table 2.3.1-7. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2. In a letter, dated February 7, 2003, from P.R. Simpson, Exelon, to NRC, D/QCNPS sent corrections to LRA Table 2.3.1-7. The corrections included deletion of aging management reference links that do not apply to certain component groups of the nuclear boiler instrumentation system and addition of an aging management reference link that was found missing for a component group.

Aging Effects

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the D/QCNPS operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the components, aging effects, and AMPs in LRA Tables 3.1-1 and 3.1-2.

The nuclear boiler instrumentation system monitors the reactor vessel temperature, reactor vessel pressure, reactor vessel water level, reactor internal differential pressure, and reactor vessel flange leakage. The long-lived, passive components in the system that are subject to an AMR consist of piping and fittings, tubing, valves, tanks, thermowells, vents, drains, filters/strainers, dampeners (Quad Cities only), and closure bolting. These components are fabricated of stainless steel, CASS, low-alloy steel, carbon steel, brass, or bronze. The operating environments are reactor coolant water or steam at 288 °C (550 °F); oxygenated or demineralized water at temperatures up to 288 °C; ambient air at metal temperatures up to 288 °C (550 °F); air, moisture, humidity, and leaking fluid; and containment nitrogen.

In Tables 3.1-1 and 3.1-2, the applicant identified the following aging effects for the nuclear boiler instrumentation system components subject to an AMR:

- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading

- wall thinning due to flow-accelerated corrosion

- loss of material due to wear

- loss of material due to general, galvanic, pitting, and crevice corrosion

In LRA Tables 2.3.1-7 and 3.1-2, the applicant also listed the following nuclear boiler instrumentation system components for which no aging effect is identified:

- external surfaces of carbon steel piping, fittings, tubing, and valves exposed to containment air (Table 3.1-2, Reference No. 3.1.2.4)

- external surfaces of stainless steel piping and fittings, dampeners, filters and strainers, valves and tubing exposed to air, moisture, and humidity (Table 3.1-2, Reference No. 3.1.2.7)

- external surfaces of stainless steel piping and fittings, tubing, tanks, thermowells, and valves exposed to containment nitrogen (Table 3.1-2, Reference No. 3.1.2.8)

Aging Management Programs

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following six AMPs to manage the aging effects associated with the nuclear boiler instrumentation system components:

- ASME Section XI Inservice Inspection Program
- Water Chemistry Program
- One-Time Inspection Program
- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Corrosion Program

Staff Evaluation. The applicant described its AMR for the nuclear boiler instrumentation system in Section 3.1 of the LRA. The staff reviewed this section to determine whether the applicant identified all the applicable aging effects for components in these systems and demonstrated that the effects of aging on the components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified by the applicant for the nuclear boiler instrumentation system are as follows:

- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading

- wall thinning due to flow-accelerated corrosion

- loss of material due to wear

- loss of material due to general, galvanic, pitting, and crevice corrosion

The applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for nuclear instrumentation system stainless steel dampeners, vessel flange leak detection line, piping and fittings (Quad Cities only), thermowells, tanks, tubing, and valves exposed to reactor coolant water or steam at 288 °C (550 °F) or containment nitrogen. This identification is consistent with Chapter IV.C1 of NUREG-1801. In addition, the applicant identified crack initiation and growth due to SCC and IGSCC and mechanical loading as an applicable aging effect for nuclear instrumentation system carbon and stainless steel small-bore piping and fittings exposed to reactor coolant water at 288 °C (550 °F). The staff notes that the identification of this aging effect for these components is consistent with Item C1.1-I of NUREG-1801.

The applicant also identifies crack initiation and growth due to SCC and IGSCC as an applicable aging effect for non-safety-related nuclear instrumentation system stainless steel filters and strainers exposed to reactor coolant water or steam at 288 °C (550 °F), stainless steel piping and fittings exposed to oxygenated water at temperatures up to 288 °C (550 °F), and stainless steel tubing exposed to demineralized water at temperatures up to 288 °C (550 °F). The staff notes that the AMR of these non-safety-related components is not presented in NUREG-1801, but similar combinations of materials and environments are evaluated in NUREG-1801. The applicant's identification of cracking as an aging effect for non-safety-related stainless steel components is consistent with Item D2.1-c, Chapter V.D2, and Item C1.1-f, Chapter IV.C1, of NUREG-1801.

Reference No. 3.1.2.7, LRA Table 3.1-2, states that there is no applicable aging effect for nuclear boiler instrumentation system stainless steel component external surfaces exposed to air, moisture, and humidity at temperatures less than100 °C (212 °F) or containment nitrogen. The staff accepts this identification of no aging effect because stainless steel is not susceptible to crack initiation and growth due to SCC and IGSCC at these low temperatures or to loss of material due to different corrosion mechanisms because the environment is not aggressive and stainless steel is resistant to corrosion.

Finally, the applicant identified crack initiation and growth due to thermal and mechanical loading as an applicable aging effect for small-bore carbon steel piping and fittings in the nuclear boiler instrumentation system. The staff notes that this assessment is consistent with Item C.1.1-i, Chapter IV.C1, of NUREG-1801.

The applicant identified crack initiation and growth due to cyclic loading as an applicable aging effect for the low-alloy steel nuclear boiler instrumentation system pressure boundary closure bolting. This identification of cracking as an applicable aging effect is consistent with Item I.2-b, Chapter VII.I, of NUREG-1801.

In LRA Section 3.1.1.2.2, the applicant identified wall thinning due to flow-accelerated corrosion as an aging effect for the carbon steel nuclear boiler instrumentation system piping and fittings exposed to 288 °C (550 °F) steam. However, the applicant stated that the carbon steel components in the nuclear boiler instrumentation system are not susceptible to flow-accelerated corrosion and do not require aging management for this effect. This determination is based on the fact that these components operate less than 2 percent of the plant operating time or at flow rates less than 1.8 m/s (6 ft/s). The applicant references EPRI reports NSAC-202L-R2 and TR-114882 as the bases for these criteria. In RAI 3.1-18, the staff notes that Chapter XI.M17, "Flow-Accelerated Corrosion," of NUREG-1801 only relies on EPRI report NSAC-202L-R2 for an effective flow-accelerated corrosion program. The staff requested the applicant to confirm whether EPRI report NSAC-202L-R2 states that carbon steel components are not susceptible to flow-accelerated corrosion when subject to flow rates less than 1.8 m/s (6 ft/s) when these components are operated, and, therefore, do not require aging management. If not, the applicant must specify the applicable AMP as required by NUREG-1801.

In response to RAI 3.1-18, in a letter dated October 3, 2003, the applicant stated that the reactor vessel bottom head drain lines are included in the Dresden and Quad Cities Flow Accelerated Corrosion Program. Except for the reactor vessel bottom head drain lines, all components in the nuclear boiler instrumentation system are made of stainless steel, experience no flow, or operate less than 2 percent of plant operating time. Therefore, the reactor vessel bottom head drain lines are the only components in the nuclear boiler instrumentation system that are susceptible to flow-accelerated corrosion. In addition, the applicant stated that in LRA Table 2.3.1-7. "Component Groups Requiring Aging Management Review Nuclear Boiler Instrumentation," "Quad Cities only" should have been removed from the

Piping and Fittings line. The staff finds the applicant's response to be acceptable because the applicant does not use a flow velocity less than 1.8 m/s as one of the criteria for determining whether a component is susceptible to flow-accelerated corrosion.

The applicant identified loss of material due to wear as an aging effect for the nuclear boiler instrumentation system low-alloy and high-strength, low-alloy steel closure bolting exposed to air with metal temperatures up to 288 °C (550 °F). The staff notes that this assessment is consistent with NUREG-1801. The applicant also identified this aging mechanism for these components in a containment nitrogen environment. The staff agrees that these components are subject to loss of material due to wear.

In LRA Table 3.1-2, the applicant identified loss of material due to various forms of corrosion as an aging effect for the nuclear boiler instrumentation system stainless steel tubing exposed to saturated air; and for carbon and stainless steel piping, fittings, and valve bodies in contact with reactor coolant and oxygenated water at temperatures up to 288 °C (550 °F). This aging effect is also identified for stainless steel tubing in contact with warm, moist air. The AMR results for these components are not presented in Chapter IV.C1, "Reactor Coolant Pressure Boundary (BWR)," of NUREG-1801. However, AMR results for components with similar materials and environments can be found in other chapters of NUREG-1801 and are used here to evaluate the AMR results presented in LRA Table 3.1-2.

The applicant identified loss of material due to general corrosion as an aging effect for carbon steel, stainless steel, and brass or bronze vents or drains, piping, and valves exposed to air, moisture, humidity, and leaking fluid. The staff finds that the identification of loss of material as an applicable aging effect for the carbon steel components is consistent with Item E.2-a, Chapter V.E, of NUREG-1801. For the stainless steel, brass, or bronze components, the staff agrees that these components are subject to this aging effect in these environments, since trace levels of corrosive species are generally present in moist environments.

The applicant identified loss of material due to pitting and crevice corrosion as an aging effect for carbon and stainless steel piping and fittings, stainless steel tubing, and carbon and stainless steel valve components operating in contact with leaking reactor coolant water, oxygenated water, steam, or warm moist air at temperatures up to 288 °C (550 °F). The staff finds that, for the carbon and stainless steel components in oxygenated water, this identification is consistent with Items A4.1-a and A4.3-a, Chapter VII.A, of NUREG-1801. For the remaining environments, the staff agrees that these components are subject to loss of material, since trace levels of corrosive species commonly present in the reactor coolant, oxygenated water, or on the component surfaces can interact with moisture and condensation from moist air.

The applicant did not identify loss of material due to corrosion as an aging effect for closure bolting in the nuclear boiler instrumentation system. This is acceptable because closure bolting is made of low-alloy steel which is resistant to corrosion.

In LRA Section 3.1.1.1, the applicant did not identify the loss of fracture toughness due to thermal aging embrittlement as an applicable aging effect for CASS CRD valve bodies located around CRD housings in the nuclear boiler instrumentation system. In RAI 3.1-20a, the staff requested the applicant to explain why loss of fracture toughness is not an applicable aging effect for these valve bodies. If loss of fracture toughness is identified as an applicable aging effect, then the applicant needs to provide a program for managing that effect. In response to

RAI 3.1-20a, in a letter dated October 3, 2003, the applicant stated that NUREG 1801, AMP XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS),” the “Scope of Program” element states, “The screening criteria are applicable to all primary pressure boundary and reactor vessel internal components constructed from SA-351 Grades CF3, CF3A, CF8, CF8A, CF3M, CF3MA, CF8M, with service conditions above 250 °C (482 °F)”.

The valves associated with the nuclear boiler instrumentation system are located outside the drywell and are not insulated. The reactor coolant temperature through these valves is below 250 °C (482 °F). Additionally, the material for these valves is ASTM 182, not ASTM A351. The valves associated with the CRD hydraulic system are continuously supplied with cooling water less than 38 °C (100 °F) from the cooling water header of the control rod drive hydraulic system. This maintains the control rod drives and all associated valve temperatures to less than 121 °C (250 °F). For these reasons, the applicant concluded that loss of fracture toughness is not an applicable aging effect. The staff finds the applicant’s response to be acceptable because the use of forged stainless steel (ASTM 182) as the material of construction and the operating temperatures less than 121 °C (250 °F) preclude thermal embrittlement as an applicable aging effect for the components in question.

In LRA Section 3.1.1.1, the applicant identified no applicable aging effect for external surfaces of carbon steel piping, fittings, tubing, and valves exposed to a containment nitrogen environment. In RAI 3.1-5, the staff states that this identification of no aging effect is not acceptable because the air in BWR containment is likely to have high humidity, and this humid environment can cause corrosion of the external surface of carbon steel components. The staff requested the applicant to provide technical justification for not identifying loss of material as an applicable aging effect for the external surface of carbon steel components exposed to a containment environment. The staff evaluated the response to this RAI in Section 3.1.2.4.1 of this SER and found it acceptable. The staff agreed with the applicant that there are no applicable aging effects for external surfaces of carbon components exposed to a containment nitrogen environment because the low oxygen level present in the primary containment atmosphere precludes loss of material due to corrosion as a credible aging effect for the external surface of carbon steel components exposed to the containment environment.

The applicant identified no applicable aging effect for stainless steel components externally exposed to air, moisture, and humidity and containment nitrogen. This is acceptable because the environments to which the stainless steel components are exposed to are not aggressive.

The aging effects identified in the LRA for the nuclear boiler instrumentation system components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The AMPs for the nuclear boiler instrumentation system are identified in Section 3.1.2.4.5.1 of this SER. These programs, all of which are common AMPs, are reviewed in the following sections of this SER:

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)

- Water Chemistry Program (Section 3.0.3.2)
- One-Time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)

The applicant credited LRA Appendices B.1.2, "Water Chemistry," and B.1.23, "One-Time Inspection," for managing loss of material due to corrosion in nuclear boiler instrumentation system carbon steel and stainless steel components. The applicant stated that the One-Time Inspection Program is consistent with Chapter XI.M32, "One-Time Inspection," specified in NUREG-1801. The staff finds the use of the One-Time Inspection Program appropriate for managing loss of material in these components because it will identify the presence of any loss of material at the inner surface of the component inspected and verify the effectiveness of water chemistry.

However, in RAI 3.1-15, the staff noted that the applicant credited only LRA Appendix B.1.2, "Water Chemistry," for managing cracking in the nuclear boiler instrumentation system stainless steel components. The AMR for these components is presented in Table 3.1-2, Reference Nos. 3.1.2.13, 3.1.2.23, 3.1.2.24, 3.1.2.26, 3.1.2.38, 3.1.2.49, and 3.1.2.52. In RAI 3.1-15, the staff requested that the applicant explain why it credited the One-Time Inspection Program for managing loss of material, but not cracking. The applicant needs to credit the One-Time Inspection Program to assess whether cracking is taking place in these stainless steel components. In response to RAI 3.1-15, in a letter dated October 3, 2003, the applicant stated that these piping components do not require a one-time inspection because they are small-bore (2" and under) socket welded components, downstream of the excess flow check valves and located outside primary containment. The normal operating temperature is less than 60 °C (140 °F), the minimum temperature needed to initiate IGSCC. Therefore, the aging management references should have reported an environment of "Reactor Coolant Water (less than 60 °C or 140 °F)"; aging Effect/mechanism as "None," and the AMP as "None."

The applicant also noted that this environment is neither part of the original LRA, nor is it contained in the response provided to RAI 3.0-1, submitted to the NRC on June 11. 2003. This piping was originally considered to be in the 288 °C (550 °F) reactor water coolant environment, similar to the piping to which it is attached. However, the actual normal operating environment is less than 60 °C (140 °F). The applicant additionally noted that LRA Table 2.3.1-5, "Components Requiring Aging Management Review —Reactor Recirculation System," component group,"NSR Vents and Drains, Piping and Valves (attached support)," should not have indicated Dresden only. The staff finds the applicant's response to be acceptable because SCC is not anticipated in stainless steel components operating at temperatures below 60 °C (140 °F).

All of the AMPs listed above are credited for managing the aging effects of several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. On the basis of its review, the staff finds that the AMPs credited in the LRA for the nuclear boiler instrumentation system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.1.2.4.6 Head Spray System

Summary of Technical Information in the Application. The description of the head spray system (Dresden only) can be found in Section 2.3.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are discussed in LRA Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System." and are identified in LRA Table 2.3.1-8. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2.

Aging Effects

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the Dresden operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the components, aging effects, and AMPs in LRA Tables 3.1-1 and 3.1-2.

The head spray system is found only in Dresden Units 2 and 3 and is used to collapse the steam bubble during vessel flooding, to cool the reactor vessel head, and to collapse the steam in the vessel while the reactor is in the shutdown mode of operation. The head spray system consists of the head spray line, which interfaces with the CRD hydraulic piping, and the associated valves. The long-lived, passive components in the system that are subject to an AMR consist of piping and fittings, valves, vents, drains, flow elements, and closure bolting. These components are fabricated of stainless steel, low-alloy steel, carbon steel, brass, or bronze. The operating environments are reactor coolant water or steam at 288 °C (550 °F), demineralized water at temperatures up to 288 °C (550 °F), ambient air at metal temperatures up to 288 °C (550 °F), and containment nitrogen.

In Tables 3.1-1 and 3.1-2, the applicant identified the following aging effects for the head spray system components subject to an AMR:

- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading

- loss of material due to wear

- loss of material due to general, galvanic, pitting, and crevice corrosion

In LRA Tables 2.3.1-8 and 3.1-2, the applicant also listed the following reactor vessel head spray system components for which no aging effect is identified:

- external surfaces of stainless steel filters/strainers, piping and fittings, dampeners, tubing, and valves exposed to air, moisture, and humidity (Table 3.1-2, Reference No. 3.1.2.7)

- external surfaces of stainless steel tubing and valves exposed to containment nitrogen

(Table 3.1-2, Reference No. 3.1.2.8)

Aging Management Programs

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following five AMPs to manage the aging effects associated with the head spray system components:

- ASME Section XI Inservice Inspection Program
- Water Chemistry Program
- One-Time Inspection Program
- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program

Staff Evaluation. The applicant described its AMR for the head spray system in Section 3.1 of the LRA. The staff reviewed this section to determine whether the applicant identified all the applicable aging effects for components in the system and demonstrated that the effects of aging on the components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified by the applicant for the head spray system are as follows:

- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading

- loss of material due to wear

- loss of material due to general, galvanic, pitting, and crevice corrosion

The applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for the head spray system austenitic stainless steel components (piping, fittings, and valve bodies) exposed to reactor coolant water and steam and demineralized water at temperatures up to 288 °C (550 °F). The applicant also identified crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading as an applicable aging effect for small-bore stainless steel piping and fittings in the head spray system. The staff notes that these assessments are consistent with Chapter IV.C1 of NUREG-1801.

The applicant identified crack initiation and growth due to cyclic loading as an applicable aging effect for the low-alloy steel head spray system pressure boundary closure bolting. This identification of crack initiation and growth as an applicable aging effect is similar to Item I.2-b, Chapter VII.I, of NUREG-1801.

The applicant identified loss of material due to wear as an aging effect for the head spray system low-alloy and high-strength, low-alloy steel closure bolting exposed to air and containment nitrogen environment with metal temperatures up to 288 °C (550 °F). The staff notes that this assessment is consistent with Item C1.2-d, Chapter IV.C1, of NUREG-1801.

The applicant identified loss of material due to general, pitting, and crevice corrosion as an aging effect for the carbon steel piping, fittings, flow elements, and valve bodies in contact with demineralized water at temperatures up to 288 °C (550 °F) and for stainless steel, carbon steel, and bronze or brass vents, drains, piping, and valves in contact with air, moisture, humidity, and leaking fluid. The AMR results for these components are not presented in Chapter IV.C1, “Reactor Coolant Pressure Boundary (BWR),” of NUREG-1801. However, AMR results for components with similar materials and environments can be found in other chapters of NUREG-1801 and are used here to evaluate the AMR results presented in LRA Table 3.1-2.

The applicant identified loss of material due to general corrosion as an aging effect for stainless steel, carbon steel, and bronze or brass vents, drains, piping, and valves in contact with air, moisture, humidity, and leaking fluid. The staff finds that the identification of the carbon steel components is consistent with Item E.2-a, Chapter V.E, of NUREG-1801. For the stainless steel, brass, or bronze components, the staff agrees that these components are subject to this aging effect in these environments, since trace levels of corrosive species are generally present in moist environments.

The applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for the carbon steel piping, fittings, flow elements, and valve bodies in contact with demineralized water at temperatures up to 288 °C (550 °F). The staff finds that this identification is consistent with Item D2.1-a, Chapter V.D2, of NUREG-1801.

The applicant did not identify loss of material due to corrosion as an aging effect for closure bolting in the head spray system. This is acceptable because closure bolting is made of low-alloy steel.

The applicant identified no applicable aging effect for stainless steel components externally exposed to air, moisture, and humidity and containment nitrogen. This is acceptable because the environments to which the stainless steel components are exposed are not aggressive.

The aging effects identified in the LRA for the head spray system components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The AMPs for the head spray system are identified in Section 3.1.2.4.6 of this SER. These programs, all of which are common AMPs, are reviewed in the following sections of this SER:

- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- One-Time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)

All of the AMPs listed above are credited for managing the aging effects of several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. On the basis of its review, the staff finds that the AMPs credited in the LRA for the head spray system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.1.2.4.7 Reactor Coolant Pressure Boundary Components in Other Systems

Summary of Technical Information in the Application. The description of all reactor coolant pressure boundary components in other systems can be found in Section 2.3.2, 2.3.3, and 2.3.4 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1 and 3.1-2. The passive, long-lived components subject to AMR are identified within the following 12 systems. The appropriate LRA system tables are identified in parentheses

- High Pressure Coolant Injection (HPCI) System (LRA Table 2.3.2.1)
- Core Spray System (LRA Table 2.3.2.2)
- Reactor Core Isolation Cooling (RCIC) System (Quad City only) (LRA Table 2.3.2.4)
- Isolation Condenser (Dresden only) (LRA Table 2.3.2.5)
- Residual Heat Removal (RHR) System (Quad City only) (LRA Table 2.3.2.6)
- Low Pressure Coolant Injection (LPCI) System (Dresden only) (LRA Table 2.3.2.7)
- Standby Liquid Control (SBLC) System (LRA Table 2.3.2.8)
- Shutdown Cooling System (SDC) (Dresden only) (LRA Table 2.3.3.2)
- Control Rod Drive (CRD) Hydraulic System (LRA Table 2.3.3.3)
- Reactor Water Cleanup (RWCU) System (LRA Table 2.3.3.4)
- Main Steam (MS) System (LRA Table 2.3.4.1)
- Feedwater (FW) System (LRA Table 2.3.4.2)

Aging Effects

The applicant reviewed the industry experience (e.g., NRC information notices, generic letters, and bulletins) and the Dresden and Quad Cities operating experience (e.g., plant maintenance history, modifications, nonconformance reports, and licensee event reports) and identified the aging effects, component intended functions, environment, and materials for each group of reactor coolant pressure boundary components in the above 12 systems in Tables 3.1-1 and Table 3.1-2 of the LRA.

The long-lived, passive pressure boundary components in these 12 systems that are subject to an AMR are fabricated of stainless steel (piping and fittings, tubing, valves, dampeners, flow elements, tubesheet, channel head), CASS (piping and fittings, filters/strainers, and valves), low-alloy steel (closure bolting), and carbon steel (piping and fittings, valves, filters/strainers, flow elements, tubesheet, channel head, shell). The operating environments are reactor coolant water or steam at 288 °C (550 °F), oxygenated water up to 288 °C (550 °F), reactor coolant water up to 225 °C (437 °F), ambient air and humidity at metal temperatures up to 288 °C (550 °F), warm moist air, steam on tube side and demineralized water on shell side of isolation condensers, and containment nitrogen.

The applicant identified the following general aging effects for the reactor coolant pressure boundary components in the ESF and the auxiliary and steam and power conversion (SPC) systems:

- build up of deposit/fouling
- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading
- cumulative fatigue damage
- loss of fracture toughness due to thermal aging embrittlement
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to wear
- wall thinning due to flow-accelerated corrosion

Aging Management Programs

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following seven AMPs for the reactor coolant pressure boundary components in the ESF and the auxiliary and SPC systems:

- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Corrosion Program
- Heat Exchanger Test and Inspection Activities Program
- ASME Section XI Inservice Inspection Program
- One-Time Inspection Program
- Water Chemistry Program

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the reactor coolant pressure boundary components in the ESF and the auxiliary and SPC systems. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The applicant identified the following aging effects for the reactor coolant pressure boundary components in the ESF and the auxiliary and SPC systems.

- build up of deposit/fouling
- crack initiation and growth due to SCC, IGSCC, thermal and mechanical loading, and cyclic loading
- cumulative fatigue damage

- loss of fracture toughness due to thermal aging embrittlement
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to wear
- wall thinning due to flow-accelerated corrosion

In LRA Table 3.1-2, the applicant identified build up of deposit due to fouling as an applicable aging effect for the stainless steel tubes in the isolation condenser heat exchangers (Dresden only) exposed to steam on the tube side and demineralized water on the shell side. The applicant refers to an "EPRI/SANDIA" report that identifies fouling as an applicable effect due to construction and operating conditions. In the LRA Table 3.1-2, Reference No. 3.1.2.15, the applicant pointed out that NUREG-1801 does not identify fouling as an applicable aging effect.

In RAI B.2.6-e, the staff requested that the applicant provide a full reference to the EPRI/SANDIA report referred to in the LRA and summarize the industry and plant-specific experience related to fouling of the isolation condenser heat exchangers in demineralized water. In response to RAI B.2.6-e, in a letter dated October 3, 2003, the applicant stated that the EPRI/SANDIA reports identified in Aging Management Reference 3.1.2.15 of LRA Table 3.1-2 are EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Appendix G, Heat Exchangers," and Sandia National Laboratory Report SAND93-7070 UC-523, "Aging Management Guideline for Commercial Nuclear Power Plants—Heat Exchangers." The applicant further stated that no Dresden-specific operating experience involving fouling of the isolation condenser tubing in the demineralized water environment was identified. However, EPRI 1003056 identifies fouling as an applicable aging effect for stainless steel tubing in treated water and primary water environments. The staff finds the applicant's response to be acceptable because the staff verified that the EPRI and Sandia reports referenced by the applicant discuss fouling of heat exchangers in nuclear plants and provide credible evidence that fouling of the isolation condenser heat exchangers can occur in primary and secondary water environments.

The applicant identified crack initiation and growth due to cyclic loading as an applicable aging effect for the low-alloy steel standby liquid control system pressure boundary closure bolting exposed to containment nitrogen. The applicant pointed out (LRA Table 3.1-2, Reference No. 3.1.2.1) that NUREG-1801 does not address closure bolting in a containment nitrogen environment. However, it is the cyclic loading, and not the nitrogen environment, that is causing crack initiation and growth. The staff concludes that this identification of crack initiation and growth as an applicable effect for low-alloy steel bolting is acceptable because it is consistent with Item I.2-b in Chapter VII.I of NUREG-1801.

In LRA Table 3.1-2 (Reference Nos. 3.1.2.11, 3.1.2.26, 3.1.2.35, and 3.1.2.52), the applicant identified crack initiation and growth due to SCC as an applicable aging effect for "stainless steel casting" filters/strainers and valves, and stainless steel tanks, and piping and fittings in the control rod drive hydraulic system exposed to oxygenated water up to 288 °C (550 °F). These components serve as reactor coolant pressure boundary, are located around CRD housing, and are exposed to condensate storage tank (CST) water. Therefore, the staff concludes that this identification of crack initiation and growth due to SCC is acceptable. However, the staff noted in RAI 3.1-21a that NUREG-1801 does not address aging management of these CRD components. The staff requested that the applicant submit industry experience and plant-specific experience related to aging degradation of these CRD components. Based on this experience, the applicant was requested to provide justification for not requiring inspection (Item 3.1.2.11 requires water chemistry).

In response to RAI 3.1-21a, in a letter dated October 3, 2003, the applicant stated that no incidents of crack initiation and growth due to SCC in the control rod drive system were identified at Dresden or Quad Cities. A review of industry experience, including Dresden and Quad Cities, noted problems with degradation of the surface plating on CRD hydraulic accumulator interior surfaces resulting in some corrosion and pitting of the plated carbon steel. However, this degradation is not associated with SCC. In addition, the applicant stated that cracking was discovered in the control rod drive hydraulic control system return line near its connection to the reactor. The CRD return line to the reactor has been removed for both Dresden and Quad Cities, thereby eliminating this concern for SCC in the CRD system. Except for the return line to the reactor, the review of operating experience did not produce any indications of SCC in the control rod drive system. SCC has not occurred in the control rod drive system at Dresden or Quad Cities, and the Dresden and Quad Cities CRD systems have been modified to remove the components where SCC has occurred at other BWRs. The Dresden and Quad Cities experience base, together with the control rod drive systems' modification, supports a conclusion that properly controlled water chemistry is adequate to eliminate the potential for SCC, and inspection for occurrence of SCC in the control rod drive system is not required.

The staff finds the applicant's response to RAI 3.1-21a to be not completely satisfactory since the applicant relies upon the Water Chemistry Program alone to manage possible SCC in the control rod drive system. The applicant should perform a one-time inspection of the system components to verify that the Water Chemistry Program is providing adequate protection against SCC. The applicant needs to provide documentation for a one-time inspection. In response to Supplemental RAI 3.1-21a in a letter dated December 22, 2003, the applicant stated that the process fluid temperature in the CRD hydraulic system is less than 100 °F, and the typical flow conditions are either low flow (in the cooling water line) or stagnant flow (in the charging water and drive water lines). With process temperatures below 140 °F, EPRI TR 1003056, "Mechanical Tools Appendix A" states that cracking due to SSC is very unlikely to occur. In addition, the applicant believes that water chemistry controls sufficient to prevent loss of material due to pitting and crevice corrosion in the CRD hydraulic system are also sufficient to prevent stress corrosion cracking in that system. Nonetheless, the applicant will include inspection for stress corrosion cracking as part of its one-time inspection to validate the effectiveness of the Water Chemistry Program (LRA Appendix B.1.2) in managing the aging of stainless steel components in the CRD hydraulic system. The staff finds the applicant's response acceptable because the one-time inspection to validate the effectiveness of the water chemistry is adequate for managing possible SCC in the CRD system.

The applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for stainless steel reactor coolant pressure boundary components in the HPCI, core spray, RCIC, RHR, LPCI, SBLC, SDC, RWCU, MS, and FW systems and the isolation condenser exposed to 288 °C (550 °F) reactor coolant water or steam. Although some of these components are not evaluated in NUREG-1801, similar combinations of materials and environments are evaluated. The identification of crack initiation and growth in the stainless steel components exposed to 288 °C (550 °F) reactor coolant water or steam is consistent with Item C1.1-f, Chapter IV.C1, of NUREG-1801.

The applicant identified crack initiation and growth due to SCC and IGSCC as an applicable aging effect for the CASS reactor water cleanup system valves. This is acceptable because CASS components are susceptible to cracking due to SCC and IGSCC if the CASS ferrite content is less than 7.5 percent by volume and carbon is greater than 0.03 percent by weight.

The applicant identified crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading as an applicable aging effect for stainless steel small-bore piping and fittings in the reactor coolant pressure boundary components for the HPCI, core spray, RCIC, and RWCU systems and the isolation condenser. The applicant also identified crack initiation and growth due to thermal and mechanical loading as an applicable aging effect for carbon steel small-bore piping and fittings in the main steam and feedwater systems exposed to 288 °C (550 °F) reactor coolant water or steam. This identification of the aging effect is consistent with Item C1.1-i, Chapter IV.C1, of NUREG-1801.

The applicant identified crack initiation and growth due to SCC or cyclic loading as an applicable aging effect for the reactor coolant pressure boundary components in the isolation condenser (stainless steel tubes, carbon steel or stainless steel tubesheet and channel head, and carbon steel shell) exposed to steam on the tube side and demineralized water on the shell side. This identification of the aging effect is consistent with Item C1.4-a, Chapter IV.C1, of NUREG-1801.

The applicant identified cumulative fatigue damage as an applicable aging effect for the high-strength, low-alloy steel closure bolting in the HPCI, core spray, RCIC, RHR, LPCI, SBLC, RWCU, main steam, and feedwater systems and the isolation condenser externally exposed to air with metal temperatures up to 288 °C (550 °F). This identification is consistent with Item C1.3-g, Chapter IV.C1, in NUREG-1801.

In LRA Table 3.1-2, Reference Nos. 3.1.2.1 and 3.1.2.2, the applicant identified crack initiation and growth due to cyclic loading and loss of material due to wear as applicable aging effects for closure bolting in the reactor coolant pressure boundary portion of all the other systems and credited LRA Appendix B.1.12, “Bolting Integrity,” for managing these aging effects. This identification of aging effects is consistent with NUREG-1801 as mentioned earlier. However, the applicant does not identify loss of preload as an aging effect for this closure bolting. In LRA Appendix B.1.12, the applicant stated that loss of preload in a mechanical joint is a design driven process and, therefore, is not an aging effect. The staff noted that loss of preload, however, might take place during operation when closure bolting is subject to high temperatures, cyclic loads, differential thermal expansion, and vibrations. In RAI 3.1-13, the staff requested the applicant to explain why periodic inspection of the closure bolting for indication of loss of preload due to the aforementioned mechanisms is not required. The staff further requested the applicant, if periodic inspection is required, to reference the appropriate AMP and include the appropriate inspection in the AMP.

The applicant’s response to this RAI is evaluated in Section 3.1.2.4.1.2 of this SER. The staff found the response not completely acceptable for the following reason. LRA Section 3.1.1.2.1 does not address loss of preload as an aging effect, and states that loss of preload mechanisms are typically addressed during installation and subsequent maintenance of closure bolting. However, the applicant's response to RAI 3.1-13 stated that loss of preload will be managed, and that the enhanced Bolting Integrity Program will be comprised of periodic ISIs and piping and components preventative maintenance inspections. In Supplemental RAI 3.1-13, the staff requested the applicant to describe the maintenance program activities that are performed on the bolts so that loss of preload is significantly reduced or eliminated, and to identify whether retorquing of the bolts to the design preload values is performed after the component is reassembled. The applicant's response to Supplemental RAI 3.1-13 is evaluated in Section 3.1.2.4.1 of this SER. The staff finds the response acceptable.

The applicant identified cumulative fatigue damage as an applicable aging effect for reactor coolant pressure boundary components (carbon steel, stainless steel, and CASS piping, fittings, and valve bodies) in the HPCI, core spray, RCIC, RHR, LPCI, SBLC, RWCU, MS, and FW systems, and the isolation condenser internally exposed to 288 °C (550 °F) reactor coolant water or steam. The identification of cumulative fatigue damage as an applicable aging effect is consistent with Items C1.1-h and C1.3-d, Chapter IV.C1, of NUREG-1801.

The applicant identified loss of fracture toughness due to thermal aging embrittlement as an applicable aging effect for CASS valve bodies in the reactor water cleanup system, but not in the control rod drive hydraulic systems. Both of these systems are internally exposed to 288 °C (550 °F) reactor coolant water. In RAI 3.1-20b, the staff requested that the applicant explain why loss of fracture toughness is not an applicable aging effect for CASS valve bodies in the control rod drive hydraulic system. In addition, the staff requested that the applicant confirm whether there are any other reactor coolant pressure boundary components in the other systems that are made of CASS. If there are, then the applicant needs to submit AMR results for these components.

In response to RAI 3.1-20b, in a letter dated October 3, 2003, the applicant stated, as explained in its response to RAI 3.2-20a, that valves in the control rod drive hydraulic system are not exposed to temperatures of 250 °C (482 °F) or greater. Only the reactor water cleanup system and the reactor recirculation system include stainless steel valves in this category. All other stainless steel valves, with an operating temperature of less then 250 °C (482 °F), are assigned material types of stainless steel casting or stainless steel with the only aging effect being crack initiation and growth. The aging management results for CASS valves in the reactor water cleanup system and in the reactor recirculation system are provided in LRA Table 3.1-1, Aging Management References 3.1.1.9 and 3.1.1.15. The staff finds the applicant's response to be acceptable because the embrittlement aging effect of concern here is applicable only to CASS components exposed for extended periods of time to temperatures of 250 °C (482 °F) or greater.

The applicant identified loss of material due to general (carbon steel only), pitting, and crevice corrosion as an applicable aging effect for reactor coolant pressure boundary components in the isolation condenser (stainless steel tubes, carbon steel or stainless steel tubesheet and channel head, carbon steel shell) exposed to steam on the tube side and demineralized water on the shell side. This identification of the aging effect is consistent with Item C1.4-b, Chapter IV.C1, of NUREG-1801.

The applicant identified loss of material due to pitting and crevice corrosion as an applicable aging effect for the "stainless steel casting" filter/strainers and valves, and stainless steel piping and fittings, and tanks in the control rod drive hydraulic system exposed to oxygenated water up to 288 °C (550 °F). NUREG-1801 does not include AMR results for these control rod drive hydraulic system components. However, the applicant's identification of loss of material due to pitting and crevice corrosion as an aging effect for stainless steel components exposed to oxygenated water up to 288 °C (550 °F) is consistent with the NUREG-1801 evaluation for a similar combination of material and environment (see Item D2.1-e, Chapter V.D2, in NUREG-1801). The identification of loss of material in "stainless steel casting" components in the control rod drive hydraulic system is acceptable because the oxygenated water may contain some low levels of contaminants such as chlorides.

The applicant also identified loss of material due to pitting and crevice corrosion as an applicable aging effect for stainless steel tubing support in the main steam system externally exposed to warm, moist air. This identification of loss of material due to pitting and crevice corrosion of stainless steel supports exposed to warm, moist air is acceptable because the BWR moist environment is likely to carry corrosive contaminants, such as chlorides, which can, under certain circumstances, corrode stainless steel components.

The applicant identified loss of material due to wear as an applicable aging effect for closure bolting in the SBLC system, but not in the HPCI, core spray, RCIC, RHR, LPCI, RWCU, MS, and FW systems, and the isolation condenser externally exposed to air with metal temperatures up to 288 °C (550 °F). The staff requested in RAI 3.1-22 that the applicant provide the technical basis for not identifying loss of material due to wear as an applicable aging effect for all the closure bolting in the reactor coolant pressure boundary portion of all the other systems.

In response to RAI 3.1-22, in a letter dated October 3, 2003, the applicant stated that the LRA does, in fact, identify loss of material due to wear as an applicable aging effect for closure bolting in the HPCI, core spray, RCIC, RHR, and LPCI systems and in the isolation condenser. Loss of material due to wear is identified for closure bolting in several LRA Chapter 2.3 tables and is managed by the Bolting Integrity Program. The applicant further stated that loss of material due to wear and crack initiation and growth due to cyclic loading should have been identified for closure bolting in systems RWCU, MS, and FW and will also be managed with the Bolting Integrity Program . The environment for closure bolting Aging Management References 3.1.2.1, 3.1.2.2, 3.2.2.1, and 3.2.2.4 should have read, "Air with metal temperature up to 288 °C (550 °F). This environment description is consistent with the environment used in NUREG-1801, Chapter IV, Items C1.3-e and C1.3-f.

The applicant also stated that LRA Tables 2.3.3-4, 2.3.4-1, and 2.3.4-2 for RWCU, MS, and FW should have included closure bolting. In addition, the applicant described changes to LRA Tables 3.1-2 and 3.2-2 that specifically include closure bolting as a component subject to aging effects and the applicant's Bolting Integrity Program as the applicable AMP. The staff finds the applicant's response to be acceptable because the applicant identified loss of material due to wear as an applicable aging effect for closure bolting in all of the systems in question. The applicant further provided an AMP for dealing with this aging effect that is consistent with GALL.

In LRA Section 3.1.1.2.2, the applicant identified wall thinning due to flow-accelerated corrosion as an applicable aging effect for reactor coolant pressure boundary carbon steel components (valves, piping and fittings, and flow elements) in the feedwater and main steam systems exposed to 288 °C (550 °F) reactor coolant water or steam. This identification of wall thinning due to flow-accelerated corrosion as an applicable aging effect is consistent with Items C1.1-a and C1.1-c, Chapter IV.C1, of NUREG-1801. The applicant stated that wall thinning due to flow-accelerated corrosion is not an applicable aging effect for carbon steel components in the HPCI, core spray, RCIC, or SDC systems because D/QCNPS operates these systems for less than 2 percent of plant operating time or at flow rates less than 6 ft/sec. Under these operating conditions, according to EPRI NSAC-202L-R2 and EPRI TR-114882, the carbon steel components are not susceptible to wall thinning due to flow-accelerated corrosion.

The staff noted in RAI 3.1-23 that DC/QCNPS has now implemented extended power uprates to increase the power output of each of the four units. Such uprates are often accompanied by increases in, for example, main steam and feedwater flows in BWRs. The staff, therefore, requested the applicant to explain how the effects of extended power uprates are taken into account in identifying components susceptible to wall thinning due to flow-accelerated corrosion.

In response to RAI 3.1-23, in a letter dated October 3, 2003, the applicant listed the steam flow and the feedwater flow at Dresden and Quad Cities both before and after the power uprates and noted that both flow rates increased by about 20 percent as a result of the uprates. The applicant further stated that these increases in steam flow and feedwater have been considered and appropriately incorporated into the Flow-Accelerated Corrosion programs at Dresden and at Quad Cities. The predictive analysis, CHECWORKS, has been updated to reflect uprate design conditions such as mass flow, temperature, and steam quality. Where appropriate, inspection intervals have been moved forward to address increased wear rates. The staff finds the applicant's response to be acceptable because the CHECWORKS code provides an acceptable approach for managing possible flow-accelerated corrosion in reactor coolant pressure boundary carbon steel components.

The aging effects identified in the LRA for the reactor coolant pressure boundary components in other systems are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following seven common AMPs for managing aging in the reactor coolant pressure boundary components in the ESF, auxiliary, and SPC systems. These programs are reviewed by the staff in the SER sections listed below in parentheses:

- Bolting Integrity Program (Section 3.0.3.5)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Heat Exchanger Test and Inspection Activities Program (Section 3.0.3.16)
- ASME Section XI Inservice Inspection Program (Section 3.0.3.1)
- One-Time Inspection Program (Section 3.0.3.10)
- Water Chemistry Program (Section 3.0.3.2)

The applicant credited the BWR Stress Corrosion Cracking (LRA Appendix B.1.7) and Water Chemistry (LRA Appendix B.1.2) Programs for managing crack initiation and growth due to SCC and IGSCC in stainless steel components in the HPIC, core spray, RCIC, RHR, LPCI, SBLC, SDC, RWCU, MS, and FW systems and the isolation condenser. The applicant also stated that the BWR Stress Corrosion Cracking Program is based on BWRVIP-75, “Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules.”

In RAI 3.1-24, the staff made the following four requests to the applicant:

(1) Submit information about D/QCNPS plant-specific experience related to IGSCC cracking of the stainless steel components in the HPIC, core spray, RCIC, RHR, LPCI, SBLC, SDC, RWCU, MS, and FW systems and the isolation condenser.

(2) Submit information about mitigation actions taken at D/QCNPS with respect to selection of materials that are resistant to sensitization, use of special processes that reduce residual tensile stress, and monitoring of water chemistry as specified by NUREG-1801, Chapter XI.M7.

(3) Confirm whether HWC and NMCA are implemented at D/QCNPS, and If so, explain how this implementation has affected monitoring of water chemistry parameters.

(4) Submit information on the inspection frequency (based on whether HWC and/or NMCA are used) and the corresponding number of welds to be inspected following the BWRVIP-75 guidelines.

The staff’s evaluation of RAI 3.1-24 is presented in Section 3.1.2.4.3.2 of this SER. In that evaluation, the staff concludes that the responses to RAIs 3.1-24(a) and (b) are acceptable, but the responses to RAIs 3.1-24(c) and (d) need to be clarified.

The applicant credited LRA Appendix B.1.1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for managing loss of fracture toughness due to thermal aging embrittlement in reactor water cleanup valve bodies made of CASS. The Inservice Inspection Program includes visual inspection for detecting surface-breaking cracks in the CASS valve bodies. Inspection for cracking is acceptable for managing loss of fracture toughness in CASS valve bodies because loss of fracture toughness in CASS components becomes a concern only if cracks are present. The use of visual inspection is acceptable because the cracks are likely to be surface cracks caused by SCC or IGSCC. However, the staff noted in RAI 3.1-14 that the applicant needs to provide the technical basis showing how the proposed visual inspection technique is qualified for detecting IGSCC cracks in the CASS valve bodies. In addition, ASME Section XI, Subsection IWB, provides little guidance as to how flaws detected in CASS components should be evaluated to determine acceptability for continued service. Therefore, the applicant should submit a procedure describing how the detected flaws in D/QCNPS CASS valve bodies will be evaluated.

The applicant’s response to this RAI is evaluated in Section 3.1.2.4.3.2 of this SER. The staff finds the applicant’s response acceptable because it is consistent with the GALL position that the Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS.

The applicant credited LRA Appendix B1.2, "Water Chemistry Program," alone, for managing crack initiation and growth due to SCC for “stainless steel casting” valves, filters/strainers, and stainless steel tanks and piping and fittings in the control rod drive hydraulic system exposed to oxygenated water up to 288 °C (550 °F). The applicant pointed out in the LRA that NUREG-

1801 does not address this environment for these CRD components located around CRD housing containing CST water and that this also serves as a reactor coolant pressure boundary. However, the staff notes in RAI 3.1-21b that Appendix B1.2 is just a mitigation program and not a condition monitoring program, and therefore, requested the applicant to submit a program to verify the effectiveness of the Water Chemistry Program and to assure that degradation is not occurring. In response to RAI 3.1-21b, in a letter dated October 3, 2003, the applicant stated that SCC occurs through the combination of high stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. Elimination or reduction in any of these three factors will decrease the likelihood of SCC occurring. The control rod drive system water is supplied by the CST. The water in the CST is monitored and controlled to keep known detrimental contaminants below the system-specific limits indicated in the EPRI water chemistry guidelines (TR-103515) to mitigate corrosion.

The applicant asserted that the Water Chemistry Program is generally effective in removing impurities from intermediate and high flow areas. NUREG-1801 identifies circumstances in which the water chemistry program is to be augmented to manage the effects of aging for license renewal. For example, control of CST chemistry in accordance with EPRI guidelines does not preclude loss of material of stainless steel at locations of stagnant flow conditions. Accordingly, in those cases, verification of the effectiveness of the CST Chemistry Control Program is undertaken to ensure that significant degradation is not occurring and the component intended function will be maintained during the period of extended operation. As discussed in NUREG-1801, an acceptable verification program is a one-time inspection of selected components at susceptible locations in the system. AMP B.1.23, “One-Time Inspection,” requires an inspection of components exposed to CST water. An inspection is to be conducted of stainless steel CRD components exposed to CST water to verify the effectiveness of CST chemistry and confirm the absence of loss of material in stagnant flow areas, as required by NUREG 1801. The references for these inspections are in LRA Table 3.1-2, Aging Management References 3.1.2.10, 3.1.2.25, 3.1.2.34, and 3.1.2.53. The applicant asserted that the water chemistry controls that are sufficiently effective to prevent loss of material at stagnant flow locations are also expected to be effective at preventing SCC.

The staff does not agree with the applicant that a one-time inspection for loss of material would cover the need for a one-time inspection for cracking due to SCC because the locations susceptible to loss of material are generally different than the locations susceptible to cracking due to SCC. Therefore, in Supplemental RAI 3.1-21(b), the staff requested the applicant to provide a one-time inspection for cracking due to SCC at the susceptible locations.

In response to Supplemental RAI 3.1-21(b), in a letter dated November 21, 2003, the applicant stated that the process fluid temperature in the control rod drive hydraulic system is less than 100 °F, and the typical flow conditions are either low flow (in the cooling water line) or stagnant flow (in the charging water and drive water lines). Under these conditions, it is expected that the stagnant flow locations that are susceptible to loss of material due to pitting and crevice corrosion are also the locations that may be susceptible to cracking due to SCC. In the piping system for the control rod drive hydraulic system, where the same water chemistry applies to all parts of the system, Exelon believes that water chemistry controls sufficient to prevent loss of material due to pitting and crevice corrosion are also sufficient to prevent SCC. In addition, with process temperatures below 140 °F, EPRI TR-1003056, “Mechanical Tools, Appendix A,” states that cracking due to SSC is very unlikely to occur in the control rod drive hydraulic system. Nonetheless, the applicant will include inspection for SCC as part of its one-time inspection to validate the effectiveness of the Water Chemistry Program (LRA Appendix B.1.2) in managing the aging of stainless steel components in the control rod drive hydraulic system. This is part of Commitment #23 of Appendix A of this SER. The staff finds the response acceptable because the control rod drive hydraulic system piping is not susceptible to cracking due to SCC because it is exposed to a fluid temperature of 100 °F, which is less than the temperature 140 °F at which stainless steel becomes susceptible to SCC. In addition, the applicant has committed to perform a one-time inspection to validate the effectiveness of the Water Chemistry Program. This is part of Commitment #23 in Appendix A of this SER.

The staff reviewed the UFSAR Supplement in Appendix A of the LRA for each of the above seven AMPs to ensure that the program descriptions adequately describe the AMPs. No inconsistencies were found on the basis of the above analyses as related to the pressure boundary components in the ESF and the auxiliary and SPC systems.

All of the AMPs listed above are credited for managing the aging effects of several components in various different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor coolant pressure boundary components in other systems will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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 Engineered Safety Features Systems

This section addresses the aging management of the components of the engineered safety features (ESF) systems. The systems are described in the following SER sections:

- high pressure coolant injection system (2.3.2.1)
- core spray system (2.3.2.2)
- containment isolation components and primary containment piping system (2.3.2.3)
- reactor core isolation cooling system (Quad Cities only) (2.3.2.4)
- isolation condenser (Dresden only) (2.3.2.5)
- residual heat removal system (Quad Cities only) (2.3.2.6)
- low pressure coolant injection system (Dresden only) (2.3.2.7)
- standby liquid control system (2.3.2.8)
- standby gas treatment system (2.3.2.9)
- automatic depressurization system (2.3.2.10)
- anticipated transient without scram system (2.3.2.11)

The applicant noted in LRA Section 2.3.2 that the ATWS system is not classified in the Dresden or Quad Cities UFSAR as an ESF. However, the ATWS system is evaluated in this section because of its similarity with other systems that are characterized as ESF systems.

As discussed in Section 3.0.1 of this SER, the components in each of these ESF systems are rolled up into one of two LRA tables. LRA Table 3.2-1 consists of ESF system components that are evaluated in the GALL Report, and LRA Table 3.2-2 consists of ESF system components that are not evaluated in the GALL Report.

3.2.1 Summary of Technical Information in the Application

In LRA Section 3.2, the applicant described its AMRs for the ESF systems.

The description of the systems that comprise the ESF systems can be found in Section 2.3.2 of the LRA.

The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.2-1 through 2.3.2-11.

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

The applicant's review of industry operating experience included a review of operating experience through 2002. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL.

The applicant's on-going review of plant-specific and industry-wide operating experience is conducted in accordance with the Exelon's Operating Experience Program.

3.2.2 Staff Evaluation

In Section 3.2 of the LRA, the applicant described its AMR for the ESF systems. The staff reviewed LRA Section 3.2 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the ESF system components that are determined to be within the scope of license renewal and subject to an AMR.

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

In LRA Section 3.2, the applicant provided brief descriptions of the ESF systems and summarized the results of its AMR of the ESF systems.

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

Table 3.2-1 Staff Evaluation for Dresden and Quad Cities Engineered Safety Features System Components in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.1 below.)
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to general corrosion	Water Chemistry and One-Time Inspection	Water Chemistry and One-Time Inspection	Consistent with GALL, with exception. GALL recommends further evaluation. (See Sections 3.0.3.2 and 3.2.2.2.2.)
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant specific	Water Chemistry, One-Time Inspection, Bolting Integrity, and Structural Monitoring Program	Consistent with GALL, with exception. GALL recommends further evaluation. (See Sections 3.0.3.2, 3.0.3.5, and 3.2.2.2.2.)
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry, One-Time Inspection, Compressed Air Monitoring, Bolting Integrity, and Structural Monitoring Program	Consistent with GALL, with exception. GALL recommends further evaluation. (See Sections 3.0.3.2, 3.0.3.5, and 3.2.2.2.3.)
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to pitting and crevice corrosion	Plant specific	Water Chemistry, One-Time Inspection, Compressed Air Monitoring, Bolting Integrity, and Structural Monitoring Program	Consistent with GALL, with exception. GALL recommends further evaluation. (See Sections 3.0.3.2, 3.0.3.5, and 3.2.2.2.3.)

Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Containment isolation valves and associated piping	Loss of material due to microbiologically influenced corrosion	Plant specific	Heat Exchanger Test and Inspection Activities, Water Chemistry, Selective Leaching of Materials, and Lube Oil Monitoring Activities	Consistent with GALL, with exception. GALL recommends further evaluation. (See Sections 3.0.3.2 and 3.2.2.2.4.)
Seals in standby gas treatment system	Changes in properties due to elastomer degradation	Plant specific	Periodic Inspection of Ventilation System Elastomers	Consistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.5.)
Drywell and suppression chamber spray system nozzles and flow orifices	Plugging of nozzles and flow orifices due to general corrosion	Plant specific	Periodic Testing of Drywell and Torus Spray Nozzles	Materials used are inconsistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.6.)
Piping and fittings of CASS in emergency core cooling system	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement CASS	N/A	CASS material does not exist at Dresden and Quad Cities.
Components serviced by open-cycle cooling system	Local loss of material due to corrosion and/or buildup of deposit due to biofouling	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System	Materials used are inconsistent with GALL.
Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System	Materials used are inconsistent with GALL.
Emergency core cooling system valves and lines to and from HPCI and RCIC pump turbines	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion	Consistent with GALL, with exception. (See Section 3.2.2.2.7.)
Pumps, valves, piping, and fittings in emergency core cooling systems	Crack initiation and growth due to SCC and IGSCC	Water Chemistry and BWR Stress Corrosion Cracking	Water Chemistry and BWR Stress Corrosion Cracking	Consistent with GALL, with exception. (See Sections 3.0.3.2, 3.2.2.1, and 3.2.2.2.8.)
Closure bolting in high pressure or high temperature systems	Loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC	Bolting Integrity	Bolting Integrity	Consistent with GALL, with exception. (See Sections 3.0.3.5 and 3.2.2.1.)

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant's claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

3.2.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

The applicant indicated that all TLAAs, including those for the Class 1 components of the ESF systems, were evaluated in the RCS section of the LRA. The ESF systems involved in the TLAA are high pressure coolant injection, core spray, reactor core isolation cooling, isolation condenser, residual heat removal, low pressure coolant injection, standby liquid control, and automatic depressurization systems. The applicant discussed the TLAA in Section 4.3 of the LRA, "Metal Fatigue of the Reactor Vessel, Internals, and Reactor Coolant Pressure Boundary Piping and Components." This TLAA is evaluated in Section 4.3 of this SER.

3.2.2.2.2 Loss of Material Due to General Corrosion

Loss of material due to general corrosion could occur in the pumps, valves, piping, and fittings associated with the BWR emergency core cooling systems (ECCS) and with lines to the suppression chamber and to the drywell and suppression chamber spray system. Since control of primary water chemistry does not preclude loss of material due to general corrosion at locations of stagnant flow conditions, the GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion to verify the effectiveness of the Chemistry Control Program. A one-time inspection of select components at susceptible locations is considered an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

The applicant stated in LRA Section 3.2.1.1.2 that an inspection of selected components exposed to a stagnant flow water environment will be conducted in accordance with the One-Time Inspection Program (B.1.23.). The inspection of selected components will verify the effectiveness of the Chemistry Control Program to manage loss of material due to general corrosion in low flow or stagnant flow areas by ensuring that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. The applicant stated that representative HPCI components, such as carbon steel HPCI torus suction check valves and the HPCI booster pumps, were selected to provide typical samples of the aging effects seen in the ESF systems. Each will undergo a visual examination. The staff finds the applicant's One-Time Inspection Program fulfills its purpose of verifying the effectiveness of the Chemistry Control Program, and is acceptable. The staff's evaluation of the Water Chemistry Program (B.1.2), including its exception to the GALL program, and One-Time Inspection Program is provided in Section 3.0.3.2 and Section 3.0.3.10, respectively, of this SER.

Loss of material due to general corrosion could also occur in the drywell and suppression chamber spray systems header and spray nozzle components, standby gas treatment system components, containment isolation valves and associated piping, the automatic depressurization system piping and fittings, ECCS header piping and fittings and spray nozzles, and the external surfaces of BWR carbon steel components. The GALL Report recommends further evaluation on a plant-specific basis to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

The applicant stated in LRA Section 3.2.1.1.3 that an inspection in accordance with the One-Time Inspection Program (B.1.23) of SGTS ducts and components will be performed. This One-Time Inspection Program will provide assurance that penetrating corrosion of SGTS components is not occurring at an unacceptable rate. The inspection will consist of VT-3 visual inspections for the presence of general corrosion in selected standby gas treatment components.

The applicant stated that a one-time inspection will be performed for carbon steel piping most likely to experience a loss of material in the Dresden and Quad Cities safety relief discharge piping, Dresden and Quad Cities HPCI systems, Dresden LPCI (spray piping) system, Quad Cities RHR (spray piping), and the Quad Cities RCIC system. The examination will consist of four ultrasonic tests for the safety relief discharge piping and HPCI piping at the water-line area where general, pitting, and crevice corrosion are more susceptible because of repeated wetting and drying. An evaluation of the inspection results will be performed to determine that there is no unacceptable loss of material for the above ECCS piping exposed to a containment atmosphere environment (wet gas). The applicant also stated that containment isolation barriers (penetration piping and isolation valves) will be inspected per the requirements of AMP

10 CFR Part 50, Appendix J (B.1.28), to verify the pressure retaining integrity of individual penetrations.

Carbon steel components are generally susceptible to aging effects in a moisture environment, and may thus require an AMP that requires periodic monitoring, rather than a one-time inspection. In RAI 3.2-1(a), the staff requested the applicant to justify the use of the One-Time Inspection Program alone to manage the aging effects for the components covered in LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5. In RAI 3.2-1(b), the staff also requested the applicant to provide the basis for the determination of the sample size and location for inspection, and to explain why the proposed one-time inspection of the HPCI and SR discharge piping will be adequate to ensure that the effects of aging to the RCIC piping will be adequately managed during the extended operation.

By letter dated October 3, 2003, the applicant responded to RAI 3.2-1(a) by stating the following.

> The one-time inspection ten-element programs associated with LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5, contain allowances for implementing further condition monitoring contingent upon the results of the initial inspections. For the HPCI turbine exhaust piping inspection, engineering will determine the thickness measurement acceptance criteria prior to conducting the examinations. Results of the examinations will be evaluated by engineering to determine a) if loss of material aging is occurring and, if so, b) the rate at which the material is being lost. Engineering evaluations of the test results will also c) determine the need for follow-up examinations to monitor the progression of aging degradation, and (d) identify appropriate corrective actions to mitigate any excessive rates of loss of material discovered. Corrective actions, if necessary, would expand to include other components.
>
> For the safety relief valve discharge piping inspection, any ultrasonic examinations that reveal material loss will be documented and evaluated. The inspection results will determine the amount and rate of corrosion at the waterline. Given the corrosion rate, the remaining life of the piping will be calculated to determine if it is adequate for the extended period of operation. If the projected life of the piping is insufficient for the extended period of operation, engineering will determine if there is a need for altering the water chemistry, replacing the piping, or whether an aging management activity is required to be put in place to manage loss of material in piping during the license renewal period.
>
> The inspection of the ventilation system ductwork and components will determine if penetrating corrosion indicating a loss of material aging degradation is occurring. Results of the examinations will be evaluated by engineering to determine a) if penetrating corrosion indicating a loss of material aging is occurring and, if so, b) the rate at which the material is being lost. Engineering evaluations of the examination results will also c) determine the need for follow-up examinations to monitor the progression of aging degradation, and d) to identify appropriate corrective actions to mitigate any excessive rates of loss of material discovered. Corrective actions, if necessary, would expand to include other components.
>
> Evaluations are performed for test or inspection results that do not satisfy established criteria and a condition report is initiated to document the concern in accordance with the corrective actions program. The corrective actions program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence.

The staff has reviewed the applicant’s response dated October 3, 2003, and finds that the applicant has adequately clarified all the issues raised in RAI 3.2-1(a) regarding the use of the One-Time Inspection Program for the carbon steel components covered by LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5. Based on the fact that the One-Time Inspection Program is pertinent to the components and environments addressed in LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5, and that sufficient inspections will be conducted, as needed, based on initial component test and evaluation, the staff considers the applicant's response to be acceptable.

To respond to RAI 3.2-1(b), the applicant stated the following.

> An ultrasonic examination will be conducted on the steel safety relief valve discharge piping around the torus waterline. . . . The water level in the torus fluctuates approximately four inches between high and low water level, subjecting the section of steel safety relief valve discharge piping at the waterline to repeated wetting and drying. That action makes the piping more susceptible to general pitting and crevice corrosion. The number of pipes within the total sample population for each unit is small (five pipes per unit). Each line contains a carbon steel thermowell and two carbon steel vacuum breakers. The sample locations chosen is representative of the material and environmental conditions that this piping and components experience.
>
> Dresden and Quad Cities will perform an inspection of selected components in the Dresden and Quad Cities HPCI piping systems, Quad Cities RCIC piping systems, LPCI system (Dresden only) (drywell and torus spray piping and components subject to a containment atmosphere environment), and RHR system (Quad Cities only) (drywell and torus spray piping and components subject to a containment atmosphere environment). The inspection will consist of an examination of a representative sample of carbon steel piping system components, including piping and fittings, within the scope of License Renewal that are exposed to a wet gas or air environment to verify that there is no unacceptable loss of material.
>
> The population to be sampled includes: 1) carbon steel piping in the drywell and suppression chamber spray headers from the closed motor-operated spray valves, up to but not including the spray nozzles. . . , 2) HPCI and RCIC (Quad Cities only) turbine exhaust piping, 3) suppression chamber level gauge upper stop valve. Note that there should have been references in Table 2.3.2-1, HPCI system, and Table 2.3.2-4, RCIC system, in the Piping and Fittings Component Group, to Aging Management References 3.2.1.3 and 3.2.1.5.
>
> The suppression chamber level normally fluctuates approximately four inches. Within the sample population, the HPCI and RCIC turbine exhaust piping are most likely to experience a loss of material aging effect within this zone of fluctuation due to differential aeration. Therefore, the inspection shall be conducted on a HPCI turbine exhaust line as a representative sample that is the bounding loss of material condition for all piping within the systems. The containment piping and components that are located above the waterline are subjected to a humid wetted air environment that is less corrosive than the selected sample location. The number of pipes within this total bounding sample population is small and the sample location chosen is representative of the material and environmental conditions that all remaining pipes experience. The applicant stated that the approach to this one-time inspection is similar to the approach approved in NUREG-1769, "Peach Bottom SER, Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3," Section 3.0.3.21.1.

The staff has reviewed the applicant's responses in the above letter and finds that the applicant has adequately addressed all the issues raised in RAI 3.2-1(b). Specifically, the staff finds the sample location determination methodology, as described in the applicant's response, to adequately bound the systems and components to which Items 3.2.1.3 and 3.2.1.5 pertain. Industry experience has indicated that environmental conditions existing at the defined sample test locations, should result in higher rates of material loss than less severe piping environments. The question of piping samples on the HPCI piping adequately reflecting material loss in the RCIC system has been addressed by the applicant's response which states that the RCIC system piping at Quad Cities will be included within the population to be sampled. This additional information clarifies the staff's concerns over the applicant's basis for the determination of the sample size and location for inspection and justifies why the proposed one-time inspection of the HPCI and safety relief valve discharge piping will be adequate to ensure that the effects of aging to the RCIC piping will be adequately managed during the extended period of operation.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.2.2.2.3 Local Loss of Material Due to Pitting and Crevice Corrosion

Local loss of material due to pitting and crevice corrosion could occur in pumps, valves, piping, and fittings associated with BWR ECCS piping and fittings and with lines to the suppression chamber and to the drywell and suppression chamber spray system. Since control of primary water chemistry does not preclude loss of material due to crevice and pitting corrosion at locations of stagnant flow conditions, the GALL Report recommends further evaluation of programs to manage loss of material due to crevice and pitting corrosion to verify the effectiveness of the Chemistry Control Program. A one-time inspection of select components at susceptible locations is considered an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

The applicant stated in LRA Section 3.2.1.1.4 that an inspection of selected components exposed to a stagnant flow water environment will be conducted in accordance with the One-Time Inspection Program (B.1.23.). The inspection of selected components will verify the effectiveness of the Chemistry Control Program in low flow or stagnant flow areas. The inspections ensure that significant degradation due to pitting and crevice corrosion is not occurring and the component intended function will be maintained during the extended period of operation. Examinations will be conducted on components in areas where typically stagnant flow is present but occasionally there is flow, which will cause replenishment of the oxygen supply. Inspections will be conducted on the HPCI torus suction check valves, the HPCI booster pumps, and the control rod drive (CRD) scram valves, which were selected to provide typical samples of the aging effects seen in the ESF systems. The HPCI torus suction check valves are exposed to torus water, while the carbon steel HPCI booster pumps and the stainless steel CRD scram valves are exposed to condensate storage tank water. Each will undergo a visual examination. The staff finds the applicant's One-Time Inspection Program fulfills its purpose of verifying the effectiveness of the Chemistry Control Program, and is acceptable. The staff's evaluation of the Water Chemistry Program (B.1.2), including its exception to the GALL program, and the One-Time Inspection Program is provided in Section 3.0.3.2 and Section 3.0.3.10, respectively, of this SER.

Local loss of material from pitting and crevice corrosion could also occur in the containment isolation valves and associated piping, and automatic depressurization system piping and fittings. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to pitting and crevice corrosion of these components.

The applicant stated in LRA Section 3.2.1.1.5 that an inspection, in accordance with the One-Time Inspection Program (B.1.23), will be performed for carbon steel piping most likely to experience a loss of material in the Dresden and Quad Cities safety relief discharge piping, Dresden and Quad Cities HPCI systems, Dresden LPCI (spray piping) system, Quad Cities RHR (spray piping), and the Quad Cities RCIC system that are exposed to a containment atmosphere environment (wet gas). The safety relief discharge piping at Dresden and Quad Cities is carbon steel. The water level in the suppression chamber fluctuates, subjecting the section of safety relief discharge piping, HPCI piping, and RCIC piping at the water line to repeated wetting and drying, and therefore making it more susceptible to general, pitting, and crevice corrosion in that area. The examination will consist of four ultrasonic tests to detect reduction in wall thickness due to loss of material on the inside of the safety relief discharge and HPCI piping at the water line. An evaluation of the inspection results will be performed to determine that there is no unacceptable loss of material for the selected piping in the above ECCS piping and components exposed to a containment atmosphere environment (wet gas). In addition, containment isolation barriers (penetration piping and isolation valves) will be inspected per the requirements of AMP 10 CFR Part 50, Appendix J (B.1.28), to verify the pressure retaining integrity of individual penetrations.

Carbon steel components are generally susceptible to aging effects in a moist environment, and may thus require an AMP that requires periodic monitoring, rather than a one-time inspection. The staff's request for additional information was provided in RAI 3.2-1(a) for the applicant to justify the use of the One-Time Inspection Program alone to manage the aging effects for the components covered in LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5. The staff's request for additional information was also provided in RAI 3.2-1(b) for the applicant to provide the basis for the determination of the sample size and location for inspection, and to explain why the proposed one-time inspection of the HPCI and safety relief valve discharge piping will be adequate to ensure that the effects of aging to the RCIC piping will be adequately managed during the extended operation. The staff's discussion of these RAIs and their resolution by the applicant are provided in Section 3.2.2.2.2 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to pitting and crevice corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.2.2.2.4 Local Loss of Material Due to Microbiologically Influenced Corrosion

Local loss of material due to microbiologically influenced corrosion (MIC) could occur in BWR containment isolation valves and associated piping in systems that are not addressed in other chapters of the GALL Report. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to MIC of the containment isolation barriers.

The applicant stated in LRA Section 3.2.1.1.6 that management of aging due to local loss of material resulting from MIC in the drywell equipment drain sump and drywell floor drain sump containment isolation barriers is performed in accordance with AMP 10 CFR Part 50, Appendix J (B.1.28). No other containment isolation barriers are subject to loss of material due to MIC or biofouling. The staff's evaluation of this AMP is provided in Section 3.0.3.13 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of local loss of material due to MIC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.2.2.2.5 Changes in Properties Due to Elastomer Degradation

Changes in properties due to elastomer degradation could occur in seals associated with the SGTS ductwork and filters. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of changes in properties due to elastomer degradation.

The applicant stated in LRA Section 3.2.1.1.7 that aging management of SGTS elastomers will be performed by the periodic inspection of ventilation system elastomers in accordance with the plant-specific AMP, Periodic Inspection of Ventilation System Elastomers (B.2.3.). The staff's evaluation of this AMP is provided in Section 3.0.3.17 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of changes in properties due to elastomer degradation, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.2.2.2.6 Buildup of Deposits Due to Corrosion

The plugging of components due to general corrosion could occur in the spray nozzles and flow orifices of the drywell and suppression chamber spray system. This aging mechanism and effect will apply since the spray nozzles and flow orifices are occasionally wetted, even though the majority of the time this system is on standby. The wetting and drying of these components can aid in the acceleration of this particular corrosion. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place to manage this aging effect.

The GALL Report specifies carbon steel material for the drywell and suppression chamber spray system nozzles and flow orifices. In LRA Table 3.2-1, Item 3.2.1.8, the applicant stated that Dresden and Quad Cities have brass/bronze spray nozzles, without providing the plant-specific AMR results for the components. In RAI 3.2-4, the staff requested the applicant to identify the requested AMR links for the components. By letter dated October 3, 2003, the applicant stated that neither drywell nor suppression chamber spray loops contain flow orifices. As such, the material and environment combination specified in Item 3.2.1.8 could not be credited. The applicant also stated that non-NUREG-1801 AMR links in LRA Table 3.2-2, Items 3.2.2.12 and 3.2.2.78, were created for the external and internal environments of the Dresden and Quad Cities brass/bronze spray nozzles.

The applicant further stated that the spray nozzles are included in LRA Table 2.3.2-6, for the RHR system, under the component group “spray nozzles (Quad Cities only),” and in Table 2.3.2-7, for LPCI system, under component group “spray nozzles (Dresden only).” Both tables provide AMR links, Items 3.2.2.12 and 3.2.2.78, for the line items with a “pressure boundary” component intended function, and an AMR link of 3.2.2.78 for line items with a “spray” component intended function. Based on the additional information provided above in the letter of October 3, 2003, the staff found that no aging effect was identified for the external environment of the spray nozzles because the containment nitrogen environment is not conducive to promoting aging degradation. For the internal environment, the applicant will use the plant-specific Periodic Testing of Drywell and Torus Spray Nozzles Program (B.2.4) to manage the plugging general corrosion of spray nozzles. The staff finds the applicant’s response adequately addresses the staff’s concerns on the AMR of the Dresden/Quad Cities spray nozzles, and is acceptable. The staff evaluation of the plant-specific Periodic Testing of Drywell and Torus Spray Nozzles Program is provided in Section 3.2.2.3.1 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of buildup of deposits due to corrosion, as recommended in the GALL report. Since the applicant’s AMR results are otherwise consistent with 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).

3.2.2.2.7 Exception to GALL for Wall Thinning Due to Flow-Accelerated Corrosion

The applicant stated in LRA Section 3.2.1.2.1 that flow-accelerated corrosion is an applicable aging mechanism for the Quad Cities HPCI steam line drains. However, carbon steel components in the ATWS, isolation condenser, core spray, LPCI (Dresden only), RHR (Quad Cities only), primary containment and suppression pool piping, HPCI (except as previously noted), and RCIC (Quad Cities only) systems are not susceptible to flow-accelerated corrosion and do not require aging management. This exception is based on the following.

- EPRI NSAC-202L-R2, ”Recommendations for an Effective Flow-Accelerated Corrosion Program,” allows an exclusion from flow-accelerated corrosion for systems that operate less than 2 percent of plant operating time.

- EPRI TR-114882, ”Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” states that flow rates less than 6 ft/sec do not need to be considered for flow accelerated corrosion.

- NUREG-1557, ”Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal,” states that erosion/corrosion in HPCI and the RCIC turbine steam supply piping is nonsignificant due to the low flow range.

- Dresden and Quad Cities operate these systems less than 2 percent of plant operating time or at flow rates of less than 6 ft/sec. Additionally, plant experience has not revealed flow-accelerated corrosion in these lines.

On the basis of its review, the staff finds that the applicant has presented adequate bases for excluding consideration of flow-accelerated corrosion, as an aging mechanism, for the above-mentioned ESF carbon steel components. This conclusion is based on the industry guidance on the material erosion/corrosion for piping under the conditions of infrequent and slow rates of flow. It is also based on the fact that Dresden and Quad Cities operate these systems at less than 2 percent of plant operating time or at flow rates of less than 6 ft/sec, both bounded by the industry guidelines. In addition, plant-specific operating experience has not revealed flow-accelerated corrosion in these lines. Based on the above, the exception to GALL flow-accelerated corrosion for the identified ESF lines is, therefore, acceptable.

3.2.2.2.8 Exception to GALL for Crack Initiation and Growth Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

In LRA Section 3.2.1.2.2, the applicant stated that NUREG-1801 Program XI.M7, "BWR Stress Corrosion Cracking," does not apply to the segments of ECCS systems which are stainless steel and contain torus water. EPRI TR-1003056, "Mechanical Tools," Appendix A, states that cracking due to SCC and IGSCC is not likely in a high purity environment below 200 °F. NUREG-1801 Program XI.M7 applies to piping that contains reactor coolant at a temperature above 200 °F. The ECCS piping that contains torus water does not reach this level of temperature. Therefore, XI.M7 does not apply. The applicant stated that the Water Chemistry Program alone will manage aging due to cracking by controlling chloride and sulfate contaminants. The staff finds the applicant's basis of taking exception to the GALL program to be acceptable for the above ECCS piping since it is in accordance with the general industry practice.

On the basis of its review, the staff finds that the applicant has presented adequate bases for excluding consideration of crack initiation and growth due to SCC and ISCC, as an aging mechanism, for the above-mentioned ECCS stainless steel components. This conclusion is based on the industry guidance on the material cracking for piping under the conditions of a high purity environment below 200 °F. Based on the above, the exception to GALL crack initiation and growth for the identified ECCS system segments is, therefore, acceptable.

3.2.2.3 Aging Management Programs for ESF System Components

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

The applicant credits 17 AMPs to manage the aging effects associated with components in the ESF systems. All but one AMP are credited to manage aging for components in other system groups (common AMPs). The staff's evaluation of the common AMPs credited with managing aging effects in ESF system components are provided in Section 3.0.3 of this SER. The common AMPs are listed as follows:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- 10 CFR Part 50, Appendix J Inspection Program (Section 3.0.3.13)
- Structures Monitoring Program (Section 3.0.3.14)
- Heat Exchanger Test and Inspection Activities (Section 3.0.3.15)
- Lubricating Oil Monitoring Activities (Section 3.0.3.16)
- Periodic Inspection of Ventilation Elastomers Program (Section 3.0.3.17)

The staff's evaluation of the ESF system-specific AMP, Periodic Testing of Drywell and Torus Spray Nozzles Program, is provided below.

3.2.2.3.1 Periodic Testing of Drywell and Torus Spray Nozzles Program

<u>Summary of Technical Information in the Application</u>. The applicant described its Periodic Testing of Drywell and Torus Spray Nozzles program in Section B.2.4 of Appendix B to the Application. The applicant states that the program is not consistent with a GALL report program; therefore, the applicant summarized the program in terms of the 10-element program as described in Branch Technical Position, Appendix A of the SRP-LR.

The applicant stated that the program addresses a NUREG-1801 Section V.D2.5 concern that flow orifices and spray nozzles in the drywell and torus spray subsystems are subject to plugging by rust from carbon steel piping components. The Dresden and Quad Cities drywell and torus spray nozzles are made of bronze. There are no carbon steel flow orifices in the system piping, within the scope of license renewal. However, upstream carbon steel piping is subject to possible general corrosion. These periodic tests use approved plant procedures to verify that the drywell and torus spray nozzles are free from plugging that could result from corrosion product buildup from upstream sources.

The applicant concludes that the periodic drywell and torus spray nozzle flow tests effectively manage drywell and torus spray header and spray nozzle plugging by corrosion products and that the program provides reasonable assurance that intended functions are maintained consistent with the current licensing basis during the period of extended operation.

<u>Staff Evaluation</u>. In LRA Section B.2.4, "Periodic Testing of Drywell and Torus Spray Nozzles," the applicant described its AMP to verify that the drywell and torus spray nozzles are free from plugging that could result from corrosion product buildup from upstream sources. The staff reviewed this program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled Quality Assurance Program. The staff's evaluation of the Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The remaining

seven elements are discussed below. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that the scope of testing include the drywell and torus spray nozzles. Although there are no carbon steel flow orifices in the system piping which are within the scope of license renewal, upstream carbon steel piping is subject to possible general corrosion. These periodic tests, therefore, use approved plant procedures to verify that the drywell and torus spray nozzles are free from plugging that could result from corrosion product buildup from upstream sources. The staff considers the scope of the AMR activity covered by the program to be clearly defined, and is acceptable.

[Preventive Actions] The applicant stated that the spray nozzle tests do not provide any preventive actions. The spray nozzle tests provide condition monitoring to detect the degradation prior to a loss of function.

[Parameters Monitored/Inspected] The applicant stated that the flow tests demonstrate that the drywell and torus spray nozzles are not blocked by debris or corrosion products, and thereby demonstrate that the nozzles are available to provide the drywell and torus steam quenching functions. Drywell nozzles are tested with compressed air; torus nozzles are tested with water. Test procedures require that flow be demonstrated through each individual nozzle. The staff finds the parameters used to potentially detect material degradation of the nozzles are consistent with general industry experience, and are acceptable.

[Detection of Aging Effects] The applicant stated that the periodic drywell and torus spray nozzle flow tests detect plugging by corrosion products from the degradation of carbon steel piping and fittings. In LRA Section B.2.4, the applicant stated that drywell nozzles are tested with compressed air, and torus nozzles are tested with water to verify that the drywell and torus spray nozzles are free from plugging that could result from corrosion product buildup from upstream carbon steel piping. In RAI B.2.4(c), the staff requested the applicant to explain how the flow tests will reveal the degree of component degradation due to general corrosion, and how general corrosion for the upstream carbon steel piping will be adequately managed. By letter dated October 3, 2003, the applicant stated that the flow tests will not reveal the degree of spray nozzle degradation due to general corrosion of the nozzles since the nozzle material is not related to the aging effect of plugging. Repeated wetting and drying of carbon steel spray header piping upstream can, however, result in corrosion buildup (crud) that may break free from the pipe wall and lodge in a nozzle. The applicant stated that the AMR link, Item 3.2.2.78, is used as the AMR reference for the spray nozzles, and that Item 3.2.2.78 should have listed an aging effect/mechanism of “Plugging of Spray Nozzles/Crud.” The applicant also stated that the aging effect of loss of material due to general corrosion for the upstream carbon steel piping is addressed in LRA Table 3.2-1, Item 3.2.1.3. The staff finds that the applicant’s responses address the staff’s concerns regarding detection of material degradation by the proposed flow tests, and the management of upstream carbon steel piping. These are acceptable to the staff.

[Monitoring and Trending] The applicant stated that the results of the spray nozzle tests are monitored but are not trended. If flow to a nozzle is blocked or restricted, the degraded condition is evaluated and corrective actions are taken to restore normal flow. The applicant did not specify in LRA Section B.2.4 the frequency of the testing and/or monitoring. In RAI B.2.4(a), the staff requested that the applicant provide this additional information. By letter dated October 3, 2003, the applicant stated that both the Quad Cities and Dresden Technical

Specification Surveillance Requirement SR 3.6.2.4.2 requires that the suppression pool spray nozzles be verified as unobstructed every 10 years. Both the Quad Cities and Dresden Technical Requirements Manual Surveillance Requirement TSR 3.6.a.2 requires that each drywell spray nozzle be verified as unobstructed every 10 years. The staff considers the above-stated frequency of testing to be acceptable in detecting degradation in performance due to the passive nozzle design and due to the fact that it has been shown to be acceptable through operating experience.

[Acceptance Criteria] The applicant stated that the test procedures contain acceptance criteria that require that flow be observed from and through each individual drywell and torus spray nozzle. This test procedure is to provide assurance that flow to the drywell and torus spray headers and spray nozzles is not blocked or restricted. The applicant did not provide sufficient details for the acceptance criteria in LRA Section B.2.4. In RAI B.2.4(b), the staff requested the applicant to elaborate on the acceptance criteria, including the definition of an acceptable flow. By letter dated October 3, 2003, the applicant stated its acceptance criteria as described in Dresden procedure DOS 1500-14, “LPCI Torus Spray Test,” such that “water flow is detectable from each individual suppression pool spray nozzle.” QCTS 0320-02, “Suppression Chamber Spray Header and Nozzle Water Spray Test,” acceptance criteria is that “adequate flow is observed from all spray nozzles in RHR A and RHR B loops.” The Quad Cities and Dresden technical specification surveillance requirement will also be used to verify that each suppression pool spray nozzle is unobstructed.

For the drywell spray nozzles, the applicant stated that Dresden procedure DTS 1500-3, “LPCI Containment Spray Test,” acceptance criteria is that “air flow is detectable from each individual drywell spray nozzle.” QCTS 0320-03, “Drywell Spray Header and Nozzle Air Test,” acceptance criteria is that there is “sufficient flow through all spray header nozzles.” The Quad Cities and Dresden technical requirements manual surveillance requirement will also be used to verify that each drywell spray nozzle is unobstructed by performance of an air or smoke flow test of the drywell spray nozzles. The applicant further stated that both DTS 1500-03 and QCTS 0320-03 specify the use of a remote sensing device, such as a smoke tube, to verify air flow from all spray nozzles.

The staff finds that the applicant has a documented description of the acceptance criteria in place, which are found to be sufficient in defining what constitutes an acceptable nozzle test. This is acceptable to the staff.

[Operating Experience] The applicant stated that Dresden has not detected any degradation of the drywell and torus spray headers or spray nozzles. Quad Cities has experienced two events in which foreign material was found in the spray nozzles. In 1998, small amounts of rust were found in some nozzles after a flow test. However, the small amounts of rust found did not pose a blockage problem. In 2000, a 1" x 3" block of wood was found lodged in a spray nozzle subsequent to a spray test, but this was a foreign material exclusion problem unrelated to aging. No rust was found in the spray nozzles during the 2000 test. In RAI B.2.4(d), the staff requested the applicant to discuss corrective actions that have been taken (i.e., procedural controls) to avoid the recurrence of the above event. By letter dated October 3, 2003, the applicant stated that in Condition Report Q2000-00355, the cause was determined to be improper past foreign material exclusion (FME) controls. The applicant stated that this event, along with several others, was reviewed at a Mechanical Maintenance Department weekly meeting. In addition, an evaluation of past operability was performed that concluded that operability was not impacted by the material that was discovered in the nozzle.

Based on the actions taken by the applicant to prevent recurrence of the event, the staff finds the Dresden and Quad Cities operating experience demonstrates that the periodic flow tests effectively manage drywell and torus spray header and spray nozzle plugging by corrosion products, so that the intended function of providing a quenching spray will be maintained during the period of extended operation.

The applicant provided its UFSAR Supplement for the Periodic Testing of Drywell and Torus Spray Nozzles Program in Section A.2.4 of the LRA. The staff reviewed the UFSAR Supplement and finds that the summary description contains a sufficient level of information to satisfy 10 CFR 54.21(d), and is acceptable.

<u>Conclusions</u>. On the basis of its review of the applicant's program, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.2.2.4 Aging Management Review of Plant-Specific Engineered Safety Features Systems Components

In this section of the SER, the staff presents its review of the applicant's AMR for the specific components within the ESF systems. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3.2-1 through 2.3.2-11 to determine whether the applicant had properly identified the applicable aging effects and the AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects for each ESF component, ensuring that each aging effect was evaluated in the appropriate LRA AMR table in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

3.2.2.4.1 High-Pressure Coolant Injection System

<u>Summary of Technical Information in the Application</u>. The description of the HPCI system can be found in Section 2.3.2.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-1. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the HPCI system are described in LRA Section 2.3.2.1 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-1 of the LRA lists individual components of the system including closure bolting, dampeners, filters/strainers, NSR vents or drains, piping and fittings, pumps, restricting orifices, sight glasses, thermowells, tubing, valves, diffusers, flexible hoses, flow orifices, heat exchangers, rupture disc, tanks, traps, and turbine casings.

Low-alloy steel components exposed to containment nitrogen are identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel components exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking. Low-alloy steel components exposed to outdoor ambient conditions are identified as being subject to loss of material due to general corrosion and wear.

Stainless steel, carbon steel, brass, bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion.

Carbon steel components exposed to 25–288 °C (77–550 °F) demineralized water, air or 288 °C (550 °F) steam, or air and steam up to 320 °C (608 °F) (primarily steam) are identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel components exposed to 288 °C (550 °F) reactor coolant water, or 320 °C (608 °F) steam are identified as being subject to wall thinning due to flow-accelerated corrosion. Carbon steel components exposed to lubricating oil (with contaminants and/or moisture) or air are identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion.

Carbon steel casting exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to wall thinning due to flow-accelerated corrosion. Carbon steel casting and carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Stainless steel components exposed to 25–288 °C (77–550 °F) demineralized water, 288 °C (550 °F) reactor coolant water, or air and steam up to 320 °C (608 °F) (primarily steam) are identified as being subject to crack initiation and growth due to stress corrosion cracking and intergranular stress-corrosion cracking. Stainless steel components exposed to air and saturated air, air and steam up to 320 °C (608 °F) (primarily air), or lubricating oil (with contaminants and/or moisture) are identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel components exposed to air and steam up to 320 °C (608 °F) are identified as being subject to loss of material due to pitting and crevice corrosion.

Stainless steel casting and stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Aluminum exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to pitting and crevice corrosion.

Steel chrome moly exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to pitting.

Alloy steel casting exposed to air and steam up to 320 °C (608 °F) is identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Brass, bronze, and cast iron exposed to lubricating oil (with contaminants and/or moisture) are identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion.

Elastomers, neoprene, and similar material exposed to lubricating oil (with contaminants and/or moisture) or moist air are identified as being subject to hardening and loss of strength due to elastomer degradation.

Admiralty brass tubes, brass tube sheets, carbon steel channel heads, and carbon steel shells exposed to condensate (demineralized water) on the tube side and lubricating oil on the shell side are identified as being subject to loss of material due to general corrosion, galvanic corrosion, MIC, erosion or FAC, wear, and selective leaching, as well as cracking due to mechanical fatigue and SCC. Admiralty brass tubes, carbon steel tube sheets, carbon steel channel heads, and carbon steel shells exposed to condensate (demineralized water) on the tube side and reactor coolant water and warm moist air on the shell side are identified as being subject to loss of material due to general corrosion, galvanic corrosion, MIC, erosion or FAC, wear, selective leaching, pitting corrosion, and crevice corrosion, as well as cracking due to mechanical fatigue and SCC. Admiralty brass exposed to condensate (demineralized water) on the tube side and lubricating oil on the shell side, or condensate (demineralized water) on the tube side and reactor coolant water and warm moist air on the shell side, are identified as being subject to buildup of deposit due to fouling.

No aging effects are identified for glass exposed to 25–288 °C (77–550 °F) demineralized water, or air and steam up to 320 °C (608 °F).

Aging Management Programs

The following AMPs are utilized to manage aging effects in the HPCI system:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- Structures Monitoring Program (Section 3.0.3.14)
- Heat Exchanger Test and Inspection Activities (Section 3.0.3.15)
- Lube Oil Monitoring Program (Section 3.0.3.16)

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

Staff Evaluation. Aging Effects: The staff reviewed the information in LRA Tables 2.3.2-1, 3.2-1, and 3.2-2 for the HPCI system. During its review, the staff determined that additional information was needed to complete its review.

The applicant identified in LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5, loss of material due to general corrosion and pitting/crevice corrosion, respectively, for components in standby gas treatment, containment isolation, and emergency core cooling systems. LRA Table 2.3.2-1, for HPCI system, and Table 2.3.2-4, for RCIC system (Quad Cities only), however, does not provide Items 3.2.1.3 and 3.2.1.5 as the AMR links for components in the two systems. In RAI 3.2-2, the staff requested the applicant to explain why Items 3.2.1.3 and 3.2.1.5 are not included in Tables 2.3.2-1 and 2.3.2-4 as the AMR links.

By letter dated October 3, 2003, the applicant stated the following.

> LRA Table 3.2-1, Aging Management References 3.2.1.3 and 3.2.1.5, are not included in LRA Tables 2.3.2-1 and 2.3.2-4 as aging management references because NUREG-1801, Chapter V, does not address HPCI and RCIC carbon steel piping and fittings with an "air and steam up to 320 °C (608 °F) (primarily air)" environment and with a loss of material aging effect due to general, pitting, and crevice corrosion. As such, a non-NUREG-1801 aging management reference was utilized. Table 2.3.2-1 (component group of "Piping and Fittings (includes thermowells)") and Table 2.3.2-4 (component group of "Piping and Fittings (Quad Cities only) (includes rupture discs)") refer to Aging Management Reference 3.2.2.126 for a loss of material due to pitting and crevice corrosion. Aging Management Reference 3.2.2.126 should also have included the aging mechanism of general corrosion.

The staff noted a contradiction in the above applicant's response. It pertains to the exclusion of AMR links, Items 3.2.1.3 and 3.2.1.5, from LRA Tables 2.3.2-1 and 2.3.2-4, respectively, for HPCI and RCIC carbon steel components. LRA Sections 3.2.1.1.3 and 3.2.1.1.5, which are referenced by Items 3.2.1.3 and 3.2.1.5, respectively, provide direct references to HPCI (covered in Table 2.3.2-1) and RCIC (covered in Table 2.3.2-4) piping and components addressed in NUREG-1801. In addition, the applicant's response also contradicts the response to RAI 3.2-1(b), which specifically stated that AMR links, Items 3.2.1.3 and 3.2.1.5, should have been provided in Tables 2.3.2-1 and 2.3.2.4, under the piping and fittings component group. The staff requested the applicant to clarify the above inconsistencies found in its responses to RAIs 3.2-1(b) and 3.2-2. By letter dated December 12, 2003, the applicant stated that it acknowledged the inconsistency found in its response to RAI 3.2-2, and the inconsistency between responses to RAIs 3.2-1(b) and 3.2-2. The applicant stated that these deficiencies will be resolved by revising LRA Tables 2.3.2-1 and 2.3.2-4 to include AMR links, Items 3.2.1.3 and 3.2.1.5, for HPCI and RCIC piping and fittings. The staff finds the applicant's response to be acceptable and concludes that RAI 3.2-2 is closed.

The aging effects identified in the LRA for the HPCI system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified..

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the HPCI system:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- Structures Monitoring Program (Section 3.0.3.14)

- Heat Exchanger Test and Inspection Activities (Section 3.0.3.15)
- Lube Oil Monitoring Program (Section 3.0.3.16)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant's AMR for each of the components in the HPCI system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

In LRA Table 3.2-2, Items 3.2.2.40 and 3.2.2.42, the applicant identified loss of material from galvanic corrosion as an aging effect/mechanism for heat exchangers. Water Chemistry Program (B.1.2) and Heat Exchanger Test and Inspection Activities (B.2.6) were credited to manage this component grouping, in lieu of an AMP specifically developed for the galvanic corrosion. In RAI 3.2-3, the staff requested the applicant to provide the basis for concluding the adequacy of the specified AMPs to manage aging effects for the HPCI heat exchangers due to galvanic corrosion.

By letter dated October 3, 2003, the applicant stated the following.

> The two Dresden and Quad Cities HPCI heat exchangers that are in scope of license renewal are the HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers. Aging Management Reference 3.2.2.40 addresses the HPCI Lubrication Oil Coolers, and Aging Management Reference 3.2.2.42 addresses the HPCI Turbine Gland Seal Condensers. LRA Appendix B, B.1.2, "Water Chemistry" and B.2.6, "Heat Exchanger Test and Inspection Activities," are credited with managing the loss of material aging effect due to galvanic corrosion.
>
> Sandia National Laboratory Report SAND93-7070 UC-523, "Aging Management Guideline for Commercial Nuclear Power Plants - Heat Exchangers," identifies that galvanic corrosion is not a significant aging mechanism for the primary water (shell) side of the HPCI Turbine Gland Seal Condensers and for the oil (shell) side of the HPCI Lubrication Oil Coolers. SAND93-7070 states that galvanic corrosion can be significant for the tube side of both heat exchangers, which are cooled by treated (demineralized) water. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, Section 3.1.3, states that control of galvanic corrosion in treated water systems is possible by following the EPRI Chemistry Guidelines for treated water systems. LRA Appendix B, B.1.2, "Water Chemistry," is based on EPRI Report TR-103515, "BWR Water Chemistry Guidelines."
>
> SAND93-7070 identifies such activities as inspection, eddy current testing, and performance testing as being effective for the detection and mitigation of galvanic corrosion. LRA Appendix B, B.2.6, "Heat Exchanger Test and Inspection Activities," provides for performance monitoring of the HPCI system and visual inspection and eddy current testing of the HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers.
>
> SAND93-7070 identifies that only about 1% of the total number of aging failures of heat exchangers was attributed to galvanic corrosion, because heat exchanger design specifications require that materials of construction be compatible and that galvanic couples between adjacent materials be minimized. The Dresden and Quad Cities HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers have been previously visually inspected and eddy current tested. No failures

due to galvanic corrosion were detected.

The staff has reviewed the applicant's responses provided in the letter of October 3, 2003, and finds that the applicant has adequately addressed all the issues raised in RAI 3.2-3. This is based on the fact that (1) necessary techniques and evaluations are inclusive of the AMPs utilized, (2) stringent design specifications have been required of the heat exchangers, and (3) the plant-specific operating history has shown no failure on the heat exchangers. Therefore, the staff finds the two accredited AMPs, Water Chemistry Program and Heat Exchanger Test and Inspection Activities, to be adequate in managing galvanic corrosion for the heat exchangers.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the core spray system, or to provide an accompanying program to monitor and/or prevent aging. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

In reference to the 10 CFR 54.4(a)(2) components ((a)(2) components) (i.e., non-safety-related affecting safety-related), the applicant stated that a one-time, internal, visual inspection will be performed for possible general, crevice, galvanic, and pitting corrosion. In RAI B.1.23-1, the staff requested the applicant to clarify (1) if aging of (a)(2) components is managed only by the One-Time Inspection Program or is the One-Time Inspection Program used to augment other AMPs for these components, and (2) if any (a)(2) components are managed only by the One-Time Inspection Program, describe the aging effects and justify the use of the program alone to manage these aging effects. By letter dated October 3, 2003, the applicant stated the following.

> For most 10 CFR 54.4(a)(2) components that have intended functions of "Leakage Boundary (spatial)" or "Structural Integrity (attached)," the One-Time Inspection Program does not augment other AMPs. However, as discussed in the response to RAI B.1.23-2, an additional aging management program is applicable for 10 CFR 54.4(a)(2) components with an environment of Lubricating Oil in the Reactor Core Cooling Isolation System and the High Pressure Coolant Injection System, or. . . . For (a)(2) components where aging is managed only by a one-time inspection, Exelon will perform a one-time inspection of selected (a)(2) components to determine whether degradation, if any, caused by loss of material due to general, crevice, or pitting corrosion is proceeding at an acceptably slow rate to ensure that the intended function(s) of the components is maintained during the extended period of operation. The one-time inspection will be performed near the end of the current operating term and before the period of extended operation.

This is part of Commitment #24 of Appendix A of this SER. The staff finds the applicant's response to RAI B.1.23-1(1) to be acceptable, based on the staff's acceptance of the applicant's response to RAI B.1.23-2(a).

The applicant stated that based on the material-environment combinations associated with the (a)(2) components, aging, if any, is expected to progress very slowly. The visual inspections will check for indications of general, crevice, and pitting corrosion. For material-environment combinations with corrosion rates such that loss of intended function due to excessive corrosion might occur during the extended period of operation, corrective actions, such as replacement and/or implementation of additional aging management activities, will be taken. The staff finds the applicant's response to RAI B.1.23-1(2) to be acceptable, based on the staff's acceptance of the applicant's response to RAI B.1.23-2(b).

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the HPCI system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.2 Core Spray System

Summary of Technical Information in the Application. The description of the core spray system can be found in Section 2.3.2.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-2. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1, and 3.2-2.

Aging Effects

Components of the core spray system are described in LRA Section 2.3.2.2 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-2 of the LRA lists individual components of the system including closure bolting, flow elements, NSR vents or drains, piping and fittings, pumps, restricting orifices, sight glasses, thermowells, tubing, and valves.

Low-alloy steel exposed to containment nitrogen is identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water or wet gas is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed up to 225 °C (437 °F) reactor coolant water and carbon steel casting exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to wall thinning due to flow-accelerated corrosion.

Carbon steel casting and carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Stainless steel and stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to crack initiation and growth due to stress-corrosion cracking. Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water and 288 °C (550 °F) reactor coolant water or steam are identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to saturated air is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the core spray system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-2, 3.2-1, and 3.2-2 for the core spray system. On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the system.

The aging effects identified in the LRA for the core spray system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects for the core spray system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.9.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant's AMR for each of the components in the core spray system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verifies that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the core spray system, or to provide an accompanying program to monitor and/or prevent aging. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the core spray system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.3 Containment Isolation Components and Primary Containment Piping System

Summary of Technical Information in the Application. The description of the containment isolation components and primary containment piping system can be found in Section 2.3.2.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-3. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the containment isolation components and primary containment piping system are described in LRA Section 2.3.2.3 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-3 of the LRA lists individual components of the system including closure bolting, flow elements, NSR vents or drains, piping and fittings, restricting orifices, thermowells, tubing, valves, flexible hoses, isolation barriers, and tanks.

Low-alloy steel exposed to containment nitrogen is identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel occasionally exposed to moist air on the inside surface and ambient air on the outside surface is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to treated water or raw water on the inside surface and ambient air on the outside surface is identified as being subject to loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling. Carbon steel exposed to moist atmosphere (air/nitrogen), steam, or demineralized water is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water, or saturated air, warm moist air, or wet gas is identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Carbon steel casting exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to wall thinning due to flow-accelerated corrosion. Carbon steel casting and carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Stainless steel casting and stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to crack initiation and growth due to stress corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to warm moist air and saturated air is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion. Brass and bronze exposed to saturated air are identified as being subject to loss of material due to pitting and crevice corrosion.

Elastomers neoprene and similar material exposed to saturated air are identified as being subject to hardening and loss of strength due to elastomer degradation.

Copper exposed to saturated air or warm, moist air is identified as being subject to loss of material due to pitting and crevice corrosion.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects for the containment isolation components and primary containment piping system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- 10 CFR Part 50, Appendix J Inspection Program (Section 3.0.3.13)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-3, 3.2-1, and 3.2-2 for the containment isolation components and primary containment piping system. On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the system.

The aging effects identified in the LRA for the containment isolation components and primary containment piping system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the containment isolation components and primary containment piping system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section (3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- 10 CFR Part 50, Appendix J Inspection Program (Section 3..0.3.13)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant's AMR for each of the components in the containment isolation components and primary containment piping system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the containment isolation components and primary containment piping, or to provide an accompanying program to monitor and/or prevent aging. The staff's discussion of this RAI and its resolution by the applicant are provided in Section

3.0.3.10 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the containment isolation components and primary containment piping system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.4 Reactor Core Isolation Cooling System—Quad Cities Only

Summary of Technical Information in the Application. The description of the RCIC system can be found in Section 2.3.2.4 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-4. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the RCIC system are described in LRA Section 2.3.2.4 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-4 of the LRA lists individual components of the system including closure bolting, dampeners, filters/strainers, NSR vents or drains, piping and fittings, pumps, restricting orifices, sight glasses, tubing, valves, flexible hoses, tanks, traps, and turbine casings.

Low-alloy steel exposed to containment nitrogen is identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air and steam up to 320 °C (608 °F) (primarily air) or air and steam up to 320 °C (608 °F) (primarily steam) is identified as being subject to loss of material due to pitting and crevice corrosion. Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water or air, or 288 °C (550 °F) steam, or air and steam up to 320 °C (608 °F) (primarily steam), or air and steam up to 320 °C (608 °F) experiences loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to 288 °C (608 °F) steam is identified as experiencing wall thinning due to flow-accelerated corrosion. Carbon steel exposed to lubricating oil (with contaminants and/or moisture) or air is subject to loss of material due to general, galvanic, pitting, and crevice corrosion.

Carbon steel casting or carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water is subject to wall thinning due to flow-accelerated corrosion, as well as loss of material due to general, pitting, and crevice corrosion.

Stainless steel casting and stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water and 288 °C (550 °F) reactor coolant water, or air and steam up to 320 °C (608 °F) (primarily steam), is identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to saturated air, or air and steam up to 320 °C (608 °F) (primarily air), or lubricating oil (with contaminants and/or moisture) is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Stainless steel exposed to air and steam up to 320 °C (608 °F) is identified as being subject to loss of material due to pitting and crevice corrosion.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion.

Steel chrome moly exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to pitting. No aging effects are identified for steel chrome moly exposed to air, moisture, and humidity <100 °C (212 °F).

Cast iron exposed to lubricating oil (with contaminants and/or moisture) is identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion. Cast iron exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to selective leaching. Cast iron exposed to air, moisture, and humidity <100 °C (212 °F) is identified as being subject to loss of material due to pitting and crevice corrosion.

Alloy steel casting exposed to air and steam up to 320 °C (608 °F) is identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Elastomers, neoprene, and similar materials subjected to moist containment atmosphere (air/nitrogen), steam, or demineralized water are identified as being subject to hardening and loss of strength due to elastomer degradation.

No aging effects are identified for glass exposed to lubricating oil (with contaminants and/or moisture), air, moisture, and humidity <100 °C (212 °F).

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects for the RCIC system:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-4, 3.2-1, and 3.2-2 for the RCIC system. During its review, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI 3.2-1(a) for the applicant to justify the use of the One-Time Inspection Program alone to manage the aging effects for the components covered in LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5. The staff's request for additional information was also provided in RAI 3.2-1(b) for the applicant to provide the basis for the determination of the sample size and location for inspection, and to explain why the proposed one-time inspection of the HPCI and SR discharge piping will be adequate to ensure that the effects of aging to the RCIC piping will be adequately managed during the extended operation. The staff's discussion of these RAIs and their resolution by the applicant are provided in Section 3.2.2.2.2 of this SER.

The staff's request for additional information was provided in RAI 3.2-2 for the applicant to explain why the AMR links, Items 3.2.1.3. and 3.2.1.5, are not included in LRA Tables 2.3.2-1 and 2.3.2-4. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.2.2.4.1.2 of this SER.

The aging effects identified in the LRA for the RCIC system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the RCIC system:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)
- Lubricating Oil Monitoring Program (Section 3.0.3.16)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for the RCIC system.

After evaluating the applicant's AMR for each of the components in the RCIC system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the RCIC system, or to provide an accompanying program to monitor and/or prevent aging. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

The staff's request for additional information was provided in RAI B.1.23-1 for the applicant to clarify and justify the use of the One-Time Inspection Program for managing the age-related degradation of 10 CFR 54.4(a)(2) components. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.2.2.4.1.2 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the RCIC system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.5 Isolation Condenser—Dresden Only

Summary of Technical Information in the Application. The description of the isolation condenser can be found in Section 2.3.2.5 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-5. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the isolation condenser are described in LRA Section 2.3.2.5 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-5 of the LRA lists individual components of the system including closure bolting, flow elements, NSR vents or drains, piping and fittings, pumps, sight glasses, thermowells, tubing, valves, isolation condensers, and tanks.

Low-alloy steel exposed to containment nitrogen is identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking. Low-alloy steel exposed to outdoor ambient conditions is identified as being subject to loss of material due to general corrosion and wear.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water, outdoor ambient conditions, or treated water is identified as being subject to loss of material due to general, pitting, and crevice corrosion. No aging effects are identified for carbon steel exposed to containment nitrogen.

Carbon steel casting and carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Stainless steel casting exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water and 288 °C (550 °F) reactor coolant water is identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to 288 °C (550 °F) reactor coolant water is subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking due to thermal and mechanical loading. Stainless steel exposed to saturated air is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion.

Aluminum exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to pitting and crevice corrosion. Aluminum exposed to outdoor ambient conditions is identified as being subject to loss of material due to pitting.

Stainless steel tubes, carbon steel tube sheets, stainless and carbon steel channel heads, and carbon steel shells exposed to steam on the tube side and demineralized water on the shell side are identified as being subject to loss of material due to general pitting and crevice corrosion, as well as crack initiation and growth due to stress corrosion cracking and cyclic loading. Stainless steel tubes exposed to steam on the tube side and demineralized water on the shell side are identified as being subject to deposit buildup due to fouling.

No aging effects are identified for glass exposed to 25–288 °C (77–550 °F) demineralized water or saturated air.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the isolation condenser:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)

- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Heat Exchanger Test and Inspection Activities (Section 3.0.3.15)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-5, 3.2-1, and 3.2-2 for the isolation condenser. On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the isolation condenser.

The aging effects identified in the LRA for the isolation condenser are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the isolation condenser:

- Inservice Inspection Program (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Heat Exchanger Test and Inspection Activities (Section 3.0.3.15)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for the isolation condenser.

After evaluating the applicant’s AMR for each of the components in the isolation condenser, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the isolation condenser. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the isolation condenser will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.6 Residual Heat Removal System—Quad Cities Only

Summary of Technical Information in the Application. The description of the residual heat removal (RHR) system can be found in Section 2.3.2.6 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-6. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the RHR system are described in LRA Section 2.3.2.6 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-6 of the LRA lists individual components of the system including closure bolting, dampeners, ECCS suction headers, filters/strainers, flow elements, NSR vents or drains, piping and valves, piping and fittings, pumps, restricting orifices, sight glasses, spray nozzles, thermowells, tubing, and valves.

Alloy steel exposed to containment nitrogen is identified as being subject to crack initiation and growth from cyclic loading and loss of material due to wear. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water or air is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to air, moisture, and humidity <100 °C (212 °F) is identified as being subject to loss of material due to general corrosion. Carbon steel exposed to air or saturated air is identified as being subject to loss of material due to general and pitting corrosion. Carbon steel exposed to air and steam up to 320 °C (608 °F) is identified as being subject to wall thinning due to accelerated corrosion.

Carbon steel casting exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to wall thinning due to flow-accelerated corrosion.

Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water and 288 °C (550 °F) reactor coolant water is identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to air and saturated air is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. No aging effects are identified for stainless steel exposed to air, moisture, and humidity where the surface is >100 °C (212 °F), containment nitrogen, or air, moisture, and humidity <100 °C (212 °F).

Stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Brass or bronze exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Brass and bronze exposed to air are identified as being subject to plugging of flow orifices and spray nozzles due to general corrosion.

No aging effects are identified for brass, bronze, and carbon steel exposed to containment nitrogen.

No aging effects are identified for glass exposed to 25–288 °C (77–550 °F) demineralized water and air, moisture, and humidity <100 °C (212 °F).

Aging Management Programs

The following AMPs are utilized to manage aging effects in the RHR system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Periodic Testing of Drywell and Torus Spray Nozzles (Section 3.2.2.3.1)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-6, 3.2-1, and 3.2-2 for the RHR system. During its review, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI 3.2-4 for the applicant to clarify the information provided in LRA Table 3.2-1, Item 3.2.1.1, regarding the AMR of drywell and suppression chamber spray system nozzles and flow orifices. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.2.2.6 of this SER.

In LRA Table 2.3.2-6, Items 3.2.2.22, 3.2.2.23, and 3.2.2.30 were identified as AMR links for RHR dampers (Quad Cities only), all made of stainless steel. Items 3.2.2.22 and 3.2.2.23 identify air, moisture, and humidity (<212 and >212 °F, respectively) as the external environment, whereas air is identified as the environment for Item 3.2.2.30. In RAI 3.2-5, the staff requested the applicant to explain the effects of the two different temperature environments on the AMR for the dampers. The staff also requested the applicant to provide the basis for not identifying an aging effect for Items 3.2.2.22 and 3.2.2.23, while loss of material was identified for Item 3.2.2.30. By letter dated October 3, 2003, the applicant stated the following.

> LRA Table 3.2-2, Aging Management References 3.2.2.22 and 3.2.2.23 pertain to dampener (pulsation dampener) external surfaces. For Aging Management Reference 3.2.2.23 , with an environment of "Air, moisture and humidity > 100 °C (212 °F)," the external surfaces of the associated components are normally in excess of 212 °F. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, Appendix E, considers 212 °F as a "threshold temperature" for all materials in an external environment since moisture must be present (in contact with the material) for corrosion to occur. Therefore, components whose external surface temperatures are >212 °F do not require aging management of their external surfaces.
>
> For Aging Management Reference 3.2.2.22, the applicant stated that for Item 3.2.2.22, the external surfaces of the associated components are in contact with the NUREG 1801 "Air, moisture, and humidity <212 °F" environment. These general plant environmental conditions were assumed for the majority of the NUREG 1801 and non-NUREG 1801 system piping and component external surfaces. System piping and component materials under 212 °F exposed to moisture and humidity were evaluated separately for their susceptibility to corrosion degradation. EPRI 1003056, Appendix E, concludes that for an indoor (air, moisture, and humidity <212 °F) ambient environment, stainless steel that is not subjected to frequent moisture can be excluded from further consideration.
>
> Aging Management Reference 3.2.2.30 pertains to dampers (pulsation dampener) internal surfaces. The "air" environment is ambient plant air with humidity to 100% and a temperature less than 212 °F. EPRI 1003056, Appendix D, concludes that pitting and crevice corrosion is a concern for stainless steel in an environment with a potential for concentrating contaminants and when the material is susceptible to becoming wetted.

The staff finds the applicant's response to be acceptable because it has provided adequate detail related to the differences in the dampener's internal and external environmental conditions, and the expected aging effects. Also, the explanation and supporting references provided by the applicant related to the differences in potential aging effects, below and above external temperatures of 212 °F, are found to be acceptable to the staff.

In LRA Table 2.3.2-6, the AMR link, 3.2.2.14, is specified for the external surfaces of carbon steel piping and fittings (Quad Cities only), for which no aging effect was identified in a containment nitrogen environment. In RAI 3.2-6, the staff requested the applicant to provide justification for the determination that a containment nitrogen environment is not conducive to promoting aging degradation. By letter dated October 3, 2003, the applicant stated the following.

> The containment nitrogen environment exists inside the drywell and in the suppression chamber air space. These areas are made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal station operation. For loss of material corrosion degradation to occur, both moisture and oxygen must be present. For containment nitrogen component external surfaces that are not in contact with an aqueous environment, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, Appendix D, does not consider corrosion to be a concern.

The staff finds the applicant's response to be acceptable because external environmental conditions, as stated in the applicant's response relating to the minimal oxygen and moisture level, would not be conducive to the promotion of known aging effects. This is supported adequately by EPRI 1003056, Appendix D, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3.

The aging effects identified in the LRA for the RHR system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the RHR system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Periodic Testing of Drywell and Torus Spray Nozzles Program (Section 3.2.2.3.1)

With the exception of Periodic Testing of Drywell and Torus Spray Nozzles Program, these AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant's AMR for each of the components in the RHR system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the RHR system, or to provide an accompanying program to monitor and/or prevent aging. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the RHR system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>. On the basis of its review, the staff finds 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).

3.2.2.4.7 Low-Pressure Coolant Injection System—Dresden Only

Summary of Technical Information in the Application. The description of the LPCI system can be found in Section 2.3.2.7 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-7. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the LPCI system are described in LRA Section 2.3.2.7 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-7 of the LRA lists individual components of the system including closure bolting, ECCS suction headers, filters/strainers, flow elements, NSR vents or drains, piping and valves, piping and fittings, pumps, restricting orifices, sight glasses, spray nozzles, thermowells, tubing, and valves.

Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking. Low-alloy steel exposed to containment nitrogen is identified as being subject to loss of material due to wear, as well as crack initiation and growth from cyclic loading.

Carbon steel exposed to air, moisture, humidity <100 °C (212 °F), and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to air and steam up to 320 °C (608 °F) is identified as being subject to wall thinning due to flow-accelerated corrosion. Carbon steel exposed to 25–288 °C (77–550 °F) demineralized water, wet gas, or warm moist air is identified as being subject to loss of material due to general, pitting, and crevice corrosion.

Carbon steel casting exposed to air and steam up to 320 °C (608 °F) is identified as being subject to wall thinning due to flow-accelerated corrosion.

Stainless steel exposed to 25–288 °C (77–550 °F) demineralized water or 288 °C (550 °F) reactor coolant water is identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress corrosion. Stainless steel exposed to saturated air and warm, moist air is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. No aging effects are identified for stainless steel exposed to air, moisture, and humidity <100 °C (212 °F) and containment nitrogen.

Stainless steel forging exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to crack initiation and growth due to stress-corrosion cracking.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Brass and bronze exposed to air are identified as being subject to plugging of flow orifices and spray nozzles due to general corrosion. No aging effects are identified for brass exposed to containment air.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the LPCI system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Periodic Testing of Drywell and Torus Spray Nozzles Program (Section 3.2.2.3.1)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-7, 3.2-1, and 3.2-2 for the LPCI system. During its review, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI 3.2-4 for the applicant to clarify the information provided in LRA Table 3.2-1, Item 3.2.1.1, regarding the AMR of drywell and suppression chamber spray system nozzles and flow orifices. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.2.2.6 of this SER.

The aging effects identified in the LRA for the LPCI system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the LPCI system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)
- Periodic Testing of Drywell and Torus Spray Nozzles Program (Section 3.2.2.3.1)

With the exception of the Periodic Testing of Drywell and Torus Spray Nozzles Program, these AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant's AMR for each of the components in the LPCI system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect. During its review of Table 3.2-2, the staff determined that additional information was needed to complete its review.

The staff's request for additional information was provided in RAI B.1.23-2 for the applicant to justify the use of the One-Time Inspection Program alone to manage the age-related degradation associated with components in the LPCI system. The staff's discussion of this RAI and its resolution by the applicant are provided in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the LPCI system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.8 Standby Liquid Control System

Summary of Technical Information in the Application. The description of the standby liquid control (SLC) system can be found in Section 2.3.2.8 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-8. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the SLC system are described in LRA Section 2.3.2.8 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-8 of the LRA lists individual components of the system including accumulators, closure bolting, dampeners, NSR vents or drains, piping and valves, piping and fittings, pumps, sight glasses, tanks, thermowells, tubing, and valves.

Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress-corrosion cracking. Low-alloy steel exposed to containment nitrogen is identified as being subject to loss of material due to wear, as well as crack initiation and growth from cyclic loading.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion. Carbon steel exposed to sodium pentaborate solution at 21–32 °C (70–90 °F) (24,500 ppm boron) or lubricating oil (with contaminates and/or moisture) is identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion. Carbon steel exposed to treated water or oxygenated water, up to 288 °C (550 °F) is identified as being subject to loss of material due to general pitting and crevice corrosion.

Stainless steel exposed to saturated air or sodium pentaborate solution at 21–32 °C (70–90 °F) (24,500 ppm boron), or saturated air or oxygenated water, up to 288 °C (550 °F) is identified as being subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to 288 °C (550 °F) reactor coolant water or steam is identified as being subject to crack initiation and growth due to stress-corrosion cracking intergranular stress-corrosion cracking. Stainless steel or stainless steel casting exposed to sodium pentaborate solution at 21–32 °C (70–90 °F) (24,500 ppm boron) or oxygenated water, up to 288 °C (550 °F) is identified as being subject to crack initiation and growth due to stress-corrosion cracking. Stainless steel exposed to air, moisture, humidity, and leaking fluids is identified as being subject to loss of material due to corrosion. No aging effects are identified for stainless steel exposed to containment nitrogen.

Brass and bronze exposed to air, moisture, humidity, and leaking fluids are identified as being subject to loss of material due to corrosion.

No aging effects are identified for glass exposed to air, moisture, and humidity <100 °C (212 °F) or sodium pentaborate solution at 21–32 °C (70–90 °F) (24,500 ppm boron).

Aging Management Programs

The following AMPs are utilized to manage aging effects in the SLC system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-8, 3.2-1, and 3.2-2 for the SLC system. On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the SLC system.

The aging effects identified in the LRA for the SLC system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the SLC system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.`0)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for the SLC system.

After evaluating the applicant's AMR for each of the components in the SLC system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effect.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the SLC system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.9 Standby Gas Treatment System

Summary of Technical Information in the Application. The description of the standby gas treatment (SBGT) system can be found in Section 2.3.2.9 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-9. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the SBGT system are described in LRA Section 2.3.2.9 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-9 of the LRA lists individual components of the system including closure bolting, duct, doors, closure bolts, equipment frames, fan housing, filters/strainers, flex collars, damper seals, housing and supports, manifolds, NSR vents or drains, piping and valves, seals, tubing, and valves.

Low-alloy steel exposed to outdoor ambient air and air, moisture, and humidity <100 °C (212 °F) is subject to loss of material due to general corrosion and wear.

Carbon steel exposed to air, moisture, humidity, and leaking fluids is identified as being subject to loss of material due to corrosion. Carbon steel exposed to air and steam up to 320 °C (608 °F) is identified as being subject to wall thinning due to flow-accelerated corrosion. Carbon steel exposed internally to moist air and externally to ambient plant air environment is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to outdoor ambient air conditions is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to soil and ground water is identified as being subject to loss of material due to general, pitting, crevice, and MIC.

Stainless steel exposed internally to moist air and externally to ambient plant air environment is identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid is identified as being subject to loss of material due to corrosion

Cast iron exposed internally to moist air and externally to ambient plant air environment is identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion.

Brass and bronze exposed internally to moist air and externally to ambient plant air environment is identified as being subject to loss of material due to general, galvanic, pitting, and crevice corrosion. Brass and bronze exposed to air, moisture, humidity, and leaking fluid are identified as being subject to loss of material due to corrosion. Brass and bronze exposed to saturated air are identified as being subject to loss of material due to pitting and crevice corrosion.

Elastomers, neoprene, and similar materials exposed internally to moist air and externally to ambient plant air environment or moist air is identified as being subject to hardening and loss of strength.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the SBGT system:

- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)

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

<u>Staff Evaluation</u>.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-9, 3.2-1, and 3.2-2 for the SBGT system. On the basis of its review, the staff finds the applicant has identified the appropriate aging effects for the materials and environments associated with the SBGT system.

The aging effects identified in the LRA for the SBGT system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the SBGT system:

- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for the SBGT system.

After evaluating the applicant's AMR for each of the components in the SBGT system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verifies that the applicant credited an AMP that is appropriate for the identified aging effect.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the SBGT system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.10 Automatic Depressurization System

Summary of Technical Information in the Application. The description of the automatic depressurization system (ADS) can be found in Section 2.3.2.10 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-10. The applicant stated that Dresden and Quad Cities design-basis documents treat the ADS relief valves and associated piping, solenoids, pressure controllers, and position switches as components of the main steam system. The components, aging effects, and AMPs are, therefore, provided in LRA Tables 2.3.4-1, 3.4-1, and 3.4-2.

Aging Effects

Components of the ADS are described in LRA Sections 2.3.2.10 and 2.3.4.1 as being within the scope of license renewal and subject to an AMR. The aging effects associated with these mechanical components of the ADS are provided in Section 3.4.2.4.1.1 of this SER.

Aging Management Programs

The AMPs utilized to manage the identified aging effects for the ADS are provided in Section 3.4.2.4.1.1 of this SER.

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-10, 2.3.4-1, 3.4-1, and 3.4-2 for the ADS. During its review, the staff determined that additional information was needed to complete its review.

In LRA Table 3.4-2, Item 3.4.2.51, under Discussion, the applicant stated that NUREG-1801 does not address crevice and pitting corrosion of stainless steel valves in a treated water environment. Under Aging Effect/Mechanism of Item 3.4.2.51, however, crack initiation and growth/stress-corrosion cracking and intergranular stress-corrosion cracking are identified as aging effects/mechanisms requiring management in a 288 °C steam environment. In RAI 3.2-8, the staff requested that the applicant clarify whether these valves, identified in Item 3.4.2.51, apply to the ADS system. The staff also requested the applicant to explain the above discrepancies found and to provide the correct AMR review results.

By letter dated October 3, 2003, the applicant stated the following.

> The valves in LRA Table 3.4-2, Item 3.4.2.51, are main steam system valves in applications such as main steam line drains, pressure switch and pressure transmitter isolation, and pressure control valve bypass. There are no valves in this component group that apply to the ADS system. Since the ADS system utilizes valves and other components from the main steam system, the Aging Management References for them can be found in Table 2.3.4-1, under the Component Group of "Valves." The specific reference for each particular valve will depend on its materials of construction and internal environment. For example, a main steam line PORV has an internal environment of "288 °C (550 °F) steam" and an Aging Management Reference of 3.1.1.11. The pressure controller shutoff valve for the same PORV has an internal environment of "288 °C (550 °F) reactor coolant water," and an Aging Management Reference of 3.1.1.15. The drywell pneumatic air shutoff valve for the same PORV has an internal environment of "saturated air," and an Aging Management Reference of 3.4.2.53.
>
> The aging effect/mechanism of "crack initiation and growth/stress corrosion cracking and intergranular stress corrosion cracking" and the environment of "288 °C (550 °F) steam" are correct as stated. The text in the "Discussion" column of the Aging Management Reference 3.4.2.51, was intended to explain why this line is a non-NUREG-1801 item, but is inappropriate for the attributes listed. The text should have read, "NUREG-1801, Chapter VIII, does not address stainless steel components in a 550 °F steam environment.

The staff has reviewed the above aging management references provided by the applicant for the ADS valves, and finds them acceptable because they provided adequate detail to explain how the AMR of the ADS components is performed. The staff also finds the applicant's response provided adequate detail to clarify the clerical error made in Aging Management Reference 3.4.2.51, and is, therefore, acceptable.

The aging effects identified in the LRA for the ADS are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The staff's evaluation of the AMPs utilized to manage the aging effects for the ADS are provided in Section 3.4.2.4.1.2 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ADS will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds 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).

3.2.2.4.11 Anticipated Transient Without Scram System

Summary of Technical Information in the Application. The description of the anticipated transient without scram (ATWS) system can be found in Section 2.3.2.11 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.2-11. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects

Components of the ATWS system are described in LRA Section 2.3.2.11 as being within the scope of license renewal and subject to an AMR. Table 2.3.2-11 of the LRA lists individual components of the system including closure bolting, piping and fittings, and valves.

Low-alloy steel exposed to air, moisture, humidity, and leaking fluids is identified as being subject to loss of material due to general corrosion, as well as crack initiation and growth due to cyclic loading stress corrosion cracking.

Carbon steel exposed to air, moisture, and humidity <100 °C (212 °F) is identified as being subject to loss of material due to general corrosion.

Carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel forging exposed to 25–288 °C (77–550 °F) demineralized water is identified as being subject to wall thinning due to flow-accelerated corrosion.

Stainless steel and stainless steel casting exposed to 25–288 °C (77–550 °F) demineralized water are identified as being subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. No aging effects are identified for stainless steel exposed to air, moisture, and humidity <100 °C (212 °F).

Aging Management Programs

The following AMPs are utilized to manage aging effects in the ATWS system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in LRA Tables 2.3.2-11, 3.2-1, and 3.2-2 for the ATWS system. During its review, the staff determined that additional information was needed to complete its review.

In LRA Table 2.3.2-11, Item 3.2.1.12 is identified as an AMR link for valves in the ATWS system. The aging effect/mechanism identified for Item 3.2.1.12 is wall thinning due to flow-accelerated corrosion, with Flow-Accelerated Corrosion (B.1.11) identified as an AMP. The applicant identified exceptions to flow-accelerated corrosion in LRA Section 3.2.1.2.1, where it states the following.

> Flow accelerated corrosion is an applicable aging mechanism for the Quad Cities HPCI steam line drains. However, carbon steel components in the ATWS, isolation condenser, core spray, LPCI (Dresden only), RHR (Quad Cities only), primary containment and suppression pool piping, HPCI (except as previously noted) and RCIC (Quad Cities only) systems are not susceptible to flow accelerated corrosion and do not require aging management.

In RAI 3.2-9, the staff requested that the applicant clarify the above discrepancy for the AMR of valves in the ATWS system, and verify that the aging effect/mechanism of wall thinning due to flow-accelerated corrosion, as addressed in Item 3.2.1.12, is applicable to the ATWS system.

By letter dated October 3, 2003, the applicant stated the following.

> All of the ATWS system valves are installed in piping associated with reactor vessel pressure and level process instrumentation. The valves are used to isolate, vent, drain, calibrate, and pre-pressurize these instruments. There is no flow in the process lines associated with these instruments; therefore, wall thinning due to flow-accelerated corrosion is not an applicable aging effect/mechanism for the ATWS system valves. This was not a discrepancy in the LRA. The ATWS system valves are emergency core cooling system valves that have the same component group-material-environment as in NUREG-1801, V.D2.3-a. NUREG-1801, V.D2.3-a identifies an aging effect/mechanism of "Wall thinning/Flow-accelerated corrosion." The ATWS valves were included in the SRP line for V.D2.3-a

to be in alignment with NUREG-1801, but, since there is no flow in the process lines associated with them, an exception was taken.

The staff finds the applicant has provided adequate information and detail related to the type, location, and function of the ATWS system valves identified in LRA Table 2.3.2-11, Item 3.2.1.12, and has adequately explained why the conditions necessary to promote flow-accelerated corrosion do not exist at the pertinent valve locations. This is acceptable to the staff. For more information on the exception taken by Dresden and Quad Cities on flow-accelerated corrosion, reference is made to the discussion provided in Section 3.2.2.2.7 of this SER.

The aging effects identified in the LRA for the ATWS system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the ATWS system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for the ATWS system. These AMPs are evaluated in Sections 3.0.3.2, 3.0.3.3, 3.0.3.4, 3.0.3.5, and 3.0.3.10, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the ATWS system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in LRA Table 3.2-1, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verifies that the applicant credited an AMP that is appropriate for the identified aging effect.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ATWS system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>. On the basis of its review, the staff finds 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 Auxiliary Systems

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

- Refueling equipment system
- Shutdown cooling system (Dresden only)
- Control rod drive hydraulic system
- Reactor water cleanup system
- Fire protection system
- Emergency diesel generator and auxiliaries system
- HVAC—Main Control Room
- HVAC—Reactor Building
- Emergency core cooling system corner room HVAC
- Station blackout building HVAC
- Station blackout system (diesels and auxiliaries)
- Diesel generator cooling water system
- Diesel fuel oil system
- Process sampling system
- Carbon dioxide system
- Service water system
- Reactor building closed cooling water system
- Turbine building closed cooling water system
- Demineralized water makeup system
- Residual heat removal service water system (Quad Cities only)
- Containment cooling service water system (Dresden only)
- Ultimate heat sink
- Fuel pool cooling and filter demineralizer system (Dresden only)
- Plant heating system
- Containment atmosphere monitoring system
- Nitrogen containment atmosphere dilution system
- Drywell nitrogen inerting system
- Safe shutdown makeup pump system (Quad Cities only)

As discussed in Section 3.0.1 of this SER, the components in each of the systems are described in the LRA tables. LRA Table 3.3-1 consists of auxiliary system components that are evaluated in the GALL Report. LRA Table 3.3-2-X lists all of the components in each system, regardless of whether they are addressed in the GALL Report. For those system components that are addressed in the GALL Report, LRA Table 3.3-2-X refers to LRA Table 3.3-1 for additional information.

3.3.1 Summary of Technical Information in the Application

In LRA Section 3.3, the applicant described its AMRs for the auxiliary systems group. The description of the systems that comprise the auxiliary systems group can be found in LRA Section 2.3.3. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.3-1 through 2.3.3-28.

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

The applicant's review of industry operating experience included a review of operating experience through 2002. The results of this review concluded that the aging effects requiring management, based on industry operating experience, were consistent with the aging effects identified in GALL.

The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the Exelon Operating Experience Program.

3.3.2 Staff Evaluation

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

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

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

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

Component Group	Aging Effect/ Mechanism	AMP in G0ALL Report	AMP in LRA	Staff Evaluation
Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry; One-Time Inspection	Water Chemistry Program; One-Time Inspection Program	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.3.2.2.1 below).
Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening, cracking, and loss of strength due to elastomer degradation; loss of material due to wear	Plant specific	Periodic Inspection of Ventilation System Elastomers Program	Consistent with GALL. GALL recommends further evaluation (see Section 3.3.2.2.2 below).
Components in load handling, chemical and volume control system (PWR); reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	GALL recommends further evaluation (see Section 3.3.2.2.3 below).
Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth due to SCC or cracking	Plant specific	None	Applicant has determined that heat exchangers in reactor water cleanup system (BWR) are not in scope of license renewal (see Section 3.3.2.2.4 below).
.0Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion and MIC	Plant specific	Bolting Integrity Program; Open-Cycle Cooling Water System Program; Fire Protection Program; Buried Piping and Tanks Inspections Program	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.3.2.2.5 below).
Components in reactor coolant pump oil collection system	Loss of material due to galvanic, general, pitting, and crevice corrosion	One-Time Inspection	Not applicable.	Not applicable.
Diesel fuel oil tanks in diesel fuel oil system; emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel Oil Chemistry; One-Time Inspection	Fuel Oil Chemistry Program; One-Time Inspection Program	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.3.2.2.7 below).
Piping, pump casing, and valve body and bonnets in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion	Water Chemistry; One-Time Inspection	Water Chemistry Program; One-Time Inspection Program	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.3.2.2.1 below).
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant specific	Water Chemistry Program	These components are scoped under structures and are addressed in Section 3.5.2.4.2.2 of this SER.

Component Group	Aging Effect/ Mechanism	AMP in G0ALL Report	AMP in LRA	Staff Evaluation
New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring	Structures Monitoring Program	These components are scoped under structures and are addressed in Section 3.5.2.4.2.2 of this SER.
Spent fuel storage rack and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to SCC	Water Chemistry	Water Chemistry Program	Consistent with GALL (see Section 3.3.2.1 below).
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex Monitoring	Boraflex Monitoring Program	These components are scoped under structures and are addressed in Section 3.5.2.4.2.2 of this SER.
Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid corrosion	Boric Acid Corrosion	Not applicable	The environment identified in GALL is not applicable.
Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and crevice corrosion and MIC	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System Program	Consistent with GALL (see Section 3.3.2.1 below).
Cranes, including bridge and trolleys, and rail system in load handling system	Loss of material due to general corrosion and wear	Overhead Heavy Load and Light Load Handling Systems	Inspection of Overhead Heavy Load and Light Load (related to refueling) Handling Systems Program	Consistent with GALL, with exception (see Section 3.3.2.1 below).
Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System Program	Consistent with GALL with exceptions (see Section 3.3.2.1 below).
Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.3.2.2.10 below).
Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	Compressed Air Monitoring Program	Consistent with GALL (see Section 3.3.2.1 below).
Components (doors and barrier penetration seals) and concrete structures in fire protection system	Loss of material due to wear; hardening and shrinkage due to weathering	Fire Protection	Fire Protection Program	Exceptions taken to GALL on fire door at a frequency of every operating cycle under the CLB rather than the bi-monthly frequency recommended in GALL (see Section 3.3.2.3.3 below).
Components in water-based fire protection system	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling	Fire Water System	Fire Water System	Consistent with GALL/ISG (see Section 3.3.2.3.4 below).

Component Group	Aging Effect/ Mechanism	AMP in G0ALL Report	AMP in LRA	Staff Evaluation
Components in diesel fire pump fuel system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fire Protection	Fire Protection Program	Exception taken to GALL on trending of test results (see Section 3.3.2.3.3 below).
Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Aboveground Carbon Steel Tanks	None	There are no above-ground carbon steel tanks in the diesel fuel oil system.
Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting Integrity	Bolting Integrity Program	Consistent with GALL with exceptions (see Section 3.3.2.1 below).
Components in contact with sodium pentaborate solution in standby liquid control system (BWR)	Crack initiation and growth due to SCC	Water Chemistry	Water Chemistry Program	These components are scoped under ESF and are addressed in Section 3.2.4.8.2 of this SER.
Components in reactor water cleanup system	Crack initiation and growth due to SCC and IGSCC	Reactor Water Cleanup System Inspection	BWR Reactor Water Cleanup System Program	Consistent with GALL with exceptions (see Section 3.3.2.1 below).
Components in shutdown cooling system (older BWR)	Crack initiation and growth due to SCC	BWR Stress Corrosion Cracking; Water Chemistry	BWR Stress Corrosion Cracking Program; Water Chemistry Program	Consistent with GALL with exceptions (see Section 3.3.2.1 below).
Components in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion and MIC	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System Program; Flow-Accelerated Corrosion Program	Consistent with GALL (see Section 3.3.2.1 below).
Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems; ultimate heat sink	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching of Materials Program	Consistent with GALL with exceptions (see Section 3.3.2.1 below).
Fire barriers, walls, ceilings, and floors in fire protection system	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire Protection; Structures Monitoring	Fire Protection Program; Structures Monitoring Program	These components are scoped under structures and are addressed in Sections 3.5.2.4.1 and 3.5.2.4.2 of this SER. Exceptions taken to GALL on concrete fire barrier inspection frequency of every five years under ACI 349.3R-96 concrete structures (see Section 3.3.2.3.3 below).

The staff's review of the auxiliary systems for the Dresden and Quad Cities LRA is contained within four sections of this SER. Section 3.3.2.1 is the staff review of components in the auxiliary systems that the applicant indicated are consistent with GALL and do not require further evaluation. Section 3.3.2.2 is the staff review of components in the auxiliary systems that the applicant indicated are consistent with GALL and for which GALL recommends further evaluation. Section 3.3.2.3 is the staff evaluation of AMPs that are specific to the auxiliary systems group. Section 3.3.2.4 contains an evaluation of the adequacy of aging management for components in each system in the auxiliary systems group and includes an evaluation of components in the auxiliary systems that the applicant indicated are not in GALL.

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant's claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

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

Loss of material due to pitting and crevice corrosion could occur in the piping, filter housing, valve bodies, and shell and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system (BWR) and in the piping/fitting, pump casing, and valves, and their related components, in the shutdown cooling system (older BWR). The Water Chemistry Program relies on monitoring and control of reactor water chemistry, based on the EPRI guidelines outlined in BWRVIP-29 (TR-103515) for water chemistry in BWRs, to manage the effect of loss of material from pitting or crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting or crevice corrosion. Therefore, verification of the effectiveness of the Chemistry Control Program should be performed to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from pitting and crevice corrosion to verify the effectiveness of the Water Chemistry Program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component intended functions will be maintained during the period of extended operation.

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

In Section 3.3.1.1.1 of the LRA, the applicant stated that the One-Time Inspection Program (B.1.23) will be used to perform inspection of the Dresden fuel pool cooling and filter demineralizer system to confirm the effectiveness of the Water Chemistry Program (B.1.2). The one-time inspection will be either a visual or ultrasonic examination of a stainless steel component or piping for general, pitting, and crevice corrosion. The Water Chemistry Program and the One-Time Inspection Program are evaluated in Sections 3.0.3.2 and 3.0.3.5, respectively, of this SER.

The applicant also stated, in Section 3.3.1.1.2 of the LRA, that an inspection of selected components exposed to a stagnant flow water environment will be conducted in accordance with the One-Time Inspection Program (B.1.23). The inspection of selected components will verify the effectiveness of the Chemistry Control Program to manage loss of material due to general, pitting, and crevice corrosion in low flow or stagnant flow areas by ensuring that significant degradation is not occurring and that the component intended function will be maintained during the extended period of operation. Examinations will be conducted on carbon and stainless steel components in areas where stagnant flow is typically present, but flow occasionally occurs. Such flow will replenish the oxygen supply. Inspections will be conducted on the HPCI torus suction check valves, the HPCI booster pumps, and the CRD scram valves. These components were selected to provide representative samples of the aging effects seen in the shutdown cooling system. The carbon steel HPCI torus suction check valves are exposed to torus water, while the carbon steel HPCI booster pumps and the stainless steel CRD scram valves are exposed to CST water. Both will undergo a visual exam. This inspection is also credited for those components exposed to reactor coolant, which are outside NUREG-1801, Chapter IV.C1.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to pitting and crevice corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

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

The GALL Report recommends further evaluation of programs to manage the hardening and cracking due to elastomer degradation of valves in the spent fuel pool cooling and cleanup system. The GALL Report also recommends further evaluation of programs to manage the hardening and loss of strength due to elastomer degradation of the collars and seals of the duct and the elastomer seals of the filters in the control room area, auxiliary and radwaste areas, and primary containment heating and ventilation systems, as well as the collars and seals of the duct in the diesel generator building ventilation system. The GALL Report also recommends further evaluation of programs to manage the loss of material due to wear of the collars and seals of the duct in the ventilation system. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of these aging effects.

In Section 3.3.1.1.5 of the LRA, the applicant credited the Periodic Inspection of Ventilation System Elastomers Program (B.2.3) for managing hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear for components in the control room, emergency diesel generator building, station blackout diesel generator building, and reactor building (using the requirements of the containment ventilation) ventilation system elastomers. The Periodic Inspection of Ventilation System Elastomers Programs is evaluated in Section 3.0.3.17 of this SER.

The applicant indicated, in item 3.3.1.2 of Table 3.3-1, that the elastomer linings of the valves in the fuel pool cooling and demineralizer system evaluated in NUREG-1801, Chapter VII.A4, are not within the scope of license renewal.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.3.2.2.3 Cumulative Fatigue Damage

Fatigue is a TLAA, as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

Cumulative fatigue damage of auxiliary system piping and load handling cranes is a TLAA, as defined in 10 CFR 54.3. The applicant stated that the RWCU pumps identified by NUREG-1801, Chapters VII E3.2-b and VII E3.2-c are not in the scope of license renewal and are not evaluated as a TLAA. The applicant further stated that cumulative fatigue damage of auxiliary system piping and load handling cranes is required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff's evaluation of the TLAA for auxiliary system piping outside the RCPB is addressed in Section 4.3.3.2 of this SER. The staff's evaluation of the TLAA for load handling cranes is addressed in Section 4.7.1 of this SER.

3.3.2.2.4 Crack Initiation and Growth Due to Cracking or Stress-Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage crack initiation and growth due to SCC that could occur in the regenerative and nonregenerative heat exchanger components in the reactor water cleanup system (BWR). The applicant stated that heat exchangers in the reactor water cleanup system are not in scope of license renewal. The staff verified that this is the case. On the basis of its review, the staff finds that the applicant has adequately evaluated the management of crack initiation and growth due to cracking or SCC for components in the auxiliary systems, as recommended in the GALL Report.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of crack initiation and growth due to SCC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

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

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of the piping and filter housing and supports in the control room area, the auxiliary and radwaste areas, and the primary containment heating and ventilation systems; the piping of the diesel generator building ventilation system; and the aboveground piping and fittings, valves, and pumps in the diesel fuel oil system and the diesel engine starting air, combustion air intake, and combustion air exhaust subsystems in the emergency diesel generator system. The GALL Report also recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion and MIC of the duct fittings, access doors, and closure bolts, equipment frames, and housing of the duct; pitting and crevice corrosion of the heating/cooling coils of the air handler heating/cooling; and general corrosion of the external surfaces of all carbon steel structures and components, including bolting exposed to operating temperatures less than 100 °C (212 °F) in the ventilation systems. The staff reviewed the applicant's proposed programs to ensure that they will be adequate for the management of these aging effects.

The applicant has identified loss of material due to general, pitting, and crevice corrosion and MIC as an AERM for many of the above GALL items and numerous components that are not addressed in GALL. The applicant uses the following AMPs to manage this AERM:

- Structures Monitoring Program (B.1.30)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection—Compressed Gas Program (B.1.23)
- Heat Exchanger Testing and Inspection Program (B.2.6)
- One-Time Inspection—Ventilation System (B.2.6)
- Open-Cycle Cooling Water System Program (B.1.13)
- Buried Piping and Tanks Inspection Program (B.1.25)
- Fire Protection Program (B.1.18)
- One-Time Inspection—NSR/SR Inspection Program (B.1.23)

These AMPs are reviewed in Sections 3.0.3.5, 3.0.3.6, 3.0.3.10, 3.0.3.12, 3.0.3.14, 3.0.3.16, and 3.3.2.3.3, respectively, of this SER. In its October 3, 2003, response to RAI 3.3-7, the applicant provided additional information related to how these AMPs are used to manage the loss of material. This additional information is discussed in Section 3.3.2.5.7 of the SER and in the above SER sections related to the AMPs.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general, pitting, and crevice corrosion and MIC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

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

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, galvanic, pitting, and crevice corrosion of tanks, piping, valve bodies, and tubing in the reactor coolant pump oil collection system within the Fire Protection Program. This is not applicable to either Dresden or Quad Cities.

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

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

The applicant stated that an inspection will be performed in accordance with the One-Time Inspection Program (B.1.23) to verify the effectiveness of the Fuel Oil Chemistry Program (B.1.21) to prevent loss of material. A UT examination of the lower portion of one carbon steel underground fuel oil storage tank and one day tank at each facility will be performed. The applicant clarified that the Quad Cities Unit I underground fuel oil storage tank is constructed of fiberglass; aging management for loss of material is discussed separately as a non-GALL item.

The applicant further stated that activities to prevent biofouling of the fuel oil systems are performed in accordance with the Fuel Oil Chemistry Program (B.1.21). Preventive activities under that program include routine sampling to provide assurance that contaminant levels, including water, are kept at acceptable levels for fuel oil system components, and the addition of a biocide to the underground fuel oil storage tanks with each new fuel delivery. The Fuel Oil Chemistry and One-Time Inspection Programs are evaluated in Sections 3.0.3.10 and 3.0.3.11, respectively, of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.3.2.2.8 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of the spent fuel storage rack in the spent fuel storage system. The GALL Report recommends further evaluation of programs to manage these aging effects. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

In the LRA, these components are scoped under the structures. The staff's evaluation of other Class 1 structures is documented in Section 3.5.2.4.2.2 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of reduction of neutron-absorbing capacity and loss of material due to general corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.3.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

Loss of material due to general, pitting, and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system (service water system) and in the diesel fuel oil system. The GALL's Buried Piping and Tanks Inspection Program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The staff reviews the effectiveness of the Buried Piping and Tanks Inspection Program, including its inspection frequency and operating experience, to ensure that loss of material is not occurring and that the component intended function will be maintained during the period of extended operation.

Section 3.3.1.1.4 of the LRA states that the applicant's Buried Piping and Tanks Inspection Program (B.1.25) relies on industry practice, frequency of pipe excavations, and operating experience to manage the aging of buried components. The applicant stated that since Dresden and Quad Cities infrequently expose buried components during yard excavation activities, additional testing and inspection activities are credited. The applicant stated that with the identified exceptions and enhancements, the AMP is consistent with GALL. The evaluation of the Buried Piping and Tanks Inspection Program (B.1.25) is documented in Section 3.0.3.12 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general, pitting, and crevice corrosion and MIC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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 Aging Management Programs for Auxiliary System Components

The applicant credits 23 AMPs (listed below) to manage the aging effects associated with components in the auxiliary systems. Seventeen of the AMPs are credited to manage aging for components in other system groups (common AMPs), while six AMPs are credited to manage aging only for auxiliary system components. The staff's evaluation of the common AMPs credited with managing aging for the auxiliary system components is provided in Section 3.0.3 of this SER. These common AMPs are listed below, along with their section numbers.

- Inservice Inspection Program (Section3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- Aboveground Carbon Steel Tanks Program (Section 3.0.3.9)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- 10 CFR Part 50, Appendix J Inspection Program (Section 3.0.3.13)
- Structures Monitoring Program (Section 3.0.3.14)
- Heat Exchanger Test and Inspection Activities Program (Section 3.0.3.15)
- Lube Oil Monitoring Program (Section 3.0.3.16)
- Periodic Inspection of Ventilation System Elastomers Program (Section 3.0.3.17)

The staff's evaluation of the seven auxiliary system AMPs is provided in the following sections.

3.3.2.3.1 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.1.15)

Summary of Technical Information in the Application. The applicant's overhead load handling systems inspection program is discussed in LRA Section B.1.15, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems." The applicant states that, with enhancements, the program is consistent with the GALL program XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems" with the exception that the applicant does not provide for tracking the magnitude and number of lifts because administrative controls are implemented to ensure that only allowable loads are handled and fatigue of structural elements is not expected. The applicant also states that the enhancements will provide for specific inspections for rail wear and proper crane travel on rails, and the program will provide for specific inspections for corrosion of crane structural components.

The AMP is credited with managing aging due to the loss of material of bridge and trolley crane components for the refueling systems.

The applicant claims the operating experience indicates that the program has been successful in managing aging of structural components of overhead heavy load and light load (related to refueling) handling systems so that intended functions have been maintained.

In its LRA, the applicant concludes that the of overhead heavy load and light load (related to refueling) handling systems aging management program provides reasonable assurance that loss of material aging effects are adequately managed so that the intended functions of crane structural components within the scope of license renewal are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.15, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems,” the applicant described its AMP to manage aging in bridge and trolley cranes structural components. The LRA stated that this AMP, with enhancements, is consistent with the GALL AMP, XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems” with an exception regarding a provision for tracking the magnitude and number of lifts because administrative controls are implemented to ensure that only allowable loads are handled and fatigue of structural elements is not expected. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exception and its justification to determine whether the AMP, remains adequate to manage the aging effects for which it is credited. Staff reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. In addition, the staff determined whether the applicant properly applied the GALL program to its facility.

LRA Table 3.3-1, Ref No 3.3.1.14 identifies the Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.1.15) as the applicable aging management program to manage loss of material due to general corrosion and wear in the refueling system cranes during the period of extended operation. This AMP, with enhancements, claims consistency with the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program, XI.M23 in NUREG-1801 with the exception that it does not review the number and magnitude of lifts as in element 3 of the GALL report AMP XI.M23. The LRA states the reason for the exception is because administrative controls assure ”... that only allowable loads are handled and fatigue failure of structural elements is not expected.” The AMP also states that a time-limited aging analysis concludes that there are no fatigue concerns for the period of extended operation. By letter dated August 4, 2003, the staff requested, in RAI B.1.15, the applicant to provide justifications to demonstrate how the administrative control is adequate in lieu of tracking of the number and magnitude of lifts as in element 3 of GALL report AMP XI.M23.

Furthermore, the description of B.1.15 also states that the enhancements, specific inspections for rail wear and proper crane travel on rails as well as specific inspections for corrosion of crane structural components, are scheduled to be implemented prior to the period of extended operation. This Commitment #15 of Appendix A in this SER. In the same letter mentioned above, the applicant is requested to provide an explanation of the statement in the Operating

Experience section of B.1.15 which indicate that this program has been successful in the past at Dresden and Quad Cities if the proposed enhancements to the AMP (which are the primary attributes of XI.M23) have not yet been implemented. In addition, the staff also requested the applicant to provide a statement to clarify that these enhanced inspections will be conducted on a routine basis as in element 4 of the GALL report AMP XI.M23, and to provide an explanation of how the conclusion that there are no fatigues concerns for the period of extended operation can be achieved without a fatigue analysis that considered the number and magnitude of lifts.

In its response dated October 3, 2003, the applicant specifies the justification for the adequacy of administrative controls in lieu of tracking the number and magnitude of lifts for the subject cranes in terms of the following reasons:

(a) The number and magnitude of lifts that are anticipated for any crane is significantly below the design limits. See section 4.7.1 of the LRA.
(b) Various industry documents were used to develop procedures governing crane inspections at each site, including Vendor Manuals, OSHA Chapter XVII, Title 29 Part 1910.179, and ASME/ANSI B30.2, B30.10, B30.11, B30.16 Crane Standards, NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, and 10CFR50.65, Maintenance Rule
(c) Crane inspections and functional checks are periodically performed in accordance with the above inspection procedures by qualified crane/structural steel inspectors
(d) Crane operating procedures require crane inspection prior to each use
(e) Crane operating procedures ensure that crane loading does not exceed crane capacities
(f) The reactor building overhead crane has the largest capacity of any in-scope crane at each site. This crane was designed to CMAA-70 Class A1 and is compatible with the requirements of the Occupational Safety and Health Act of 1970, as amended in 1971, as well as ANSI B30.2.0.
(g) The capacities of the cranes other than the reactor building overhead crane are relatively small. Consequently, any associated fatigue-related degradation of crane components would be identified via periodic inspections prior to loss of crane function.

The applicant further stated that enhancements to the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program will include the addition of inspections for rail wear and proper crane travel on rails as well as for corrosion of crane structural components. The existing program includes visual inspections of various crane components. The applicant clarified that the statement in the Operating Experience section of LRA Section B.1.15 indicating that the program has been successful in the past applies to the existing program. Crane inspections under the existing program are routinely performed. Inspections under the enhanced program will also be routinely performed. The applicant agreed that a statement should have been added to the enhancements section of LRA Section B.1.15 indicating that the subject crane inspections will be routinely performed.

The LRA Section B.1.15 conclusion that there are no fatigue concerns for the reactor building overhead cranes for the period of extended operation is valid despite that fact that there was no fatigue analysis. The applicant stated that the basis for this conclusion is provided in LRA Section 4.7.1, Reactor Building Crane Load Cycles, which concludes that fatigue life is not significant to the operation of the reactor building overhead crane for the period of extended operation as its projected 60-year cycle estimate is only a fraction of the number of cycles for which the crane was qualified.

On the basis of its review, the staff finds that the applicant's response acceptable because; 1) the seven elements of the administrative procedures that the applicant has provided, 2) the applicant clarified the enhancements section of LRA Section B.1.15 indicating that the subject crane inspections will be routinely performed, and 3) the applicant has shown that fatigue life is not significant to the operation of the reactor building overhead crane for the period of extended operation as its projected 60-year cycle estimate is only a fraction of the number of cycles for which the crane was qualified. All issues related to this RAI B.1.15 is considered resolved.

The staff reviewed the UFSAR supplement in Section 1.15 of Appendix A of the LRA and found that the description of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems is consistent with Section B.1.15 of the LRA. The staff finds that the information provided in the UFSAR supplement provides an adequate summary of the program activities as required by 10 CFR 54.21 (d).

Conclusions. On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this aging management program and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.2 BWR Reactor Water Cleanup System (B.1.17)

Summary of Technical Information in the Application. The applicant's program for monitoring and controlling reactor water chemistry to reduce the susceptibility of reactor water cleanup (RWCU) piping to stress corrosion cracking (SCC) and intergranular stress corrosion cracking (IGSCC) is discussed in LRA Section B.1.17 "BWR Reactor Water Cleanup System." The applicant states that the program is consistent with GALL AMP XI.M25 "BWR Reactor Water Cleanup System," with the exception that the specification of water chemistry control is in accordance with EPRI TR-103515-R2 instead of the earlier EPRI TR-103515. The applicant also states that LRA Section B.1.2 presents the water chemistry aging management program and the exceptions to the program as specified in GALL. The LRA credits this AMP with water chemistry activities that reduce susceptibility to SCC and IGSCC.

The applicant states that Dresden and Quad Cities have satisfactorily completed all actions requested in NRC GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and have replaced the RWCU system piping with piping that is resistant to IGSCC in accordance with NRC GL 88-01, "NRC Position on Intergranular Stress Corrosion Cracking (IGSCC) in BWR Austenitic Stainless Steel Piping." The applicant concluded that inspection of RWCU piping is not required. The applicant stated that operating experience has shown that, since replacing the RWCU system piping with IGSCC-resistant piping, there have been no adverse trends detected in the chemistry program.

The reactor water cleanup system is referenced in LRA Section 3, "Aging Management Review Results." This system-specific management program is credited only for the auxiliary systems. In Table 3.3-1, Ref. No. 3.3.1.24, the applicant states that crack initiation and growth due to

SCC and IGSCC in components, piping and fittings in the reactor water cleanup system is managed by reactor water cleanup system inspection. No further evaluation is recommended.

In Section B.1.17 of the LRA, the applicant indicated that the BWR Reactor Water Cleanup System AMP has been demonstrated to be capable of managing SCC and IGSCC aging effects in the RWCU piping. The applicant concludes that the BWR Reactor Water Cleanup System AMP provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB during the period of extended operation.

Staff Evaluation. In LRA Section B.1.17, "BWR Reactor Water Cleanup System," the applicant described its AMP to monitor and control reactor water chemistry to reduce the susceptibility of RWCU piping to SCC and IGSCC. The LRA states that this AMP is consistent with GALL AMP XI.M25 "BWR Reactor Water Cleanup System," with an exception regarding the specification of water chemistry control in accordance with EPRI TR-103515-R2 which is the 2000 revision of the 1993 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines," and references the LRA Section B.1.2 "Water Chemistry."

The staff confirmed, Pending confirmation from the Audit-Inspection Team's Report, the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exception and its justification to determine whether the AMP, with the exception, remains adequate to manage the aging effects for which it is credited. The staff also reviewed the USAR supplement to determine whether it provides an adequate description of the revised program. In addition, for the Dresden and Quad Cities nuclear power stations, the staff determined whether the applicant properly applied the GALL program to its facilities.

By NRC Aging Management Inspection Information Request Number AMI-15 dated September 30, 2003, the staff requested that an inspection of LRA AMP B.1.17 be included in the NRC Inspection List. The staff noted that the purpose of the inspection is to verify that the criteria delineated in GALL AMP XI.M25 are met for the Dresden and Quad City plants so that the AMP B.1.17 is consistent with GALL AMP XI.M25 (with the exception of the water chemistry program) as stated by the applicant in AMP B.1.17 in Appendix B of the LRA. In AMP B.1.17, the applicant also stated that the inspection of RWCU piping is not required because Dresden and Quad Cities have satisfactorily completed all actions requested in NRC GL 89-10, and have replaced the RWCU system piping with piping that is resistant to IGSCC in accordance with NRC GL 88-01 (the applicant claimed that this met the GALL AMP XI.M25 criteria of not requiring IGSCC inspection).

Since the applicant stated that the entire RWCU system piping was replaced with IGSCC-resistant piping in accordance with NRC GL 89-10, the staff subsequently requested the applicant to provide the following information to be verified by the NRC Audit-Inspection Team:

(i) Clarify whether the entire RWCU system piping was replaced with IGSCC-resistant material or whether only portions of the RWCU system piping for each plant were replaced.

(ii) Confirm that, if the entire RWCU system piping was replaced, the piping system includes all the RWCU welds inboard and outboard of the second isolation valves. Confirm whether the selection of material of the replaced piping and weld metal meet the material compositions as described in GALL AMP XI.M25.

(iii) Verify that, if only portions of the RWCU system piping were replaced, the entire RWCU system piping meets the screening criteria, 1(a), (b), and (c) in GALL AMP XI.M25 program element 1, Scope of the Program, as well as the material specifications in GALL AMP XI.M25 program element 2, Preventive Actions.

This is Confirmatory Item B.1.17.

The staff is awaiting verification of the acceptability of the requested information as delineated above by the NRC Audit-Inspection Team in its Inspection Report and RLEP's AMP Audit Report. The Region III's AMR Inspection Reports to be issued on or about 12/5/2003 are: 50-237/03-10 (DRS), 50-249/03-10 (DRS), 50-254/03-14 (DRS), and 50-265/03-14 (DRS). The RLEP's AMP Audit Report will also be issued on or about 12/5/2003.

Section A.1.17 of Appendix A to the LRA contains the applicant's UFSAR supplement for the BWR reactor water cleanup system program at Dresden and Quad Cities nuclear power stations. The staff reviewed the UFSAR supplement and found that the description of the BWR reactor water cleanup system program is consistent with Section B.1.17 of the LRA. The staff finds that the information contained in the UFSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

<u>Conclusions</u>. On the basis of its review and audit of the applicants program, pending adequate verification and satisfactory resolution of Confirmatory Item B.1.17, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.3 Fire Protection Program (B.1.18)

<u>Summary of Technical Information</u>. Appendix B, Section B.1.18 identifies the AMP for the FP components within the scope of license renewal. The AMP for FP SSCs includes the inspection, surveillance testing and maintenance for monitoring and controlling the effects of aging. This section addresses the consistency of the program described in Appendix B.1.18 with Section XI.M26 of NUREG-1801 and identifies exceptions and enhancements to its specific requirements. This section also discusses operating experience with the FP SSCs at the plants.

<u>Staff Evaluation</u>. The staff reviewed LRA Appendix B.1.18 to determine whether there is reasonable assurance that the AMP activities are adequate to maintain the intended functions of the FP SSCs for the period of extended operation, as required by 10 CFR 54.21(a)(1)(a)(3). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

LRA Appendix B, Section B.1.18, "Fire Protection," states that, "With enhancements the FPP is consistent with the ten elements of aging management program XI.M26, "Fire Protection," specified in NUREG-1801 with following exceptions...." In order for the staff to evaluate the adequacy of the applicant's FP AMP and reach a conclusion that it is consistent with NUREG-1801, the staff requested, in a letter dated August 4, 2003, that the applicant follow the guidelines provided in NUREG-1801 for FP AMP. NUREG-1801 contains the staff's generic evaluation of the existing plant program 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 frequencies identified in Appendix B, Section B.1.18 exceed those committed to in the applicant's FP program. The staff also requested that the applicant clarify if the plant FP programs include surveillance requirements consistent with regulatory guidelines, and if the activities defined in B.1.18 are in addition to the inspections provided under the FP program.

In a letter dated October 3,2003, the applicant responded that after the enhancements discussed in Appendix B, Section B.1.18, Subsection, "Enhancements," are implemented, the Dresden and Quad Cities FPP will be consistent with the ten element program described in NUREG-1801, XI.M26, "Fire Protection." However, after the enhancements are implemented, the following exceptions will exist:

(1) NUREG-1801, XI.M26, Element 4 states that a visual inspection of fire barrier walls, ceilings, and floors is to be performed at least once every refueling outage to ensure timely detection of concrete cracking, spalling, and loss of material before there is a loss of intended function. The Dresden and Quad Cities FPP requires inspection of concrete fire barrier walls, ceilings, and floors once every five years, which exceeds the stated frequency of NUREG-1801, XI.M26. This inspection interval, which is in excess of NUREG-1801 guidance, has been justified for the following reasons:

- Station FPP inspections and other similar station inspections have not found any significant aging effect that requires extensive corrective action for any concrete structure within the scope of license renewal. Typically, concrete cracks that have been observed have been attributed to normal concrete shrinkage occurring during construction and are non-active.

- The environment surrounding Dresden and Quad Cities is non-aggressive for concrete.

- Industry guidance contained in ACI 349.3R-96, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," indicates that a five-year inspection frequency for concrete components is adequate for timely identification and correction of degraded conditions prior to a loss of intended function.

- The FPP has provisions to allow for the number of components monitored and the frequency of inspections to be adjusted, to ensure the level of effort is commensurate with the existing degradation mechanisms that are identified.

The staff reviewed the applicant's response. On the basis of the justification provided, the staff agrees that the 5-year frequency is adequate for managing the aging effects of these concrete barriers.

(2) NUREG-1801, XI.M26, Element 4 states that VT-1 or equivalent penetration seal inspections, and VT-3 or equivalent fire door inspections, are to be performed. Personnel performing seal and fire door inspections at Dresden and Quad Cities are not qualified to

American Society for Nondestructive Testing (ASNT) requirements. However, personnel performing these inspections are trained and experienced in FPP requirements. The quality of the fire barrier penetration seal and fire door inspections are equivalent to the VT-1 and VT-3 inspections as is evidenced by the history of identifying conditions requiring maintenance, repair or replacement.

The staff reviewed the applicant's response and concurs that on the basis of the training provided and the absence of the need for special tools or equipment, the qualifications established for these inspectors are adequate.

(3) NUREG-1801, XI.M26, Element 3 states that fire doors are visually inspected at least once bi-monthly for holes in the skin of the door and that clearances are also checked at least once bi-monthly as part of an inspection program. It also states that function tests of fire doors are performed daily, weekly, or monthly (plant-specific) to verify the operability of automatic hold-open, release, closing mechanisms, and latches. The Dresden and Quad Cities FP program provides for an in-depth inspection for condition and operability of fire doors once per operating cycle, which exceeds the stated frequency of NUREG-1801, XI.M26. Dresden checks fire door clearances as part of their operating cycle inspection. Quad Cities does not check door clearances as part of their operating cycle inspection, but does check fire door clearances after maintenance has been performed on a fire door. This inspection interval in excess of NUREG-1801 is justified because the fire doors most likely to experience excessive wear are those that are subject to the most frequent use. Most frequently used doors, such as those in normal and high-traffic areas, are additionally monitored by normal plant operation during periodic fire marshal tours, operator rounds, and security patrols.

The combination of in-depth inspections and monitoring by personnel performing tours, rounds and patrols has been effective in identifying degraded doors and prompting the applicant to take corrective action as necessary. Door degradation is due to wear and physical damage. No instance of door assembly loss of material due to corrosion has been identified.

The staff reviewed the applicant's response. The staff concurs that the frequency of checking doors for aging management concerns each operating cycle is adequate. However, the staff does not agree with the applicant's position that door clearances do not need to be monitored at Quad Cities as part of the inspection program. During the conference call dated November 3, 2003, with applicant, staff stated that the NRC does not agree that door clearances do not need to be monitored at Quad Cities as part of the inspection program. In a letter dated November 20, 2003, the applicant stated that, Quad Cities will include the checking of fire door clearances as a routine part of the operating cycle inspection activities. This will be implemented prior to the extended period of operation. This is part Commitment #18 in Appendix A of this SER. A review was performed of the associated UFSAR supplement (A.1.18) and the AMP description found in section B.1.18 of the LRA. It was determined that no changes were required as a result of this change in commitment.

The staff reviewed the applicant's response and agrees that the Quad Cities AMP will include the checking of fire door clearances as a routine part of the operating cycle inspection activities.

(4) NUREG-1801, XI.M26, Element 4 states that a periodic function test and visual inspection performed at least once every six months detects degradation of the Halon and CO_2 fire

suppression systems before the loss of the component's intended function. The Quad Cities and Dresden Halon and CO_2 fire suppression systems are currently tested and inspected every 18 months. However, the Technical Requirements Manual permits a testing frequency of once every two years. Either of these frequencies exceeds the stated frequency of NUREG-1801, XI.M26, but is considered sufficient to ensure system availability and operability based on station operating history that indicates no occurrence of aging-related events having adversely affected system operation.

The staff reviewed the applicant's response and concurs that on the basis of plant experience, the 18-month frequency is adequate for aging management considerations.

(5) NUREG-1801, XI.M26, Element 6 states that any signs of corrosion and mechanical damage of the Halon or CO_2 fire suppression system are not acceptable. The Dresden and Quad Cities program requires that signs of aging degradation on the external surfaces of the Halon or CO_2 fire suppression systems be evaluated and corrective action be taken as required. Although this method could result in minor corrosion or mechanical damage being evaluated as acceptable, this approach provides reasonable assurance that corrective actions appropriate to the severity of the observed degradation will be implemented prior to a loss of the system or component's intended functions.

The staff reviewed the applicants response. The response provides evaluation method or criteria for the acceptance of discovered corrosion. During the conference call dated November 3, 2003, with the applicant, staff stated that the NRC does agree with the response that the Dresden and Quad Cities AMP requires that signs of aging degradation on the external surfaces of the Halon or CO_2 fire suppression systems be evaluated and corrective actions be taken as required. Further, staff stated that without definitive criteria, NRC staff cannot evaluate the adequacy of the aging degradation of Halon or CO_2 fire suppression systems components corrosion or mechanical damage. In a letter dated November 20, 2003, the applicant stated that, "The License Renewal Application, Appendix B, Section B.1.18," paragraph 5 of "Description" should have read as follows:

> The program will provide for aging management of external surfaces of Dresden and Quad Cities carbon dioxide system components and Dresden Halon system components for corrosion and mechanical damage through periodic operability tests based on NFPA codes and visual inspections. Tests and inspections are implemented through predefined tasks and procedures."

Section B.1.18, second bullet under "Enhancements" should have read as follows:

> The program will provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the Dresden and Quad Cities carbon dioxide systems and the Dresden Halon system.

CO_2 piping and component external surfaces are examined for indications of corrosion degradation, mechanical damage or leakage. Inspection criteria for corrosion degradation included in the inspection procedures are flaking or peeling paint (if painted), rust scale, rust stains on painted surfaces, or leakage. Inspection criteria for CO_2 leakage included in the inspection procedures include visible vapor, hissing, or surface condensation. Halon piping and component external surfaces are examined for indications of corrosion degradation, utilizing the same criteria as for CO_2, and for indications of mechanical damage. When indications of corrosion, mechanical damage or leakage are found, work supervisors and unit supervisors are notified. Any identified indications of corrosion, mechanical damage or leakage are evaluated by Engineering to determine if corrective actions are needed. The evaluations are performed using Condition Reports, in accordance with Exelon procedures. As required, work requests are initiated to perform the work to correct the degraded or inoperable conditions". This part of Commitment #18 of Appendix A of this SER.

The staff reviewed the applicant's response and agrees with the proposed AMP to manage the aging degradation on the external surfaces of the Halon or CO_2 fire suppression systems.

(6) NUREG-1801, XI.M26, Element 5 states that the performance of the fire pump is monitored during the periodic test to detect any degradation in the fuel supply lines and that periodic testing provides data (e.g., pressure) necessary for trending. The Dresden and Quad Cities diesel-driven fire pump test results and the Dresden isolation condenser diesel-driven makeup pump test results are not trended. Instead, in the event the predetermined acceptance criteria are not met, an engineering evaluation is conducted to determine the operability of the pump and the need for corrective action. This method is justified, given that there have been no reports of a loss of function of the Dresden or Quad Cities diesel-driven fire pumps as a result of the inability of the fuel oil system to deliver fuel to the engine and there have been no reports of a loss of material or flow blockage of the Dresden isolation condenser makeup pump fuel oil subsystem.

The staff has reviewed the applicant's response, and on the basis of the plant's experience, agrees with the applicant's testing methodology. This is part of Commitment #18 of Appendix A of this SER.

The activities described in the Dresden and Quad Cities LRA, Appendix B, Section B.1.18 comprise the Dresden and Quad Cities FP program. Other than what is identified above, the Dresden and Quad Cities FP program surveillance requirements are consistent with the regulatory guidelines stated in NUREG-1801, XI.M26, "Fire Protection."

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

3.3.2.3.4 Fire Water System (B.1.19)

Summary of Technical Information. Appendix B, Section B.1.19 identifies the AMP for the fire water system components within the scope of license renewal. The fire water system AMP provided for managing the loss of material and biofouling aging effects on the intended functions of the water-based FP components within the scope of license renewal. The program included inspection, surveillance testing and maintenance activities. This section addresses the consistency of B.1.19 with Section XI.M27 of NUREG-1801 and identifies exceptions and enhancements to its specific requirements. This section also discusses operating experience with the fire water system at Dresden and Quad Cities.

Staff Evaluation. The staff reviewed LRA Appendix B.1.19 to determine whether there is reasonable assurance that the AMP activities are adequate to maintain the intended functions of the fire water system SSCs for the period of extended operation, as required by 10 CFR 54.21(a)(1)(a)(3). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

LRA Appendix B, Section B.1.19, "Fire Water System," states that, "With enhancements the fire water system aging management program is consistent with the ten elements of aging management program XI.M27, "Fire Water System," specified in NUREG-1801 with the following exceptions...." In order for the staff to evaluate the adequacy of the applicant's FP AMP and reach a conclusion that it is consistent with NUREG-1801, the staff requested, in a letter dated August 4, 2003, that the applicant follow the guidelines provided in NUREG-1801 and the interim staff guidance for FP AMP [Staff Guidance (ISG)-04, "Aging Management of Fire Protection Systems for License Renewal," (ADAMS Accession ML022260137, dated December 3, 2002]. NUREG-1801 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.

In a letter dated October 3, 2003, the applicant responded with the following information. Part 1 of this response compares the Dresden and Quad Cities fire water system program against the NUREG-1801, XI.M27 program and identifies where exceptions still exist. Included in Part 1 is a discussion of how Dresden and Quad Cities are addressing ISG-04. Part 2 of the response discusses the Dresden and Quad Cities underground loop flow testing.

(1) The applicant concluded in the Dresden and Quad Cities LRA, Appendix B, Section B.1.19, that the fire water system program, after the enhancements discussed in Appendix B, Section B.1.19, Subsection, "Enhancements," are implemented, will be consistent with the ten-element program described in NUREG-1801, XI.M27, with certain exceptions. Although not stated in the LRA, after the enhancements are implemented, the fire water system program will be also be consistent with the NRC staff recommendations for fire water systems as provided in ISG-04.

Exelon evaluated the Dresden and Quad Cities fire water system program against the attributes of the ten elements of NUREG-1801, XI.M27 and identified that after the enhancements are implemented, the following exceptions will still exist:

- NUREG-1801, XI.M27, Element 3 states that NRC GL 89-13 recommends periodic flow testing of infrequently used loops of the fire water system at the maximum design flow to ensure that the system maintains its intended function. Flow tests at the maximum design flow are not practicable for Dresden and Quad Cities. Instead, the Dresden and Quad Cities flow tests analyze the system hydraulic resistance. Dresden measures underground piping pressure drops at given flows for selected segments of underground fire mains and compares them to pre-calculated allowable pressure drops for the same segments at the given flows. The measured pressure drop must be equal to or less than the allowable. The measured results are also compared with those of previous tests to identify adverse trends. Quad Cities takes pressure measurements and calculates the friction loss coefficients ("C" factor) for the various sections of the underground fire mains. The calculated "C" factor must be equal to or greater than 80 for all piping tested. The calculated results are compared with those of previous tests to identify adverse trends. A low "C" factor (Quad Cities method) or a large pressure drop (Dresden method) may be indicative of either fouling or leakage of the underground fire mains.

(b) NUREG-1801, XI.M27, "Program Description," states that the AMP (XI.M27) applies to water-based FP systems that are tested in accordance with the applicable National Fire Protection Association (NFPA) codes and standards.

The Dresden and Quad Cities fire water systems may not in all cases be tested in accordance with NFPA codes, but in these cases, technical justifications for the deviations are documented. NFPA codes were used in the design of active FP systems (i.e., fire suppression and detection systems). Similarly, inspection and periodic testing is performed in accordance with corporate and station procedures developed using NFPA codes as guidance. Corporate Procedure ER-AA-610, "Performance Based Evaluations for Fire Protection," ensures that performance-based evaluations that result in surveillance frequencies that exceed those specified in site-specific NFPA codes of record serve as the deviation justification. Where code deviations are required or desirable, they are made under the intent of the code and documented in the NFPA Code Deviation Report at each site in accordance with CC-AA-211, "Fire Protection Program." Revision to the NFPA Code Deviation Report is necessary unless the report has previously addressed the deviation.

(c) Interim staff guidance ISG-04 was issued on December 3, 2002. Included as part of ISG-04 is an amended ten-element AMP, XI.M27, for the fire water system. Applicant evaluated the Dresden and Quad Cities fire water system program against the staff recommendations for fire water systems included in ISG-04 with the following conclusions:

- In Element 3 of the amended XI.M27, the staff provides for the option of performing wall thickness evaluations in lieu of testing at maximum design flow. The flow testing discussed in (1)(a) is not performed at maximum design flow, but Dresden and Quad Cities will perform wall thickness measurements.

- In Element 4 of the amended XI.M27, the staff recommends that the applicant perform a baseline pipe wall thickness evaluation of the FP piping using a non-intrusive means of evaluating wall thickness, such as volumetric inspection, to detect general corrosion before the current license term expires. The staff also recommends that the applicant perform pipe wall thickness evaluations at plant-specific intervals during the period of extended operation. As an alternative to non-intrusive testing, the amended XI.M27 allows for a visual inspection of the internal surface of the FP piping upon each entry to the system for routine or corrective maintenance as long as it can be demonstrated that inspections are performed on a representative number of locations on a reasonable basis.

  Dresden and Quad Cities will perform periodic non-intrusive FP piping wall thickness measurements. These non-intrusive inspections will be conducted prior to the end of the current term and repeated on a frequency not exceeding every 10 years.

Element 4 of the amended XI.M27 also states that if the environmental and material conditions that exist on the interior surfaces of the below-grade FP piping are similar to the conditions that exist within the above-grade piping, the results of the inspections of the above-grade FP piping can be extrapolated to evaluate the condition of below-grade piping.

The below-grade fire mains at both Dresden and Quad Cities comprise uncoated carbon steel. The internal environment of the below-grade fire mains at both Dresden and Quad Cities is "raw water," the same as NUREG-1801 Reference VII.G.6-a. Therefore, the results of the inspections of above-grade FP uncoated carbon steel piping with a raw water environment can be extrapolated to evaluate to the condition of the below-grade fire mains.

- In Element 4 of the amended XI.M27, the staff recommends, in accordance with NFPA 25, that sprinkler head testing be performed at year 50 of the sprinkler system service life, not year 50 of plant operation, with subsequent sprinkler head testing every 10 years thereafter. Representative samples of Dresden and Quad Cities sprinkler heads will be submitted to a testing laboratory prior to being in service 50 years. This testing will be repeated on a frequency not exceeding every 10 years.

The staff reviewed the applicant's response. On the basis of the justification provided, the staff concurs that the aging of fire water system components will be adequately managed by the AMP. In a letter dated August 4, 2003, the staff requested that the applicant clarify the flow rates and testing frequencies of the underground loop flow tests and describe the plant procedure for this testing.

(2) In a letter dated October 3, 2003, the applicant responded with additional details regarding frequency and method of flow testing. Flow testing is conducted at five-year intervals at Dresden and Quad Cities. As stated in Section (1)(a) of the applicant's response, tests are not performed at the maximum design flow. By themselves, the absolute values of the flows achieved during testing at both Dresden and Quad Cities provide no indication of the condition of the underground fire mains. Utilizing the Dresden test procedure, test conditions are established to provide flow rates within a pre-determined range corresponding to a table of pre-calculated allowable pressure drops vs. flows. For the cross tie flow test, these pre-determined flows range from 2,500 gpm to 3,500 gpm. For the yard loop flow test, these pre-determined flows range from 900 gpm to 1,300 gpm.

The Quad Cities test procedure methodology ("C" factor) employs the installation of four underwriter's playpipes on each of the three pipe segments to be tested. Sequential tests are performed on each segment with one, two, three, and four playpipes flowing. Total flows and "C" factors are calculated for each combination of flowing playpipes. For each pipe segment, the "C" factors for each separate flow scenario are compared and the most appropriate one is chosen. Since more accurate "C" factors are obtained when calculated for higher flows, it is most likely that the one calculated for four flowing playpipes will be chosen. During the last flow test performed at Quad Cities, the highest calculated flows for each of the three segments, each with four playpipes flowing, were 2,296 gpm, 2,562 gpm, and 2,547 gpm.

The staff reviewed the applicant's response and on the basis of the additional technical data, concurs that the frequency and method of testing adequately addresses NUREG-1801, XI.M27, Element 3.

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

Fire Protection Portions of Table 3.3-3 - Staff Evaluation Table for Dresden and Quad Cities Auxiliary System Components Evaluated in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Components in Gaseous Fire Suppression System	Loss material, due to galvanic, general, pitting, and crevice corrosion	Fire Protection	B.1.18 - Fire Protection Program	Exception taken to Gall on inspection frequency of 18 months under current licensing basis rather than six months as recommended in Gall (See Section B.1.18)
Components in Diesel Fire Pump Fuel System	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fire Protection	B.1.18 - Fire Protection Program	Exception taken to Gall on trending of test results. (See Section B.1.18)
Components Doors and Barrier Penetration Seals	Loss of material due to wear; hardening and shrinkage due to weathering	Fire Protection	B.1.18 - Fire Protection Program	Exceptions taken to GALL on fire door at a frequency of every operating cycle under the current licensing basis rather than the bi-monthly frequency recommended in GALL (See Section B.1.18)
Components in Water-Based Fire Protection	Loss of material due to general pitting, crevice and galvanic corrosion, MIC, biofouling	Fire Water System	B.1.19 - Fire Water System	Consistent with GALL/ISG (See Section B.1.19)
Fire Barriers, Walls, Ceilings and Floors in Fire Protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring	B.1.18 - Fire Protection Program	Exceptions taken to Gall on concrete fire barrier inspection frequency of every five years under ACI 349.3R-96. concrete structures (See Section B.1.18)

3.3.2.3.5 Fuel Oil Chemistry (B.1.21)

Summary of Technical Information in the Application. The applicant's Fuel Oil Chemistry program is discussed in LRA Section B.1.21, "Fuel Oil Chemistry." The applicant states that with enhancements, the program is consistent with the ten elements of aging management program XI.M30, "Fuel Oil Chemistry," specified in NUREG-1801 with exceptions. The following enhancements and exceptions are identified in the LRA:

Enhancements

- The fuel oil chemistry program will provide for inspection of the fuel oil storage tank interiors for corrosion during the regularly scheduled tank cleaning and the performance of engineering evaluations in the event corrosion of the tank interiors is found. The applicant stated that the enhancement is scheduled for implementation at Dresden and Quad Cities prior to the period of extended operation.

Exceptions

- Corrosion mitigation activities are not performed for the Quad Cities Unit 1 underground fuel oil storage tank because it is constructed of fiberglass.

- The Dresden and Quad Cities programs use ASTM D2709 as specified by ASTM D975 for analysis of grades 1-D and 2-D fuel used at the stations.

- The Dresden and Quad Cities programs use ASTM D5452 as the preferred method of analysis.

- Dresden and Quad Cities particulate tests utilize filters with a pore size of 0.8 µm instead of 3.0 µm because 0.8 µm filters provide conservative results. The applicant stated that the use of 0.8 µm filters is consistent with use of ASTM D5452.

- Quad Cities does not add stabilizers because grade 1-D low sulfur fuel oil is used and stored fuel is periodically sampled and analyzed for quality. Dresden and Quad Cities do not add corrosion inhibitors because fuel oil storage tank bottoms are periodically sampled and analyzed for corrosion products in accordance with ASTM D4057 and ASTM D2709. Dresden and Quad Cities employ sample techniques and particulate contamination detection methods that identify fuel degradation or the presence of corrosion products at an early stage.

- Dresden and Quad Cities emergency diesel generator do not have the capability of being sampled. As an alternative, Dresden and Quad Cities sample for water and sediment from the bottom of the associated storage tanks quarterly and particulate from the fuel oil transfer pump discharge line on a monthly basis in accordance with approved procedures. The applicant does not perform multilevel sampling of other fuel oil day tanks (isolation condenser makeup pump [Dresden only], fire pump, and station blackout) because the tanks are small and experience a high turnover of fuel due to routine diesel engine operations. Additionally, ASTM D4057, Table 4, "Spot Sampling Requirements," indicates that multilevel sampling is not required for tanks with a capacity less than 42,000 gallons. The fuel oil storage tanks and day tanks at Dresden and Quad Cities are 15,000 gallons or smaller.

- At Dresden, the results of analysis of new fuel oil are reviewed for acceptability, but are not trended. In the event the quantitative oil acceptance criteria in plant procedures are approached or exceeded the fuel oil is restored to within limits or an action request or condition report is initiated.

In LRA Section B.1.21 and UFSAR A.1.21, the applicant describes the fuel oil chemistry aging management program as an existing aging management program that provides for preventive activities that manage the aging effects of loss of material and buildup of deposits in license renewal components that are exposed to fuel oil. More specifically, the Fuel Oil Chemistry program is credited together with the one-time inspection for managing the following aging effects during the period of extended operation:

- loss of material due to general, pitting, crevice corrosion, MIC and biofouling
- buildup of deposits.

The applicant's operating experience includes a small number of events where plugging of drain lines in fuel oil system low points was caused by sediment buildup. The applicant determined that these events did not affect the ability of the associated diesel generator or fire pump to perform its intended functions. In addition, Quad Cities experienced plugging of both fuel filters on one diesel generator in 1998 for an indeterminate reason. The applicant states that program activities assure that contaminant levels are maintained at acceptable levels in fuel oil for systems within the scope of license renewal. The applicant credits biocide added to the fuel oil storage tanks during each new fuel delivery and fuel oil sampling and analysis in accordance with procedures. The acceptance criteria for analysis contained in the Technical Specifications are based on the requirements of ASTM D975. The applicant also periodically cleans and inspects diesel fuel oil storage tanks for evidence of internal corrosion.

In Section B.1.21 of the LRA, the applicant concludes that the fuel oil chemistry aging management program provides reasonable assurance that the loss of material aging effects are adequately managed so that the intended functions of components exposed to fuel oil within the scope of license renewal are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.21, "Fuel Oil Chemistry," the applicant describes its AMP to manage aging effects for loss of material and buildup of deposits in license renewal components that are exposed to fuel oil. The LRA states that with enhancements the program is consistent with the ten elements of aging management program XI.M30, "Fuel Oil Chemistry," specified in NUREG-1801 with exceptions. The staff confirmed the applicant's claim of consistency during the AMR inspection. The staff reviewed the UFSAR supplement to determine whether it provides an adequate description of the revised program. The staff also reviewed the exception and its justification to determine whether the AMP, with the exception, remains adequate to manage the aging effects for which it is credited. Finally, the staff determined whether the applicant properly applied the GALL program to its facility.

During its review, the staff determined that additional information was needed to complete its review. By letter dated August 4, 2003, the staff requested, in RAI B.1.21, the applicant to provide the following additional information:

For the second exception item, concerning the application of ASTM standards D1796 and D2709, the staff identified that, based on a review of both standards, D2709 is appropriate for D975 Grades 1D and 2D fuel oil. Per D2709, D1796 is appropriate for higher viscosity fuel oil. Therefore, the staff requested the applicant to provide a basis for the statement in the LRA, “NUREG-1801 indicates that ASTM D1796 standard should be used to analyze fuel oil for water and sediment," and indicate whether this item constitutes an exception to GALL, or only a clarification. In its response dated October 3, 2003 the applicant stated that the second exception should be deleted from the LRA aging management program B.1.21 (Fuel Oil Chemistry). On the basis of its review, the staff finds the applicant's response acceptable because the applicant acknowledged that the second exception quoted in the LRA should be deleted from the LRA aging management program B.1.21 Fuel Oil Chemistry.

For the third exception item, concerning the use ASTM D5452 as the preferred method of analysis the applicant was requested to clarify the origin of the fuel oil samples to be analyzed and provide technical basis for the use of ASTM D5452 as the preferred method of analysis for fuel oil content analysis. In its response dated October 3, 2003 the applicant stated that bottom samples for particulates are collected and ASTM D5452 produces more accurate and repeatable results than using a field monitor as described in ASTM D2276. The applicant also stated that the tests methods for particulate contamination per ASTM D5452 is referenced by ASTM D2276 for situations where it is not possible to take field monitor samples. On the basis of its review, the staff finds that the applicant’s response acceptable because there is reasonable assurance that laboratory sample preparation and testing per ASTM D5452 produces more accurate and repeatable test results than using a field monitor as described in ASTM D2276 by line sampling.

For the fifth exception item, concerning the use of periodic sampling in lieu of adding stabilizers and corrosion inhibitors to diesel fuel oil, the applicant was requested to justify that the periodic sampling is representative. In its response dated October 3, 2003, the applicant clarified that bottom samples are collected from the underground fuel oil storage tank in accordance with Dresden and Quad Cities fuel oil sampling procedures. The applicant stated that Quad Cities and Dresden fuel oil inspection procedures meet the requirements of ASTM D4057 and ASTM D2709. Underground storage tank fuel oil quality testing (water, sediment and bacteria) is performed quarterly while particulate contamination (evidence for corrosion products) is performed on a monthly basis. Samples taken at or near the bottom of the tanks provide early detection for contamination since any water, sediment or particulates would settle towards the tank bottom. The applicant concluded that these samples provide the ‘worse case’ indication for identifying contamination. On the basis of its review, the staff finds the applicant's response acceptable because there is reasonable assurance that samples taken at or near the bottom of the tanks provide early detection for contamination since any water, sediment or particulates would settle towards the tank bottom.

For the sixth exception item, concerning the inability to directly sample the emergency diesel generator fuel oil day tanks the applicant was requested to provide justification as to why the day tanks are not sampled. In its response dated October 3, 2003, the applicant stated that the diesel fuel oil day tanks do not have provisions for taking direct fuel samples. The applicant identified that monthly underground storage tank sampling, periodic transfer pump discharge line sampling, and monthly drainage of accumulated water from the day tanks have proven effective in maintaining quality fuel oil to the diesel engines. In addition, the applicant stated that neither station has an operating history of diesel engine in-operability attributed to contaminated fuel. The applicant also stated that, Dresden (as part of the Dresden Diesel Generator Surveillance Tests) meets the guidance in Regulatory Guide 1.137 and EPRI NP-6314 by removing any accumulated water from the day tanks on a monthly basis or following engine operation (greater than or equal to one hour) via the day tank drains. Quad Cities (as part of the Quad Cities Diesel Generator Surveillance Tests) meets the guidance in Regulatory Guide 1.137 and EPRI NP-6314 by removing any accumulated water from the day tanks on a monthly basis or following engine operation (greater than or equal to one hour) by draining the day tank to the underground fuel oil storage tank. Sampling of the underground fuel oil storage tank is then used to detect the presence of water. On the basis of its review, the staff finds the applicant's response acceptable because the applicant’s alternative method to sample the day tanks provides reasonable assurance that contaminated fuel in the day tanks will be detected and there is no prior history of diesel engine in-operability attributed to contaminated fuel.

In the last exception, the applicant states that, at Dresden, the results of analysis of new fuel oil are reviewed for acceptability, but are not trended. The applicant was requested address how the timely detection of the conditions conducive to corrosion will be taken before the quantitative oil criteria is approached or exceeded. The applicant response dated October 3, 2003, stated that new fuel oil analysis results are not trended but are reviewed for acceptability, applies to the receipt of new fuel oil deliveries only. The applicant identified that oil samples of existing fuel oil are taken quarterly and the test results are evaluated and trended. On the basis of its review, the staff finds the applicant's response acceptable because the applicant has clarified that the statement, “new fuel oil analysis results are not trended but are reviewed for acceptability,” applies to the receipt of new fuel oil deliveries only.

LRA AMP B.1.21 indicates that the diesel fuel oil storage tanks are periodically cleaned and inspected for evidence of internal corrosion and that an enhancement will provide for inspection of the fuel oil storage tank interiors. Section 3.3.1.1.8 also indicates that UT examination of the lower portion will be performed. The applicant was requested to provide information that provides more specific UT locations, the inspection interval and operating history. In its response dated October 3, 2003, the applicant specified that an UT examination of the lower portion of one carbon steel underground fuel oil storage tank and one day tank at each facility will be performed prior to the period of extended operation and specific UT locations will be defined at that time. The results of the UT’s will be evaluated, corrective action if required taken and the need for further UT’s will be assessed. The applicant further stated that the draining, cleaning and inspection of the underground fuel oil storage tank interiors is conducted at ten (10) year intervals. The applicant identified that, to date, no tank wall aging degradation has been identified. On the basis of its review, the staff finds the applicant's response acceptable because the applicant has specified that UT examination of the lower portion of one carbon steel underground fuel oil storage tank and one day tank at each facility will be performed prior to the period of extended operation and the applicant has committed to the draining, cleaning and inspecting the underground fuel oil storage tank interiors at ten (10) year intervals. Specific UT locations will be defined later. This is Commitment #21 in Appendix A of this SER.

The UFSAR supplement does not include criteria for fuel monitoring identified in LRA AMP B.1.21, such as specific ASTM standards. For example, specific ASTM standards are identified in NUREG-1800 Table 3.3-2. The applicant was requested to submit a revised UFSAR supplement which includes specific ASTM standards applied in AMP B.1.21. In its response dated October 3, 2003, the applicant submitted a revised UFSAR supplement to include specific ASTM standards. On the basis of its review, the staff finds the applicant's response acceptable because the applicant has revised the UFSAR supplement A.1.21 Fuel Oil Chemistry to reflect consistency between the AMP and the UFSAR.

LRA AMP B.1.21 identifies operating experience which includes plugging of fuel filters and drain lines. This operating experience suggests that the fuel oil chemistry program was not effective in preventing or detecting contamination and corrosion products at an early stage. The applicant was requested to indicate what corrective actions have been implemented to prevent recurrence of these events. In addition, the applicant was requested to indicate if filters and strainer elements in the fuel oil system are periodically inspected to further assess the effectiveness of the fuel oil chemistry program. In its response dated October 3, 2003, the applicant considered the flow blockage events to be isolated incidents and concluded that system testing confirms the adequacy of the fuel oil inspection and testing in maintaining system functions. In addition, as part of the diesel surveillance testing, the applicant identified that fuel oil supply pressure and fuel oil filter discharge pressure are recorded and trended thus providing indication of the performance of the fuel filters and strainers. The applicant stated that readings outside the nominal range are brought to the attention of the System Engineer for evaluation. On the basis of its review, the staff finds the applicant's response acceptable because the system testing and operating history provide reasonable assurance that the fuel oil inspection and testing practices are effective in maintaining system functions.

The staff finds the applicant's response to RAI B.1.21 provided sufficient technical justification to show that the program, with exceptions and enhancements, will adequately manage the aging effects for which the program is credited. All technical concerns associated with RAI B.1.21 are considered resolved.

The applicant committed to revise UFSAR supplement A.1.2.1 Fuel Oil Chemistry as described in its response to RAI B.1.21 part (g). The staff reviewed this revised UFSAR supplement and found that the description of the Fuel Oil Chemistry program is consistent with Section B.1.21 of the LRA. The staff finds that the information provided in the UFSAR supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions. On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.6 Boraflex Monitoring (B.1.36)

Summary of Technical Information in the Application. The applicant's Boraflex monitoring program is discussed in LRA Section B.1.36, "Boraflex Monitoring (Quad Cities Only)." The applicant stated that the program is consistent with the GALL Program XI.M22 "Boraflex Monitoring," with no deviations. The applicant stated that its AMP is based on EPRI TR-108761, "A Synopsis of the Technology Developed to Address the Boraflex Degradation Issue." The Boraflex Monitoring program is only applicable to Quad Cities because Dresden utilizes

Boral as the neutron absorbing material in the spent fuel racks rather than Boraflex.

boraflex degrades when exposed to chemically-treated oxygenated water and gamma radiation. The degradation results in a loss of boron carbide and a reduction in the neutron-absorbing capacity of the Boraflex. This AMP is credited with managing the degradation.

Under “Operating Experience,” the stated that past inspections under the Boraflex Monitoring program have been effective at determining boron loss. The applicant stated that, to date, a boron loss of approximately one percent has been identified and trended, and that a review of the program resulted in updating the RACKLIFE program every two years to be consistent with the maintenance rule requirements.

The applicant concludes that the Quad Cities Boraflex monitoring program provides reasonable assurance that the aging effects are adequately managed so that the 5% subcriticality margin in the spent fuel pool will be maintained during the period of extended operation.

<u>Staff Evaluation</u>. In LRA Section B.1.36, “Boraflex Monitoring (Quad Cities Only),” the applicant described its AMP to manage the effects of aging on Boraflex. The LRA stated that this AMP is consistent with the GALL AMP XI.M22 "Boraflex Monitoring," with no exceptions. The staff confirmed the applicant’s claim of consistency during the AMR inspection. In addition, for the Quad Cities plant, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

The Boraflex monitoring AMP consists of (1) neutron attenuation testing (blackness testing) to determine gap formation, (2) sampling for the presence of silica in the spent fuel pool (which accompanies the loss of boron carbide), and (3) analysis of criticality to assure that the required 5% subcriticality margin is maintained. This program is implemented in response to Generic Letter 96-04, “Boraflex Degradation in Spent Fuel Pool Storage Racks.” The Boraflex monitoring activities are based on the maintenance rule and on EPRI TR-108761, "A Synopsis of the Technology Developed to Address the Boraflex Degradation Issue."

The staff noted that GALL AMP XI.M22 states that trending of the results from the silica analysis in the spent fuel pool water using the EPRI RACKLIFE predictive code (or its equivalent) is performed on a monthly, quarterly, or annual basis (depending on the Boraflex panel condition). However, in Section B.1.36 of the LRA, the applicant stated that the evaluation is performed every two years. By RAI B.1.36, the staff asked the applicant to clarify this statement and provide the technical basis for this apparent divergence from the guidelines in the GALL Report. In its response dated October 3, 2003, the applicant stated that the silica levels in each spent fuel pool are measured by Quad Cities’ chemistry department on a weekly basis and this weekly data is subsequently used as an input into the EPRI RACKLIFE program. The applicant further stated that RACKLIFE has previously been run in conjunction with the units’ outage schedules (once every two years), which is within the guidance of the RACKLIFE manual, “*Guidance and Recommended Procedures for Maintaining and Using RACKLIFE Version 1.10*,” published by EPRI in April 2002. However, since Quad Cities must move spent fuel from one pool to another to make room for refueling outage activities on either unit, and since RACKLIFE is updated whenever fuel is moved, the actual update frequency for RACKLIFE for each spent fuel pool is approximately three times every two years. The applicant changed the AMP to state that the evaluation is performed on an annual basis to reflect this and to ensure compliance with GALL XI.M22. On the basis of its review, the staff finds that the applicant's response to RAI B.1.36 adequate and acceptable because the applicant has verified that the silica level measurements and the evaluation are performed on a frequency consistent with GALL AMP XI.M22.

The staff reviewed the UFSAR supplement in LRA Appendix A.1.36 and found that the description of the Boraflex monitoring is consistent with Section B.1.36 of the LRA. The staff finds that the information provided in the UFSAR supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

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

3.3.2.3.7 Periodic Inspection of Plant Heating System (B.2.8)

Summary of Technical Information in the Application. The applicant developed this program in response to staff questions on the use of the One-Time Inspection program on the plant heating system. The program is not based on a GALL report program; therefore, the applicant summarized the program in terms of the 10-element program as described in Branch Technical Position, Appendix A of the SRP-LR. The program will use periodic visual inspections for cracking, loss of material, or other evidence of aging to monitor the condition of the system. The applicant concludes that the program provides reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. The applicant described its AMP to manage loss of material and cracking in the plant heating system. The staff reviewed this program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled Quality Assurance Program. The staff's evaluation of the Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to components of the plant heating system, including filter/strainer housings, piping and fittings, pump casings, sight glasses, tanks, thermowells traps, tubing, and valves. The staff finds that the scope is acceptable because it includes those components that rely on the program for aging management.

[Preventive or Mitigative Actions] The applicant's program monitors the condition of the system and does not provide preventative or mitigative actions. The staff has not identified the need for any preventative or mitigative actions; therefore, the staff finds this acceptable.

[Parameters Monitored or Inspected] The applicant stated that the program would monitor for cracking, loss of material, and leakage of a representative sample of brass and bronze valves, carbon steel piping and fittings, cast iron filter housings, pump casings, and valves, and stainless steel thermowells and tubing. The applicant will perform periodic visual inspections for the presence of general, crevice, galvanic, and pitting corrosion. The staff concludes that the applicant is inspecting the appropriate parameters to identify the aging effects; therefore, the staff finds this acceptable.

[Detection of Aging Effects] The applicant stated that the inspections will be performed by certified NDE examiners in accordance with ASME Code VT-3 requirements. It was not clear whether the inspections would be of the component internals exposed to steam and condensate, or whether the applicant would perform external visual inspections for evidence of cracking, through-wall corrosion, or leakage. In its submittal dated January 26, 2004, the applicant clarified that the visual inspections would be of the component internals. The staff finds this acceptable because the inspections will identify the aging effects before a loss of intended function.

[Monitoring and Trending] The applicant stated that an inspection will be performed once before the end of the current operating term, and then periodically at intervals of approximately every 5 years during the period of extended operation. The condition of the components is monitored but not trended. Components are replaced if damage or unacceptable leakage is detected. The staff finds this acceptable because inspecting approximately every five years and replacing damaged equipment will adequately manage the aging effects.

[Acceptance Criteria] The applicant stated that if any evidence of corrosion, erosion, cracks, or other degradation is found, the aging degradation will be evaluated to determine if components should be replaced or additional inspections should be performed. The staff finds performing an evaluation of any identified aging effects to be acceptable for determine the corrective actions; therefore, the staff finds this acceptable.

[Operating Experience] The applicant stated that Dresden and Quad Cities have experienced leaks or the plant heating systems, but that these leaks were identified and corrected in a timely manner and did not result in a loss of function of any safety-related system, structures, or components. The staff notes that the plant heating system is in scope of license renewal due to the potential for spacial interactions. The staff finds that the operating experience of timely correction of system leaks plus the additional periodic visual inspections supports the applicant's conclusion that the program will be effective in managing aging of the components in the scope of this program; therefore, the staff finds this acceptable.

The applicant developed this program in response to staff questions on the use of the One-Time Inspection program on the plant heating system. The program is not based on a GALL report program; therefore, the applicant summarized the program in terms of the 10-element program as described in Branch Technical Position, Appendix A of the SRP-LR. This is a confirmatory item pending formal submittal from the applicant of the 10-element program description (Confirmatory Item B.1.23-2.5).

Conclusion. On the basis of its review of the applicant's program, pending resolution of Confirmatory Items B.1.23-1 and B.1.23-2.5, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4 Aging Management Review of Auxiliary Systems

The following sections provide the results of the staff's evaluation of the adequacy of aging management for components in each of the auxiliary systems.

3.3.2.4.1 Refueling Equipment System

Summary of Technical Information in the Application. The description of the refueling equipment can be found in Section 2.3.3.1.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-1. The components, aging effects, and AMPs are provided in LRA Table 3.3-2.

Aging Effects

Table 2.3.3.1.1 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The component groups in this category in the refueling equipment system listed by the applicant in the LRA are cranes, including bridge and trolleys, and the rail system in the load handling system; fuel grapples/structural support; fuel pool gates/pressure boundary; and fuel preparation machines/structural support.

The LRA identified the following applicable aging effects for the refueling equipment:

- Carbon steel components are identified as being subject to loss of material due to general corrosion and wear from exposure to air at 100 percent relative humidity and a temperature of 49 °C (120 °F).

- Stainless steel components are identified as being subject to loss of material due to pitting and crevice corrosion from exposure to chemically treated oxygenated water.

- Aluminum components are identified as being subject to loss of material due to general and pitting corrosion from exposure to chemically treated oxygenated water.

Aging Management Programs

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

- Water Chemistry Program (B.1.2)

- Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program (B.1.15)

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

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in refueling equipment. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.1 and Tables 2.3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

Table 3.3-2, Reference No. 3.3.2.74 in the LRA identifies the loss of material due to pitting corrosion for stainless steel components in a chemically treated oxygenated water environment. It does not, however, identify crack initiation and growth due to SCC as a plausible aging effect/mechanism even though the same environmental conditions generally exist for pitting corrosion as for SCC. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.1, the applicant to provide a justification for excluding crack initiation and growth due to SCC as an aging effect/mechanism that requires management for the period of extended operation.

In its response dated October 3, 2003, the applicant stated that the cracking aging effect is discussed in EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," Appendix A, Section 3.2.2, "Stress Corrosion Cracking (SCC) of Stainless Steel in Fuel Storage and Handling Equipment." The applicant further stated that this aging effect has not been detected by industry experience or by actual site operating experience. SCC tendency increases with temperature applications greater than 60 °C (140 °F) and the introduction of chlorides (in excess of permissible limits). This is the uppermost limit for long-term operating temperature in the spent fuel pool (because higher operating temperatures are detrimental to fuel pool cooling system demineralizer resin). The applicant concluded that as such, crack initiation and growth due to SCC was not considered a credible aging effect/mechanism.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has shown that this cracking aging effect has not been detected by industry experience or by actual site operating experience and that the uppermost limit for long-term operating temperature in the spent fuel pool is 60 °C (140 °F).

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The aging effects identified in the LRA for the refueling equipment system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the refueling equipment system.

- Water Chemistry Program (Section 3.0.3.2)
- Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program (Section 3.3.2.3.1)

The Water Chemistry Program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common AMP. The staff's evaluation of this AMP is discussed in Section 3.0.3.2 of this SER.

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program is only credited with managing the aging effects of the refueling equipment system components. The staff has evaluated this AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is discussed in Section 3.3.2.3.1 of this SER.

After evaluating the applicant's AMR for each of the components in the refueling equipment system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the refueling equipment system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.2 Shutdown Cooling System (Dresden Only)

Summary of Technical Information in the Application. The description of the shutdown cooling system (Dresden only) can be found in Section 2.3.3.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-2. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1, 3.3-1, and 3.3-2.

Aging Effects

Table 2.3.3-2 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include closure bolting, dampeners, filters/strainers, heat exchangers (heat exchanger components), NSR vents or drains, piping, piping and fitting pumps, restricting orifices, sight glasses, thermowells, and valves.

Stainless steel components in an air, moisture, and humidity environment experience no aging effects. Copper-nickel heat exchanger components exposed to reactor coolant water are subject to the aging effects of fatigue and cracking due to SCC. Carbon steel heat exchanger components exposed to reactor coolant water or closed-cycle cooling water are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, flow-accelerated, and microbiologically influenced corrosion and wear. Stainless steel heat exchanger components exposed to reactor coolant water or closed-cycle cooling water are subject to the aging effects of fatigue and cracking due to SCC. Heat exchanger components are also subject to the aging effect of loss of heat transfer function due to buildup of deposit and fouling. Carbon steel, stainless steel, brass, or bronze components of the NSR drains, piping, and valves exposed to air, moisture, and leaking fluid environments are subject to the aging effect of loss of material due to corrosion. Carbon steel components exposed to containment nitrogen experience no aging effects. Stainless steel components exposed to a saturated air environment are subject to loss of material due to pitting and crevice corrosion. Stainless steel components exposed to air, moisture, and humidity or containment nitrogen environments experience no aging effects. Sight glass in a wet gas environment experiences no aging effects. Several carbon steel and stainless steel components are also subject to fatigue.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the shutdown cooling system (Dresden only):

- Water Chemistry Program (B.1.2)
- BWR Stress Corrosion Cracking Program (B.1.7)
- Flow-Accelerated Corrosion Program (B.1.11)
- Bolting Integrity Program (B.1.12)
- Closed-Cycle Cooling Water System Program (B.1.14)
- Compressed Air Monitoring Program (B.1.16)
- One-Time Inspection Program (B.1.23)
- Structures Monitoring Program (B.1.30)

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

<u>Staff Evaluation</u>. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the shutdown cooling system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.2, Table 2.3.3-2, and Tables 3.3-1, 3.3-2, and 3.1-1 in the LRA. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or an air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40, as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table

3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

In LRA Table 3.3-2, the applicant indicated that the stainless steel valves in the shutdown cooling system are exposed to saturated air and are subject to the aging effect of loss of material due to pitting and crevice corrosion. The staff finds that valves are the only component type that are identified as exposed to a saturated air environment in the shutdown cooling system. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.2, the applicant to provide clarification as to whether there are any other associated components, such as piping, pipe fittings, tubing, and tube fittings, in the shutdown cooling system that may be exposed to the same environment and hence subject to the same aging effects. If so, the staff asked the applicant to specify the applicable AMPs.

In its response dated October 3, 2003, the applicant stated that valves are the only component type that was identified as exposed to a saturated air internal environment in the shutdown cooling system. The reason for this is that the shutdown cooling valves in this group are 2-1099-X111A & B for Dresden Unit 2 and 3-1099-X111A & B for Dresden Unit 3. These valves are utilized when local leak rate testing of the shutdown cooling system primary containment penetrations X-111A and B is conducted. The penetrations are shown on boundary diagrams LR-DRE-M-32 (coordinate C-9) and LR-DRE-M-363 (coordinate C-9), but the level of detail of this diagram does not include the valves. There are piping and fittings connecting these valves to the penetrations. These piping and fittings are included in LRA Table 2.3.2-3 under component group, "Isolation Barriers (including piping, tubing, valves and vacuum breakers)," and the component intended function of "Pressure Boundary." The Aging Management Reference is 3.2.2.52. Valves 2(3)-1099-X111A & B should have been included in LRA Section 2.3.2.3, "Containment Isolation Components and Primary Containment Piping System," in Table 2.3.2-3, under the component group, "Isolation Barriers (including piping, tubing, valves and vacuum breakers)," along with the other test valves utilized for local leak rate testing of containment penetrations.

On the basis of its review, the staff finds the applicant's response acceptable because the components exposed to saturated air connecting to these valves are included and reviewed in LRA Table 2.3.2-3 under component group, "Isolation Barriers (including piping, tubing, valves and vacuum breakers)," and the Aging Management Reference is 3.2.2.52. The staff considers the issues related to RAI 3.3.2.4.2 to be resolved.

The aging effects identified in the LRA for the shutdown cooling system (Dresden only) are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the shutdown cooling system (Dresden only).

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.3, 3.0.3.4, 3.0.3.5, 3.0.3.7, 3.0.3.8, 3.0.3.10, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the shutdown cooling system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Tables 3.1-1 and 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the shutdown cooling system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.3 Control Rod Drive Hydraulic System

Summary of Technical Information in the Application. The description of the control rod drive hydraulic system can be found in Section 2.3.3.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-3. The components, aging effects, and AMPs are provided in LRA Tables 3.1-2, 3.3-1, and 3.3-2.

Aging Effects

Components of the control rod drive hydraulic system are described in Section 2.3.3.3 of the LRA as being within the scope of license renewal and subject to an AMR. Table 2.3.3-3 lists individual components of the system including accumulators, closure bolting, dampeners, filters/strainers, flow elements, NSR vents or drains, piping and fitting, piping and fitting (attached supports), pumps, restricting orifices, rupture discs, tanks, tubing, and valves.

Stainless steel components exposed to the dry gas environment experience no aging effects. Stainless steel accumulators, dampeners (Quad Cities only), filters/strainers, flow elements (Dresden only), piping and fittings (includes dampeners and tubing), pumps (Dresden only), restricting orifices (Dresden only), rupture discs, tanks (includes accumulators), tubing, and valves exposed to an air, moisture, and humidity environment experience no aging effects. Carbon steel, stainless steel, brass, or bronze NSR vents or drains, piping, and valves exposed to an air, moisture, and humidity environment or leaking fluid are subject to the aging effect of loss of material due to corrosion. Stainless steel piping and fittings (includes dampeners and tubing) exposed to containment nitrogen experience no aging effects. Stainless steel filters/strainers, piping and fittings (includes dampeners and tubing), tanks, and valves exposed to oxygenated water up to 288 °C (550 °F) are subject to the aging effects of loss of material due to pitting and crevice corrosion and cracking due to SCC. Stainless steel and carbon steel piping and fittings (includes dampeners and tubing) and valves exposed to saturated air are subject to the aging effect of loss of material due to general (carbon steel only), crevice, and pitting corrosion. Stainless steel and carbon steel piping and fittings, tanks, and valves exposed to wet gas are subject to the aging effect of loss of material due to general (carbon steel only), pitting, and crevice corrosion. Stainless steel tubing and rupture discs exposed to dry gas experience no aging effects. Copper, brass, or bronze tubing and valves exposed to saturated air are subject to the aging effect of loss of material due to pitting and crevice corrosion. Brass or bronze valves exposed to an environment of air, moisture, and humidity less than 100 °C (212 °F) experience no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the control rod drive hydraulic system:

- Water Chemistry Program (B.1.2)
- Bolting Integrity Program (B.1.12)
- Compressed Air Monitoring Program (B.1.16)
- BWR Stress Corrosion Cracking Program (B.1.7)
- One-Time Inspection Program (B.1.23)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the control rod drive hydraulic system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the control rod drive hydraulic system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.3, Table 2.3.3-3, and Tables 3.3-1, 3.3-2, and 3.1-2 in the LRA. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, and humidity or leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to a moist gas (moist nitrogen) or moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects are identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either a containment nitrogen gas environment or an air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40 as to whether pollutants such as oxygen, NO_x, $SO_{2,}$ or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there are no aging effects on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

In LRA Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of copper, brass, or bronze components in the control rod drive hydraulic system exposed to the moisture and humidity air environment because, "The plant indoor environment is not an aggressive wetted environment conducive to promoting aging degradation of brass or bronze (3.3-2, Ref No 3.3.2.23) or copper (3.3.2.34) components." The staff finds that this conclusion may not be justified because copper and copper alloy components exposed to a moist air environment may experience the aging effect of loss of material due to pitting and crevice corrosion, especially when the humidity is at 60 percent or higher and/or with the presence of pollutants such as oxygen, SO_2, NO_x, and NH_4. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.3, the applicant to provide its technical basis (including the level of humidity and the level of pollutants) for this conclusion.

In its response dated October 3, 2003, the applicant stated that copper, brass, and bronze materials are used in the indoor (air, moisture, and humidity less than 100 °C (212 °F)) ambient environment for various system piping and tubing. This environment, specified for Aging Management References 3.3.2.23 and 3.3.2.34, is the same as NUREG-1801, References V.E.1-b, VII.I.1-b, and VIII.H.1-b. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," Appendix E, conservatively concludes that the indoor ambient environment is an aggressive environment for copper and copper alloy components if subjected to periodic wetting. However, for the specific indoor environment being considered, periodic wetting of the external surfaces would be rare. In addition, M.G. Fontana and N.D. Greene in "Corrosion Engineering," Second Edition, McGraw-Hill, New York, 1978, state that copper and copper alloys are specifically chosen for their ambient condition corrosion resistance. Additionally, other than one instance of copper/brass corrosion found at the Quad Cities station, there has been no operating experience related to corrosion of copper, brass, or bronze components in an indoor, ambient environment at either the Quad Cities or Dresden stations. This one example at the Quad Cities station was due to leakage from the sodium hypochlorite system piping joints in the area of an instrument rack. The use of the sodium hypochlorite system has since been terminated, and the system has been removed. Therefore, copper, brass, and bronze components located in an environment of air, moisture, and humidity less than 100 °C (212 °F) will not require aging management.

The staff reviewed the applicant's response to the issues raised in RAI 3.3.2.4.3. On the basis of its review, the staff finds that the applicant's response to RAI 3.3.2.4.3 does not adequately address the questions in the RAI because (1) NUREG-1801, References V.E.1-b, VII.I.1-b, VIII.H.1-b, identifies the indoor ambient environment as an aggressive environment and low-alloy components in this environment require plant-specific aging management, the (2) the applicant referenced the book by M.G. Fontana and N.D. Greene, "Corrosion Engineering," Second Edition, McGraw-Hill, New York, 1978, to demonstrate that copper and copper alloys are specifically chosen for their ambient condition corrosion resistance.

While this latter reference is correct, new research results reveal that pollutants and humidity play an important role in accelerating corrosion on low-alloy materials. In *Corrosion, Understanding the Basics*, edited by J.R. Davis, pp. 207 - 210, ASM International, Material Park (2000), the author specifically states that copper and copper alloy components exposed to a moist air environment will experience the aging effect of loss of material due to pitting and crevice corrosion, especially when the humidity is at 60 percent or higher and/or with the presence of pollutants such as oxygen, SO_2, NO_x, and NH_4.

Further, the applicant did not provide an answer pertaining to the second part of the question in RAI 3.3.2.4.3 (i.e., the humidity and pollutant levels). Although the applicant indicated that periodic wetting is rare for these components, the response did not completely rule out the possibility of periodic wetting, especially for the extended period of operation. The applicant was requested to provide (1) further clarification on how often the periodic wetting and drying could occur on the relevant components and (2) the technical basis for the conclusion that copper, brass, and bronze components located in an environment of air, moisture, and humidity less than 100 °C (212 °F) do not require aging management.

In its response dated December 17, 2003, the applicant stated that the following is the basis for the assessment that periodic wetting (either continuously wetted or alternately wetting and drying) of the external surfaces of copper and copper alloys is rare for an indoor (air, moisture and humidity less than 100 °C (212 °F)) ambient environment.

- The internal fluids for systems containing copper and copper alloy piping and components are predominately either saturated air or dry gas. The internal fluids for copper and copper alloy piping and components in the control rod drive hydraulic system are only saturated air or dry gas. Therefore, leakage at a joint in one of these systems would not result in wetting of the affected component.

- Copper and copper alloy piping and components are typically not insulated because the fluids are predominately either saturated air or dry gas. For those cases in which the fluid is other than saturated or dry air, the fluid in contact with the copper and copper alloy piping and components is not of a temperature that would cause condensation on the component. Therefore, wetting from contaminated insulation or condensation is not a consideration.

- Leakage from other systems onto the control rod drive hydraulic system copper and copper alloy piping and components would be detected by normal operator rounds. Leaks would not be allowed to persist, and wetting from leaks would not be long lasting or repetitive.

- The statements above are supported by the Quad Cities and Dresden station operation experience. As stated in the original response to RAI 3.3.2.4-03, other than one instance of copper/brass corrosion found at the Quad Cities station, there has been no operating experience related to corrosion of copper, brass, or bronze components in an indoor ambient environment at either the Quad Cities or Dresden Stations. This one example at the Quad Cities station was due to leakage from sodium hypochlorite system piping joints in the area of an instrument rack. The use of the sodium hypochlorite system has since been terminated, and the system has been removed.

The staff reviewed the applicant’s additional response to RAI 3.3.2.4.3 supplemental information request for the control rod drive hydraulic system and finds it adequate and acceptable because the applicant has indicated that (1) the wetting caused by leakage from other systems will be detected and removed in a timely manner and the use of the sodium hypochlorite system has already been terminated, and (2) the internal fluid for copper and copper alloy piping and components in the control rod drive hydraulic system is only saturated air or dry gas. The staff considers all issues related to RAI 3.3.2.4.3 to be closed.

The aging effects identified in the LRA for the control rod hydraulic system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the control rod hydraulic system:

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.3, 3.0.3.5, 3.0.3.8, 3.0.3.10, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the control rod drive hydraulic system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Tables 3.1-2 and 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the control rod hydraulic system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.4 Reactor Water Cleanup System

Summary of Technical Information in the Application. The description of the reactor water cleanup system can be found in Section 2.3.3.4 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Tables 2.3.3-4. The components, aging effects, and AMPs are provided in LRA Tables 3.1-1, 3.3-1, and 3.3-2.

Aging Effects

Table 2.3.3-4 of the LRA lists individual components that are within the scope of license renewal and subject to AMR. The components include closure bolting, NSR vents or drains, piping and valves, other piping and fittings and valves, and sight glasses.

The LRA identifies that low-alloy steel, carbon steel, stainless steel, brass, and bronze in an air, moisture, and humidity environment or leaking fluid are subject to loss of material due to general corrosion/corrosion. Low-alloy steel, carbon steel, CASS, and stainless steel in air with metal temperatures up to 288 °C (550 °F) or in reactor coolant water or steam, as well as in oxygenated water, are subject to cumulative fatigue damage due to fatigue. Low-alloy steel, stainless steel, and CASS in an air, moisture, humidity and leaking fluid environment, or in 288 °C (550 °F) reactor coolant water or steam, as well as in an oxygenated water environment, are subject to crack initiation and growth due to SCC and IGSCC. Carbon steel and stainless steel in oxygenated water are also subject to loss of material from pitting and crevice corrosion. CASS in 288 °C (550 °F) reactor coolant water is subject to loss of fracture toughness due to thermal aging embrittlement. The applicant stated that glass in wet gas is not subject to any aging effect. The LRA does not identify any aging effect for stainless steel components in moist air less than 100 °C (212 °F) or in a containment nitrogen environment.

Aging Management Programs

The LRA credits the following AMPs with managing the identified aging effects for the reactor water cleanup system:

- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)
- Water Chemistry Program (B.1.2)
- BWR Stress Corrosion Cracking Program (B.1.7)
- BWR Reactor Water Cleanup System Program (B.1.17)
- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program (B.1.1)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the reactor water cleanup system will be adequately managed by these AMPs during the period of extended operation.

The closure bolting, piping and fittings, and valves are also covered by TLAAs to address fatigue. TLAAs of applicable components are described in Section 4.3 of the LRA.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the reactor water cleanup system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-4, 3.1-1, 3.3-1, and 3.3-2 for the reactor water cleanup system. During its review, the staff determined that additional information was needed.

For the environment of moist air, the applicant stated, in Table 3.3-2, page 3-141 of the LRA, that loss of material due to pitting and crevice corrosion for stainless steel components is an applicable aging effect and that the One-Time Inspection Program (B.1.23) is the applicable AMP. However, in the environment of air, moisture, and humidity less than 100 °C (212 °F), stainless steel components are claimed by the applicant, in Table 3.3-2, page 3-96 of the LRA, to have no applicable aging effect. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.4, the applicant to provide the following additional information:

(a) Explain the difference between the environment of moist air and air, moisture, and humidity less than 100 °C (212 °F), as stated in Table 3.3-2, page 3-141 and page 3-96, respectively, of the LRA, and justify the different conclusions drawn in terms of the combination of components/materials/environment/applicable aging effect.

(b) In NUREG-1801 (Volume II, Chapter VII, Section E4), carbon steel components in auxiliary systems, such as piping and fittings and pump casings, in an oxygenated water environment are addressed. The applicable aging effects are loss of material and fatigue. For loss of material, the recommended AMP is Chapter XI.M2, "Water Chemistry," augmented by verification of the effectiveness of the Chemistry Control Program. NUREG-1801 suggests that for these cases, the detection of aging effects is to be further evaluated. In Table 3.3-2 (page 3-116, item 3.3.3-140) of the LRA, the applicant stated that NUREG-1801 does not address carbon steel components in an oxygenated water environment. Clarify this statement based on the above information provided by NUREG-1801.

In its response dated October 3, 2003, to part (a) of the RAI, the applicant stated that the environment of moist air (identified in LRA Table 3.3-2, page 3-141) and the environment of air, moisture, and humidity less than 100 °C (212 °F) (identified in LRA Table 3.3-2, page 3-96) are the same. The only difference is in how they are described, which is verbatim with NUREG-1801, Volume II, Chapter VII, for the respective systems. For example, NUREG-1801, Volume II, Chapter VII, Items F1.1-a and H2.2-a, are aligned with the control room ventilation and the emergency diesel generator systems, respectively. Item F1.1-a identifies the environment as "Warm, moist air," while Item H2.2-a identifies the environment as "Moist air."

The applicant clarified that the subject Aging Management Reference (3.3.2.291) identified on page 3-141 of the LRA and those Aging Management References (3.3.2.37, 3.3.2.38, and 3.3.2.40) on page 3-96 are associated with internal environments and external environments, respectively.

The applicant further stated that Aging Management Reference 3.3.2.291 of LRA Table 3.3-2 is associated with components made of stainless steel with an indoor ambient internal environment. It specifically addressed components in the emergency diesel generator and SBO diesel generator air start systems. The "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," EPRI 1003056, Appendix D, was utilized to perform the AMR for these components. It specifically identifies loss of material due pitting and crevice corrosion as the aging effect/mechanism.

The applicant further clarified that Aging Management References 3.3.2.37 and 3.3.2.38 of LRA Table 3.3-2 are associated with components made of ductile iron and malleable iron, respectively, with indoor ambient external environments. EPRI 1003056, Appendix E, was utilized to perform the AMR for these components although it does not specifically address the associated material types. However, it does address gray cast iron, which is considered to be less corrosion resistant than ductile iron and malleable iron. Therefore, the conclusions of EPRI 1003056, Appendix E, for gray cast iron should bound those for the subject material types. EPRI 1003056, Appendix E, conservatively considers an indoor ambient environment to be aggressively corrosive. Since the indoor ambient environment is only marginally corrosive, a determination was made that it was unnecessary to manage the aging of ductile iron and malleable iron components in this environment.

Finally, the applicant stated that Aging Management Reference 3.3.2.40 of LRA Table 3.3-2 is associated with components made of stainless steel in an indoor ambient external environment. EPRI 1003056, Appendix E, was utilized to perform the AMR for these components. EPRI 1003056, Appendix E, indicates that stainless steel materials are not subject to any viable aging mechanism in the absence of aggressive chemical species. The affected components are not subject to any aggressive chemical species. Therefore, the applicant concluded that it was unnecessary to manage the aging of stainless steel components in this environment.

On the basis of its review, the staff finds the applicant's response to part (a) of RAI 3.3.2.4.4 acceptable because (1) the applicant documented that the environment of moist air (identified in LRA Table 3.3-2, page 3-141) and the environment of air, moisture, and humidity less than 100 °C (212 °F) (identified in LRA Table 3.3-2, page 3-96) are the same, and (2) the applicant verified that the affected stainless steel components with an indoor ambient external environment described in Table 3.3-2, page 3-96, of the LRA are not subject to any aggressive chemical species and therefore it is unnecessary to manage the aging of stainless steel components in this environment. This is consistent with the recommendations of "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," EPRI 1003056, Appendix E.

In its response dated October 3, 2003, to part (b) of the RAI, the applicant stated that the statement in Aging Management Reference 3.3.2-140 (identified as 3.3.3-140 in the RAI) of LRA Table 3.3-2, indicating that NUREG-1801 does not address carbon steel components in an oxygenated water environment, is in reference to carbon steel piping and fittings in the reactor water cleanup system. The cited NUREG-1801 section (Volume II, Chapter VII, Section E4) addresses carbon steel components in the shutdown cooling system. The NUREG-1801 section corresponding to the reactor water cleanup system is Volume II, Chapter VII, Section E3, which does not address carbon steel piping and fittings. However, the applicant clarified that Aging Management Reference 3.3.2-140 of LRA Table 3.3-2 should have stated that NUREG-1801 does not address carbon steel piping and fittings in an oxygenated water environment for the reactor water cleanup system.

The staff finds the applicant's response to part (b) of RAI 3.3.2.4.4 acceptable because the applicant clarified that Aging Management Reference 3.3.2-140 of LRA Table 3.3-2 should have stated that NUREG-1801 does not address carbon steel piping and fittings in an oxygenated water environment for the reactor water cleanup system. The staff considers the issues related to RAI 3.3.2.4.4 part (a) and part (b) to be closed.

The aging effects identified in the LRA for the reactor water cleanup system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

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

- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- BWR Reactor Water Cleanup System Program (3.3.2.3.2)
- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program (Section 3.0.3.1)
- Structures Monitoring Program (3.0.3.14)

These AMPs, other than the BWR Reactor Water Cleanup System Program (B.1.17), are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. These AMPs are evaluated in Sections 3.0.3.5, 3.0.3.10, 3.0.3.2, 3.0.3.3, and 3.0.3.1, respectively, of this SER.

The staff has evaluated the system-specific AMP, BWR Reactor Water Cleanup System Program, in Section 3.3.2.3.2 of this SER and found it to be acceptable for managing the aging effects identified for this system.

After evaluating the applicant’s AMR for each of the components in the reactor water cleanup system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Tables 3.1-1 and 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

The fatigue of the reactor water cleanup system components is addressed in the TLAA in Section 4.3.3, “Reactor Coolant Pressure Boundary Piping and Component Fatigue Analysis,” and Section 4.3.4, “Effects of Reactor Coolant Environment on Fatigue Life of Components and Piping (Generic Safety Issue 190),” of the LRA. This TLAA is evaluated in Section 4.3 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor water cleanup system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>. On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the reactor water cleanup system 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 UFSAR Supplement program descriptions and concludes that the UFSAR Supplement provides an adequate program description of the AMPs credited for managing aging in the reactor water cleanup system, as required by 10 CFR 54.21(d).

3.3.2.4.5 Fire Protection System

The applicant described its FP AMP in Sections B.1.18, Fire Protection, and B.1.19, Fire Water System, of the LRA. The applicant credits the FPP with managing the aging of FP system components that are within the scope of license renewal and subject to an AMR.

Summary of Technical Information in the Application. Table 2.3.3-5 in Section 2.3.3.2 of the LRA identifies component groups and provides aging management references in Tables 3.3.1 and 3.3.2 for GALL (NUREG-1801) and non-GALL items respectively.

Staff Evaluation. The staff reviewed Sections 3.3, Appendix B.1.18, and Appendix B.1.19 of the LRA to determine whether the applicant had demonstrated the effects of aging for the FP system will be adequately managed during the period of extended operations. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

Chapter XI.M26 of NUREG-1801 includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier protection seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire-rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The AMP also includes periodic inspection and testing of the Halon/CO_2 fire suppression system.

Chapter XI.M27 of NUREG-1801 applies to water-based FP systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, stand pipes, water storage tanks, and above-ground and underground piping and components that are tested in accordance with the applicable codes and standards of the National Fire Protection Association (NFPA). Such testing assures the minimum functionality of the systems. Also, these systems are normally maintained at the required operating pressure and are monitored such that loss of system pressure is immediately detected and corrective actions will be initiated.

The review of Section 3.3 of the LRA included an examination of Tables 3.3.1 and 3.3.2. LRA Tables 3.3-1 and 3.3-2 do not identify any aging effects on FP buried piping, fittings and tanks. However, these components are exposed to soil and groundwater environment, and are subject to general, pitting and crevice corrosion, and microbiological influenced corrosion (MIC) that may result in loss of material. In a letter dated August 4, 2003, the staff requested clarification regarding Tables 3.3-1 and 3.3-2. In RAI 3.3.2.4.5-1.a, the staff requested that the applicant provide justification for not identifying any aging effect/mechanism for FP SSCs.

In a letter dated October 3, 2003, the applicant responded that FP buried piping and fittings that are exposed to soil and groundwater environment are addressed in LRA Section 2.3.3.5, Table 2.3.3-5, under component group "Piping and Fittings (includes flex hose, hose reels, hoses, nozzles, tubing, sprinklers, and gaskets of buried fire mains)." These components are subject to pitting and crevice corrosion and MIC that may result in loss of material. The aging management results for this component group are provided in LRA Table 3.3-2 (Aging Management References 3.3.2.33, 3.3.2.131, and 3.3.2.154). There are no tanks in the FP system that are exposed to soil and groundwater environment (buried tank). These components are evaluated for loss of material (pitting, crevice corrosion, selective leaching and

MIC), and changes in material properties (elastomer degradation and loss of resiliency) aging effects/mechanisms. The staff reviewed the applicant's response and concurs that the FP piping can be adequately addressed under the component group "Piping and Fittings" and aging management references 3.3.2.33, 3.3.2.131, and 3.3.1.154.

The staff requested in RAI 3.3.2.4.5-1.b that the applicant provide justification for not identifying any aging effect/mechanism for fire hose stations, which are exposed to a warm and moist environment and are subject so pitting and corrosion that may result in loss of material. In a letter dated October 3, 2003, the applicant responded that fire hose stations are addressed in LRA Section 2.3.3.5, Table 2.3.3-5 under the component group "Piping and Fittings (includes flex hose, hose reels, hoses, nozzles, tubing, sprinklers, and gaskets of buried fire mains)". NUREG 1801 considers fire hose station as a piping component in the Fire Water System AMP, B1.19 (NUREG-1801 XI.M27). The aging management results of the carbon steel components that are exposed to warm and moist air environment are provided in aging management reference 3.3.2.144, Table 3.3-2, under the component group "Piping and Fittings". These components are subject to general pitting and crevice corrosion, which may result in loss of material. The staff reviewed applicant's response and concurs that hose stations can be adequately addressed under component group "Piping and Fittings" and aging management references 3.3.2.144.

The line items with reference numbers, 3.3.2.138, 3.3.2.212, and 3.3.2.234 of LRA Table 3.3.2 state that the piping and nozzles components of the CO_2 system do not require an AMP, citing a dry gas atmosphere. However, these component types are exposed to a warm and moist environment in the turbine building, and are subject to pitting and corrosion that may result in loss of material. In a letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.5-1c, that the applicant provide justification for not identifying any aging effect/mechanism for Halon/CO_2 total flooding fire suppression systems components including nozzles, valves, piping, fittings, tubing, hose stations, and tanks, as these component types are exposed to a warm and moist environment in the turbine building, and are subject to pitting and corrosion that may result in loss of material. In a letter dated October 3, 2003, the applicant responded that dry gas atmosphere is an internal environment of the Halon/CO_2 fire suppression systems and is associated with aging reference numbers, 3.3.2.138, 3.3.2.212, and 3.3.2.234 on Table 3.3-2. That table provides aging management results for the internal dry gas environment. Aging management reference 3.3.1.5 in Table 3.3.1 provides the aging management results of external surfaces for carbon steel components that are subject to pitting and corrosion, which may result in loss of material. The aging management results for the external surfaces of brass and bronze components are provided in aging management reference 3.3.2.23 in Table 3.3.2. The staff reviewed the applicant's response. Although aging management reference 3.3.1.5.on Table 3.3.1 does not specifically list either Halon or CO_2 fire suppression systems, including these systems in this aspect of the AMP is acceptable.

The line item with reference number 3.3.2.62 of LRA Table 3.3-2 states that cementitious fire proofing does not require an AMP, because a "non-aggressive," vibration free plant indoor environment is not conducive to promoting aging of cementitious fireproofing. However, industry experience, including previous experience at the Dresden Nuclear Power Station, has shown that deterioration of the steel under the coating may cause the cementitious material to become separated from the steel, and in some cases fall off. In a letter dated August 4, 2003, the applicant was requested to provide justification for not having an AMP that will assure its integrity of the cementitious fire proofing.

In a response dated October 3, 2003, the applicant agreed that upon review of aging management reference 3.3.2.62, that cementitious fire proofing requires aging management due to separation caused by deterioration of the structural steel under the coating. The structural steel coatings are currently inspected as part of AMP, B.1.18, "Fire Protection". This also applies to aging management reference 3.3.2.63, for ceramic fiber fire wrap. Both LRA aging management references 3.3.2.62 and 3.3.2.63 should have read as follows:

Ref No	**Component Group**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Discussion**
3.3.2.62	Fire Proofing	Cementitious Fire Proofing	Indoor	Separation/ deterioration of steel	Fire Protection (B.1.18)	NUREG-1801 does not address cementitious fireproofing in an indoor environment.
3.3.2.63	Fire Wrap	Ceramic Fiber	Indoor	Separation/ deterioration of steel	Fire Protection (B.1.18)	NUREG-1801 does not address ceramic fiber fire wrap in an indoor environment.

LRA Section A.1.18 on Page A-8 (Dresden, Units 2 and 3) of the LRA should have read as follows:

> The fire protection aging management program includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals; fire wraps and fire proofing; fire barrier walls, ceilings, and floors; flood barrier penetration seals that also serve as fire barrier seals; and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The program includes surveillance tests of fuel oil systems for the diesel-driven fire pumps and isolation condenser diesel-driven makeup pumps to ensure that the fuel supply lines can perform intended functions. The program also includes visual inspections and periodic operability tests of Halon and CO_2 fire suppression systems based on NFPA codes.

Prior to the period of extended operation, the program will be revised to include:

- Inspection of oil spill barriers
- Inspection of external surfaces of the Halon and the CO_2 fire suppression system
- Periodic capacity tests of the isolation condenser makeup pumps
- Specific fuel supply leak inspection criteria for fire pumps and isolation condenser makeup pumps during tests
- Specific inspection criteria for fire doors
- Inspection frequencies for fire doors and spill barriers

This is part of Commitment #18 of Appendix A in this SER.

LRA Section A.1.18 on Page A-32 (Quad Cities, Units 1 and 2) of the LRA should have read as follows:

> The fire protection AMP includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals; fire wraps and fire proofing; fire barrier walls, ceilings, and floors; flood barrier penetration seals that also serve as fire barrier seals; and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The program includes surveillance tests of fuel oil systems for the diesel-driven fire pumps to ensure that the fuel supply line can perform intended functions. The program also includes visual inspections and periodic operability tests of the carbon dioxide fire suppression system based on NFPA codes.

Prior to the period of extended operation, the program will be revised to include:

- Inspection of oil spill barriers
- Inspection of external surfaces of the CO_2 fire suppression system
- Specific fuel supply leak inspection criteria for fire pumps
- Specific inspection criteria for fire doors

This is part of Commitment #18 of Appendix A in this SER.

LRA Section B.1.18 program description paragraph 3 on Page B-38 of the LRA should have read as follows:

> The program provides for visual inspection of fire barrier penetration seals, fire wraps, fire proofing, and flood barrier penetration seals that also serve as fire barrier seals for signs of degradation, such as damage, holes, cracking, and loss of material, through periodic inspection, surveillance and maintenance activities. The inspections are implemented through station procedures. Flood barrier penetration seal inspections are part of the structures monitoring program.

The staff reviewed the applicants response. The staff finds the inclusion of fire proofing into the AMP acceptable as proposed by the applicant because the AMP as revised will effectively manage the aging effects of the fire proofing and fire wraps.

The aging effects identified in the LRA for the FP system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the FP system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.5A Fire Water System

Summary of Technical Information. Appendix B, Section B.1.19 identifies the AMP for the fire water system components within the scope of license renewal. The fire water system AMP provided for managing the loss of material and biofouling aging effects on the intended functions of the water-based FP components within the scope of license renewal. The program included inspection, surveillance testing and maintenance activities. This section addresses the consistency of B.1.19 with Section XI.M27 of NUREG-1801 and identifies exceptions and enhancements to its specific requirements. This section also discusses operating experience with the fire water system at Dresden and Quad Cities.

Staff Evaluation. The staff reviewed LRA Appendix B.1.19 to determine whether there is reasonable assurance that the AMP activities are adequate to maintain the intended functions of the fire water system SSCs for the period of extended operation, as required by 10 CFR 54.21(a)(1)(a)(3). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

LRA Appendix B, Section B.1.19, "Fire Water System," states that, "With enhancements the fire water system aging management program is consistent with the ten elements of aging management program XI.M27, "Fire Water System," specified in NUREG-1801 with the following exceptions...." In order for the staff to evaluate the adequacy of the applicant's FP AMP and reach a conclusion that it is consistent with NUREG-1801, the staff requested, in a letter dated August 4, 2003, that the applicant follow the guidelines provided in NUREG-1801 and the interim staff guidance for FP AMP [Staff Guidance (ISG)-04, "Aging Management of Fire Protection Systems for License Renewal," (ADAMS Accession # ML022260137), dated December 3, 2002]. NUREG-1801 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.

In a letter dated October 3, 2003, the applicant responded with the following information. Part 1 of this response compares the Dresden and Quad Cities fire water system program against the NUREG-1801, XI.M27 program and identifies where exceptions still exist. Included in Part 1 is a discussion of how Dresden and Quad Cities are addressing ISG-04. Part 2 of the response discusses the Dresden and Quad Cities underground loop flow testing.

(1) The applicant concluded in the Dresden and Quad Cities LRA, Appendix B, Section B.1.19, that the fire water system program, after the enhancements discussed in Appendix B, Section B.1.19, Subsection, "Enhancements," are implemented, will be consistent with the ten-element program described in NUREG-1801, XI.M27, with certain exceptions. Although not stated in the LRA, after the enhancements are implemented, the fire water system program will be also be consistent with the NRC staff recommendations for fire water systems as provided in ISG-04.

Exelon evaluated the Dresden and Quad Cities fire water system program against the attributes of the ten elements of NUREG-1801, XI.M27 and identified that after the enhancements are implemented, the following exceptions will still exist:

- NUREG-1801, XI.M27, Element 3 states that NRC GL 89-13 recommends periodic flow testing of infrequently used loops of the fire water system at the maximum design flow to ensure that the system maintains its intended function. Flow tests at the maximum design flow are not practicable for Dresden and Quad Cities. Instead, the Dresden and Quad Cities flow tests analyze the system hydraulic resistance. Dresden measures underground piping pressure drops at given flows for selected segments of underground fire mains and compares them to pre-calculated allowable pressure drops for the same segments at the given flows. The measured pressure drop must be equal to or less than the allowable. The measured results are also compared with those of previous tests to identify adverse trends. Quad Cities takes pressure measurements and calculates the friction loss coefficients ("C" factor) for the various sections of the underground fire mains. The calculated "C" factor must be equal to or greater than 80 for all piping tested. The calculated results are compared with those of previous tests to identify adverse trends. A low "C" factor (Quad Cities method) or a large pressure drop (Dresden method) may be indicative of either fouling or leakage of the underground fire mains.

(b) NUREG-1801, XI.M27, "Program Description," states that the AMP (XI.M27) applies to water-based FP systems that are tested in accordance with the applicable National Fire Protection Association (NFPA) codes and standards.

The Dresden and Quad Cities fire water systems may not in all cases be tested in accordance with NFPA codes, but in these cases, technical justifications for the deviations are documented. NFPA codes were used in the design of active FP systems (i.e., fire suppression and detection systems). Similarly, inspection and periodic testing is performed in accordance with corporate and station procedures developed using NFPA codes as guidance. Corporate Procedure ER-AA-610, "Performance Based Evaluations for Fire Protection," ensures that performance-based evaluations that result in surveillance frequencies that exceed those specified in site-specific NFPA codes of record serve as the deviation justification. Where code deviations are required or desirable, they are made under the intent of the code and documented in the NFPA Code Deviation Report at each site in accordance with CC-AA-211, "Fire Protection Program." Revision to the NFPA Code Deviation Report is necessary unless the report has previously addressed the deviation.

(c) Interim staff guidance ISG-04 was issued on December 3, 2002. Included as part of ISG-04 is an amended ten-element AMP, XI.M27, for the fire water system. Applicant evaluated the Dresden and Quad Cities fire water system program against the staff recommendations for fire water systems included in ISG-04 with the following conclusions:

- In Element 3 of the amended XI.M27, the staff provides for the option of performing wall thickness evaluations in lieu of testing at maximum design flow. The flow testing discussed in (1)(a) is not performed at maximum design flow, but Dresden and Quad Cities will perform wall thickness measurements.

- In Element 4 of the amended XI.M27, the staff recommends that the applicant perform a baseline pipe wall thickness evaluation of the FP piping using a non-intrusive means of evaluating wall thickness, such as volumetric inspection, to detect general corrosion before the current license term expires. The staff also recommends that the applicant perform pipe wall thickness evaluations at plant-specific intervals during the period of extended operation. As an alternative to non-intrusive testing, the amended XI.M27 allows for a visual inspection of the internal surface of the FP piping upon each entry to the system for routine or corrective maintenance as long as it can be demonstrated that inspections are performed on a representative number of locations on a reasonable basis.

Dresden and Quad Cities will perform periodic non-intrusive FP piping wall thickness measurements. These non-intrusive inspections will be conducted prior to the end of the current term and repeated on a frequency not exceeding every 10 years. This is part of Commitment #19 of Appendix A of this SER.

Element 4 of the amended XI.M27 also states that if the environmental and material conditions that exist on the interior surfaces of the below-grade FP piping are similar to the conditions that exist within the above-grade piping, the results of the inspections of the above-grade FP piping can be extrapolated to evaluate the condition of below-grade piping.

The below-grade fire mains at both Dresden and Quad Cities comprise uncoated carbon steel. The internal environment of the below-grade fire mains at both Dresden and Quad Cities is "raw water," the same as NUREG-1801 Reference VII.G.6-a. Therefore, the results of the inspections of above-grade FP uncoated carbon steel piping with a raw water environment can be extrapolated to evaluate to the condition of the below-grade fire mains.

- In Element 4 of the amended XI.M27, the staff recommends, in accordance with NFPA 25, that sprinkler head testing be performed at year 50 of the sprinkler system service life, not year 50 of plant operation, with subsequent sprinkler head testing every 10 years thereafter. Representative samples of Dresden and Quad Cities sprinkler heads will be submitted to a testing laboratory prior to being in service 50 years. This testing will be repeated on a frequency not exceeding every 10 years. This is part of Commitment #19 of Appendix A of this SER.

The staff reviewed the applicant's response. On the basis of the justification provided, the staff concurs that the aging of fire water system components will be adequately managed by the AMP. In a letter dated August 4, 2003, the staff requested that the applicant clarify the flow rates and testing frequencies of the underground loop flow tests and describe the plant procedure for this testing.

(2) In a letter dated October 3, 2003, the applicant responded with additional details regarding frequency and method of flow testing. Flow testing is conducted at five-year intervals at Dresden and Quad Cities. As stated in Section (1)(a) of the applicant's response, tests are not performed at the maximum design flow. By themselves, the absolute values of the flows achieved during testing at both Dresden and Quad Cities provide no indication of the condition of the underground fire mains. Utilizing the Dresden test procedure, test conditions are established to provide flow rates within a pre-determined range corresponding to a table of pre-calculated allowable pressure drops vs. flows. For the cross tie flow test, these pre-determined flows range from 2,500 gpm to 3,500 gpm. For the yard loop flow test, these pre-determined flows range from 900 gpm to 1,300 gpm.

The Quad Cities test procedure methodology ("C" factor) employs the installation of four underwriter's playpipes on each of the three pipe segments to be tested. Sequential tests are performed on each segment with one, two, three, and four playpipes flowing. Total flows and "C" factors are calculated for each combination of flowing playpipes. For each pipe segment, the "C" factors for each separate flow scenario are compared and the most appropriate one is chosen. Since more accurate "C" factors are obtained when calculated for higher flows, it is most likely that the one calculated for four flowing playpipes will be chosen. During the last flow test performed at Quad Cities, the highest calculated flows for each of the three segments, each with four playpipes flowing, were 2,296 gpm, 2,562 gpm, and 2,547 gpm.

The staff reviewed the applicant's response and on the basis of the additional technical data, concurs that the frequency and method of testing adequately addresses NUREG-1801, XI.M27, Element 3.

The aging effects identified in the LRA for the fire water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the fire water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.6 Emergency Diesel Generator and Auxiliaries System

Summary of Technical Information in the Application. The description of the emergency diesel generator and auxiliaries system can be found in Section 2.3.3.6 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-6. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Components of the emergency diesel generator and auxiliaries system are described in Section 2.3.3.6 of the LRA as being within the scope of license renewal and subject to an AMR. Table 2.3.3-6 of the LRA lists individual components of the system, including piping, tubings, ducts, hinges, latches, pumps, valves, heat exchangers, coolers, filters/strainers, restricting orifices, tanks, vessels, closure bolting, doors, equipment frames, flexible hoses, flex collars, lubricators, mufflers, tanks, sight glasses, thermowells, air accumulator vessels, debris screens, NSR vents or drains, and turbochargers.

Carbon steel in outdoor ambient conditions is subject to loss of material due to general, pitting, and crevice corrosion. High-strength, low-alloy steel in outdoor ambient conditions is subject to loss of material due to general corrosion and wear. Cast iron exposed to indoor moist and humid air is subject to loss of material due to general, pitting, and crevice corrosion. No aging effect is identified for stainless steel, aluminum, brass, bronze, and copper exposed to indoor moist and humid air. Stainless steel, aluminum, brass, bronze, cast iron, and copper exposed to an internal environment of moist air are subject to loss of material due to pitting, crevice, and/or general corrosion. Elastomer seals exposed to an internal environment of moist air or saturated air are subject to hardening and loss of strength due to elastomer degradation. Cast iron exposed to an internal environment of hot diesel engine exhaust gases is subject to loss of material due to general, pitting, and crevice corrosion. Brass, bronze, cast iron, and copper exposed to chemically treated demineralized water are subject to loss of material due to general, pitting, and crevice corrosion, MIC, and/or select leaching. Carbon steel, stainless steel, brass, and bronze exposed to chemically treated demineralized water are subject to cracking due to SCC. Carbon steel and cast iron exposed to lubricating oil are subject to loss of material due to general, pitting, and crevice corrosion. No aging effect is identified for brass or bronze in dry air.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the emergency diesel generator and auxiliaries system:

- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Closed-Cycle Cooling Water System Program (B.1.14)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Structures Monitoring Program (B.1.30)
- Compressed Air Monitoring Program (B.1.16)
- Lube Oil Monitoring Program (B.2.5)
- Fuel Oil Chemistry Program (B.1.21)
- Periodic Inspection of Ventilation System Elastomers Program (B.2.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the emergency diesel generator and auxiliaries system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the emergency diesel generator and auxiliaries system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.6 and Tables 2.3.3-6, 3.3-1, and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in

Section 3.3.2.5.2 of this SER.

In LRA Table 3.3-2, Reference No. 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in outdoor ambient conditions are subject to the aging effect of loss of material due to general corrosion and wear. However, the applicant did not include crack initiation and growth due to SCC or other mechanisms as an applicable aging effect/mechanism. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide its technical basis for not including this aging effect/mechanism. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.5 of this SER.

The applicant uses the Bolting Integrity Program (B.1.12) to manage general corrosion on external surfaces of many auxiliary system nonbolting components. The staff notes that the Bolting Integrity Program description states, "The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment." This suggests that only the bolting material will be inspected for aging degradation. By letter dated August 4, 2003, the staff requested, in RAI 3.3-9, the applicant to explain (including the acceptance criteria and inspection interval) how the Bolting Integrity Program is used to manage general corrosion on external surfaces of nonbolting components, such as piping, valves, mufflers, and others. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.9 of this SER.

In Table 2.3.3-6, page 2-119 of the LRA, Aging Management Reference 3.3.1.7 refers to piping and fittings (and attached support) and valves (and attached support). In Table 3.3-1, page 3-74 of the LRA, Aging Management Reference 3.3.1.7 credits the Fuel Oil Chemistry and One-Time Inspection Programs for managing the aging effects of the fuel oil tank and day tank. On the other hand, the "Tanks" group in Table 2.3.3-6 does not include Aging Management Reference 3.3.1.7 that links to the Fuel Oil Chemistry Program and the One-Time Inspection Program for managing the aging effects of the fuel oil tank and day tank. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.6(a), the applicant to provide clarification of the discrepancy.

In its response dated October 3, 2003, the applicant stated that the piping, fittings, and valves referred to in Aging Management Reference 3.3.1.7 belong to the diesel fuel oil system and diesel fuel oil tanks, as shown in Table 3.3-1 in the "Components Evaluated" column. The diesel fuel oil system is discussed in LRA Section 2.3.3.13, Table 2.3.3-13 (page 2-140). The "Tanks" group shown in LRA Table 2.3.3-6 (page 2-119) includes the diesel generator cooling water expansion tanks that are managed by the Closed-Cycle Cooling Water System Program.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has clarified that the "Tanks" group in Table 2.3.3-6 includes the diesel generator cooling water expansion tanks that are managed by the Closed-Cycle Cooling Water System Program. The piping, fittings, and valves referred to in Aging Management Reference 3.3.1.7 belong to the diesel fuel oil system that is managed by the Fuel Oil Chemistry and One-Time Inspection Programs. This is part of Commitment #23 of Appendix A of this SER.

Cracking is identified as an aging effect of brass or bronze valves exposed to chemically treated demineralized water in Aging Management Reference 3.3.2.258, Table 2.3.3-6, of the LRA. Loss of material is, however, not identified as an aging effect. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.6(b), the applicant to provide justification for not identifying loss of material as an aging effect for brass or bronze valves exposed to chemically treated demineralized water.

In its response dated October 3, 2003, the applicant agreed with the staff that loss of material applies for brass or bronze in a (nitrite) treated water environment. An Aging Management Reference similar to 3.3.2.134 should have been added in LRA Table 2.3.3-6 for the valves component group. The applicant has identified the Closed-Cycle Cooling Water System Program (B.1.14) and Selective Leaching of Materials Program (B.1.24) for managing the aging effect of loss of material in these components.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant stated that loss of material is an applicable aging effect for brass or bronze valves exposed to chemically treated demineralized water. The applicant also committed the Closed-Cycle Cooling Water System Program (B.1.14) and the Selective Leaching of Materials Program (B.1.24) for managing loss of material for these components. The staff considers all issues related to RAI 3.3.2.4.6(a) and (b) to be closed.

The aging effects identified in the LRA for the emergency diesel generator and auxiliaries system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the emergency diesel generator and auxiliaries system:

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- Lube Oil Monitoring Program (Section 3.0.3.16)
- Fuel Oil Chemistry Program (Section 3.3.2.3.5)
- Periodic Inspection of Ventilation System Elastomers Program (Section 3.0.3.17)

The Bolting Integrity Program, Open-Cycle Cooling Water System Program, Closed-Cycle Cooling Water System Program, One-Time Inspection Program, Selective Leaching of Materials Program, Structures Monitoring Program, Compressed Air Monitoring Program, Lube Oil Monitoring Program, and Periodic Inspection of Ventilation System Elastomers Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.6, 3.0.3.7, 3.0.3.10, 3.0.3.11, 3.0.3.14, 3.0.3.8, 3.0.3.16, and 3.0.3.17, respectively, of this SER.

The Fuel Oil Chemistry Program is a system-specific AMP. The staff's evaluation of this AMP is documented in Section 3.3.2.3.5 of this SER.

After evaluating the applicant's AMR for each of the components in the emergency diesel generator and auxiliaries system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the emergency diesel generator and auxiliaries system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.7 HVAC—Main Control Room

Summary of Technical Information in the Application. The description of the HVAC—Main Control Room can be found in Section 2.3.3.7 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-7. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-7 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include air handlers heating/cooling (CR HVAC), dampeners, debris screens, diffusers, doors, duct fittings, hinges, latches, closure bolts, equipment frames (includes dampers), duct, housings, silencers, filters/strainers, heat exchangers, flow elements, flex collars, doors and dampener seals, housings and supports, NSR vents or drains, piping and valves, piping and fittings, piping and fittings (attached support) (Quad Cities only), seals, sight glasses, tubing, and valves.

Carbon steel components are identified as being subject to loss of material due to general, pitting, and crevice corrosion and MIC [for duct (drip-pan) and piping for moisture drainage] from exposure to warm, moist air. Copper-nickel, brass, bronze, stainless steel, and copper components are identified as being subject to loss of material due to pitting and crevice corrosion from exposure to warm, moist air. Neoprene and similar elastomers are identified as being subject to hardening and loss of material due to wear from exposure to warm, moist air. Neoprene is also identified as being subject to hardening and loss of strength and elastomer degradation from exposure to warm, moist air. Exposure of aluminum-zinc alloy components to warm, moist air has no aging effect. Exposure of carbon steel, copper, brass, bronze, and ductile iron components to dry gas has no aging effect. Copper tubes, tubesheets, and end bells and aluminum fins are identified as being subject to cracking due to mechanical fatigue from exposure to refrigerant on the tube side and warm, moist air on the shell side. Copper tubes are also identified as being subject to buildup of deposits and fouling from exposure to refrigerant on the tube side and warm, moist air on the shell side. Heat exchanger tubes made from 90-10 copper-nickel and shells made from carbon steel are subject to cracking due to mechanical fatigue and SCC and loss of material due to general, galvanic, pitting, and crevice corrosion and MIC, erosion or flow-accelerated corrosion, and wear from exposure to raw water on the tube side and refrigerant on the shell side. Heat exchanger tubes made from 90-10 copper-nickel are also subject to buildup of deposits and fouling from exposure to raw water on the tube side and refrigerant on the shell side. Carbon steel, stainless steel, brass, or bronze components are identified as being subject to loss of material due to corrosion from exposure to air, moisture, humidity, and leaking fluid. Carbon steel pipes, fittings, and valves are identified as being subject to loss of material due to general corrosion from exposure to raw, untreated salt water or fresh water. Cast iron valves are identified as being subject to loss of material due to general, pitting, crevice, and galvanic corrosion, erosion, and selective leaching, and MIC flow blockage/biofouling, silting, and corrosion buildup from exposure to raw, untreated salt water or fresh water. External surfaces of cast iron components are also identified as being subject to loss of material due to pitting and crevice corrosion from exposure to air, moisture, and humidity less than 100 °C (212 °F).

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the HVAC—Main Control Room:

- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Compressed Air Monitoring Program (B.1.16)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Periodic Inspection of Ventilation System Elastomers Program (B.2.3)
- Heat Exchanger Test and Inspection Activities Program (B.2.6)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the HVAC—Main Control Room will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the HVAC—Main Control Room. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.7, Table 2.3.3-7, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations for which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various auxiliary systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

The applicant uses the Bolting Integrity Program (B.1.12) to manage general corrosion on external surfaces of many auxiliary system nonbolting components. The staff notes that the Bolting Integrity Program description states, "The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment." This suggests that only the bolting material will be inspected for aging degradation. By letter dated August 4, 2003, the staff requested, in RAI 3.3-9, the applicant to explain (including the acceptance criteria and inspection interval) how the Bolting Integrity Program is used to manage general corrosion on external surfaces of non-bolting components, such as piping, valves, mufflers, and others. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.9 of this SER.

In the treated water environment of the HVAC—Main Control Room, the relevant conditions could exist for crack initiation and growth due to SCC to occur in carbon steel components. However, this aging effect/mechanism was only addressed for heat exchanger tubes in the auxiliary systems AMR. The staff requested the applicant to provide justification for not including crack initiation and growth due to SCC in carbon steel components, other than the heat exchanger tubes, in a treated water environment. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.7 pertaining to this issue.

In its response dated October 3, 2003, the applicant stated that, for carbon steel components, SCC occurs only in nitrite treated water, per Appendix A of "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," EPRI 1003056. For the Dresden and Quad Cities stations, the emergency diesel generator jacket water, reactor building closed-cycle cooling water system, and turbine building closed-cycle cooling water system utilize nitrite treated water; therefore, these are subject to SCC and the resulting crack initiation and growth. These aging mechanisms, aging effects, and required AMPs are shown for these systems in LRA Section 3.3—Aging Management References 3.3.2.68 (flow elements), 3.3.2.77 or 3.3.2.117 (heat exchangers), 3.3.2.137 (piping and fittings), 3.3.2.174 (pumps), 3.3.2.211

(tanks), 3.3.2.233 (tubing), and 3.3.2.267 (valves). These reference numbers apply to the following component groups for the abovementioned systems.

- emergency diesel generator jacket water (LRA Section 2.3.3.6), including piping and fittings, pumps, tanks, tubing, and valves

- reactor building closed-cycle cooling water system (LRA Section 2.3.3.17), including flow elements, heat exchangers (3.3.2.117 for Dresden heat exchangers and 3.3.2.77 for Quad City heat exchangers), piping and fittings, pumps, tanks, tubing, and valves

- turbine building closed-cycle cooling water system (LRA Section 2.3.3.18), including piping and fittings and valves

The heat exchanger tubes, including those of the control room HVAC coolers, for Dresden and Quad Cities are not made of carbon steel. Additionally, the environment for the main control room HVAC coolers is raw water, refrigerant, and warm, moist air. Therefore, the conditions relevant to SCC do not exist.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant provided further clarifications on the AMR for these relevant components and the heat exchanger tubes, including those of the control room HVAC coolers, for Dresden and Quad Cities that are not made of carbon steel. The staff considers the issues related to RAI 3.3.2.4.7 to be resolved.

The aging effects identified in the LRA for the HVAC—Main Control Room are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the HVAC—Main Control Room:

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Heat Exchanger Test and Inspection Activities Program (Section 3.0.3.15)
- Periodic Inspection of Ventilation System Elastomers Program (Section 3.0.3.17)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is discussed in Sections 3.0.3.5, 3.0.3.6, 3.0.3.8, 3.0.3.10, 3.0.3.11, 3.0.3.15, and 3.0.3.17, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the HVAC—Main Control Room, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the HVAC—Main Control Room will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.8 HVAC—Reactor Building

Summary of Technical Information in the Application. The description of the HVAC—Reactor Building can be found in Section 2.3.3.8 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-8. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-28 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include doors, closure bolts, duct fittings, equipment frames (include dampers, duct, housings, piping, and valves), hinges, latches, tubing, and valves. Listed components particular only to Dresden include debris screens, housing and supports, filters/strainers, piping and fittings, and seals.

Aluminum-zinc alloy components exposed to warm, moist air have no aging effect. Carbon steel components exposed to warm, moist air are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Stainless steel components exposed to warm, moist air or saturated air are subject to the aging effect of loss of material due to pitting and crevice corrosion. Copper and copper alloys exposed to saturated air are subject to the aging effect of loss of material due to pitting and crevice corrosion. Copper, copper alloys, and stainless steel exposed to air, moisture, and humidity experience no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the HVAC—Reactor Building:

- Compressed Air Monitoring Program (B.1.16)
- One-Time Inspection Program (B.1.23)
- Periodic Inspection of Ventilation System Elastomers Program (B.2.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the HVAC—Reactor Building will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the HVAC—Reactor Building. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.8, Table 2.3.3-8, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or the air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40 as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on the aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

Loss of material due to selective leaching may be an applicable aging effect for copper alloy components exposed to a saturated air environment where water condensation on the surfaces of these components may occur. However, in LRA Table 3.3-2, Reference No. 52, 242, and 262, loss of material due to selective leaching was not identified as an applicable aging effect for copper alloy components in saturated air. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.8 requesting the applicant to provide the technical basis for excluding this aging effect from AMR.

In its response dated October 3, 2003, the applicant stated that the copper alloy materials of Aging Management References 3.3.2.52, 3.3.2.242, and 3.3.2.262 are used in compressed gas and ventilation systems at Dresden and Quad Cities. These are not installed in areas where water would be expected to pool. For Aging Management References 3.3.2.52, 3.3.2.242, and 3.3.2.262, the susceptible materials, copper alloys, are not exposed to water for prolonged periods and, therefore, selective leaching is not considered an aging mechanism for Dresden and Quad Cities applications. The staff requested the applicant to provide clarification, with justification, on how long is considered a prolonged period to support the conclusion that selective leaching is not considered an applicable aging mechanism.

In its response dated December 17, 2003, the applicant stated that the copper alloy components used in the reactor building HVAC system, and referenced in Aging Management References 3.3.2.52, 3.3.2.242, and 3.3.2.262, contain air (instrument and process air) as their process fluid. The applicable components are (1) tubing for instrumentation, (2) restricting orifice (filter/strainer) for differential pressure instrument, and (3) tubing, manual/check valves, and solenoid valves for air-operated dampers and valves. These components are located in the reactor building general areas where the relative humidity level is a maximum of 90 percent. Neither the internal process nor the external environments could cause wetting of these components. The statement, "not exposed to water for prolonged periods," refers to the fact that the only potential source of wetting would be exposure to leaks from other systems. Since the HVAC controls are located in the reactor building general areas, these leaks would be detected by operators during their rounds and corrected. Operator rounds in the reactor building are performed at least once per day, so the duration of wetting would at most be a few days, assuming the leakage starts small. Therefore, the copper alloy components in the reactor building HVAC are not subject to an aggressive wetted environment conducive to promoting a loss of material due to selective leaching. The external environment AMR results for these components are provided in LRA Reference Nos. 3.3.2.23 and 3.3.2.34.

The staff finds the applicant's additional response to the RAI 3.3.2.4-8 supplemental information request adequate and acceptable because the applicant has demonstrated that the occasions in which the copper alloy components could come in contact with water are very rare and the periods during which these components are wet, if any, are very limited (only a few days). Therefore, no aging management is required for the copper alloy components in the HVAC—Reactor Building.

The aging effects identified in the LRA for the HVAC—Reactor Building are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the HVAC—Reactor Building.

- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Periodic Inspection of Ventilation System Elastomers Program (Section 3.0.3.17)

These AMPs are credited for managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.8, 3.0.3.10, and 3.0.3.17, respectively, of this SER.

After evaluating the applicant’s AMR for each of the components in the HVAC—Reactor Building, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the HVAC—Reactor Building will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.9 Emergency Core Cooling System Corner Room HVAC

Summary of Technical Information in the Application. The description of the ECCS corner room HVAC can be found in Section 2.3.3.9 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-9. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-9 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include air handlers heating/cooling (Aux & RW HVAC), duct and fittings, access doors, closure bolting, and equipment frames.

The LRA identifies that copper, stainless steel, and carbon steel components exposed to a raw water environment on one side and a warm, moist air environment on the other side are subject to the aging effects of loss of material due to general (carbon steel), galvanic, pitting, crevice, and microbiologically influenced corrosion, erosion or flow-accelerated corrosion, and wear.

Copper, stainless steel, and carbon steel components exposed to a raw water environment on one side and a warm, moist air environment on the other side are subject to the aging effect of cracking due to fatigue and SCC. Copper tubes exposed to a raw water environment are also subject to the loss of heat transfer function aging effect due to buildup of deposit and fouling. Aluminum fins exposed to a warm, moist air environment experience no aging effects. Aluminum fins connected to copper tubes are subject to loss of material due to galvanic corrosion.

Aging Management Programs

The following AMP is utilized to manage the identified aging effects in the ECCS corner room HVAC:

- Open-Cycle Cooling Water System Program (B.1.13)

A description of this AMP is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the air handler components of the ECCS corner room HVAC will be adequately managed by this AMP during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMP credited for managing the aging effects, in the ECCS corner room HVAC. The staff also reviewed the applicable UFSAR Supplements for the AMP to ensure that the program descriptions adequately describe the AMP.

Aging Effects

The staff reviewed the information in Section 2.3.3.9, Table 2.3.3-9, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the ECCS corner room HVAC system. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

Normally, HVAC systems contain elastomer materials, but no elastomer materials are identified in LRA Table 2.3.3-9. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.9, the applicant to clarify if there are any elastomer components in the ECCS corner room HVAC. By letter dated October 3, 2003, the applicant responded that there is no ductwork attached to the cooler and there are no flexible collars, damper or door gaskets, seals, or other soft parts associated with the ECCS corner room HVAC system. This response is acceptable because it clarifies that there are no elastomers in the ECCS corner room HVAC system.

The aging effects identified in the LRA for the ECCS corner room HVAC system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMP to manage the aging effects described above for the ECCS corner room HVAC:

- Open-Cycle Cooling Water System Program (Section 3.0.3.6)

This AMP is credited for managing the aging effects of components in several structures and systems and, therefore, is considered a common AMP. The staff's evaluation of this AMP is documented in Section 3.0.3.6 of this SER.

After evaluating the applicant's AMR for each of the components in the ECCS corner room HVAC system, the staff evaluated the AMP listed above to determine if it is appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

The response to RAI 3.3-7 clarified that the Open-Cycle Cooling Water System Program is used to manage external surfaces in the ECCS corner room HVAC system.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ECCS corner room HVAC system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.10 Station Blackout Building HVAC

Summary of Technical Information in the Application. The description of the station blackout building HVAC can be found in Section 2.3.3.10 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-10. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3.10 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include air handlers heating/cooling (DGB HVAC (Quad Cities only)), debris screens, duct fittings, hinges, latches, flow elements, and tubing.

Carbon steel components are subject to loss of material due to general, pitting, and crevice corrosion and MIC [for duct (drip-pan) and piping for moisture drainage] from exposure to warm, moist air. Stainless steel and copper components are subject to loss of material due to pitting and crevice corrosion from exposure to warm, moist air. Exposure of aluminum-zinc alloy components to warm, moist air has no aging effect. Copper tubes and galvanized steel end bells are identified as being subject to loss of material due to galvanic, pitting, and crevice corrosion and wear from exposure to refrigerant on the tube side and warm, moist air on the shell side. Copper tubes are also identified as being subject to buildup of deposits and fouling from exposure to refrigerant on the tube side and warm, moist air on the shell side.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the station blackout building HVAC:

- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- One-Time Inspection—Ventilation System (B.1.23)
- Heat Exchanger Test and Inspection Activities Program (B.2.6)
- Periodic Inspection of Ventilation System Elastomers Program (B.2.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the air handler components of the station blackout building HVAC will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the station blackout building HVAC. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.10 and Tables 2.3.3-10, 3.3-1, and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or the air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40 as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various auxiliary systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

The aging effects identified in the LRA for the station blackout building HVAC are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the station blackout building HVAC:

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- One-Time Inspection—Ventilation System Program (Section 3.0.3.10)
- Heat Exchanger Test and Inspection Activities Program (Section 3.0.3.15)
- Periodic Inspection of Ventilation System Elastomers Program (Section 3.0.3.17)

The Bolting Integrity, Open-Cycle Cooling Water System, One-Time Inspection—Ventilation System, Heat Exchanger Test and Inspection Activities, and Periodic Inspection of Ventilation System Elastomers Programs are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff's evaluation of these AMPs is discussed in Sections 3.0.3.5, 3.0.3.6, 3.0.3.10, 3.0.3.15, and 3.0.3.17, respectively, of the SER.

After evaluating the applicant's AMR for each of the components in the station blackout building HVAC, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the station blackout building HVAC will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.11 Station Blackout System (Diesel and Auxiliaries)

Summary of Technical Information in the Application. The description of the station blackout system (diesel and auxiliaries) can be found in Section 2.3.3.11 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-11. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-11 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include air accumulators, closure bolting, filters/strainers, flexible hoses, flow elements, heat exchangers (includes coolers and heat exchangers), lubricators, mufflers, piping and fittings (includes heaters, orifices, and thermowells), pumps, restricting orifices, sight glasses, thermowells, tubing, turbochargers, and valves.

High-strength, low-alloy steel closure bolting components exposed to outdoor ambient air are subject to the aging effect of loss of material due to general corrosion and wear. Aluminum components exposed to an air, moisture, and humidity environment experience no aging effects. Aluminum components exposed to a moist air environment are subject to the aging effect of loss of material due to general and pitting corrosion. Aluminum components exposed to a diesel fuel oil environment are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Cast iron components exposed to a diesel fuel oil environment are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Cast iron components exposed to a lubricating oil environment are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Cast iron components exposed to a moist air environment are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Cast iron components exposed to an air, moisture, and humidity environment are subject to the aging effect of loss of material due to pitting and crevice corrosion. Cast iron components exposed to a treated demineralized water less than 90 °C (194 °F) environment are subject to the aging effect of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion and selective leaching. Cast iron components exposed to hot diesel engine gases containing moisture and particles are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Carbon steel components exposed to lubricating oil (with contaminants and/or water) are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Carbon steel or cast steel components exposed to Glycol-based cooling water are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion, erosion or flow-accelerated corrosion, and wear and cracking due to mechanical fatigue. Carbon steel or cast steel components exposed to outdoor ambient air are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Stainless steel components exposed to chemically treated demineralized water less than 90 °C (194 °F) are subject to the aging effect of cracking due to SCC and IGSCC. Stainless steel components exposed to lubricating oil (with contaminants and/or water) or moist air are subject to the aging effect of loss of material due to pitting and crevice corrosion. Stainless steel components exposed to diesel fuel oil are subject to the aging effect of loss of material due to pitting and crevice corrosion. Stainless steel components exposed to moist air are subject to the aging effect of loss of material due to pitting and crevice corrosion. Stainless steel components exposed to air, moisture, and humidity experience no aging effects. Copper piping and fittings or copper alloy thermowell or heat exchanger tubes exposed to Glycol-based cooling water are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion, erosion or flow-accelerated corrosion, wear (except thermowell), cracking due to mechanical fatigue (except thermowell), and selective leaching (copper alloy). Copper heat exchanger tubes exposed to Glycol-based cooling water are also subject to the aging effect of loss of intended function due to buildup of deposit/fouling. Copper alloy components exposed to diesel fuel oil or lubricating oil are subject to the aging effect of loss of material due to general, crevice, and pitting corrosion. Copper or copper alloy components exposed to an air, moisture, and humidity environment experience no aging effects. Neoprene components exposed to dry gas or saturated air are subject to the aging effects of hardening and loss of strength and elastomer degradation. Iron malleable components exposed to chemically treated demineralized water environments are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically induced corrosion and selective leaching. Iron malleable components exposed to a lubricating oil environment are subject to the aging effects of loss of material due to general, galvanic, pitting, and crevice corrosion. Iron malleable components exposed to an air, moisture, and humidity environment experience no aging effects. Glass components exposed to chemically treated demineralized water or air, moisture, and humidity environments experience no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the station blackout system (diesel and auxiliaries):

- Bolting Integrity Program (B.1.12)
- Closed-Cycle Cooling Water System Program (B.1.14)
- Fuel Oil Chemistry Program (B.1.21)

- One-Time Inspection—Compressed Gas Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Buried Piping and Tanks Inspections Program (B.1.25)
- Structures Monitoring Program (B.1.30)
- Lube Oil Monitoring Activities Program (B.2.5)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the station blackout system (diesels and auxiliaries) will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the station blackout system (diesel and auxiliaries). The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.11, Table 2.3.3-11, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects are identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or an air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40 as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this

SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on the aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and(3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

In LRA Table 3.3-2, Reference No. 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions are subject to the aging effect of loss of material due to general corrosion and wear. However, the applicant does not include crack initiation and growth due to SCC or other mechanisms as an applicable aging effect/mechanism. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide its technical basis for not including this aging effect/mechanism. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.5 of this SER.

Loss of material due to selective leaching is a plausible aging effect for cast iron components in a moist air and humidity environment, especially when there is water condensation on the surfaces of these components. However, in LRA Table 3.3-2, Reference No. 55, loss of material due to selective leaching was not identified as a plausible aging effect for cast iron components in moist air. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.11(a) requesting the applicant to provide its technical basis for excluding this aging effect from the AMR. In its response dated October 3, 2003, the applicant stated that the cast iron material components in AMR Reference No. 3.3.2.55 are not installed in areas where water or condensation would be expected to pool or where there would be prolonged exposure to water; therefore, the applicant concluded that selective leaching is not considered an aging mechanism for Dresden and Quad Cities applications. Since the fuel oil strainers covered by AMR Reference No. 3.3.2.55 are not installed in areas where water or condensation would pool or where there would be a prolonged exposure to water, the staff concludes that it is unlikely for the strainers to experience selective leaching. The staff also notes that these components will receive a one-time inspection for loss of material and that this inspection would identify selective leaching if it were to occur. Therefore, the staff finds the identification of aging effects and the aging management acceptable for the strainers.

Loss of material due to pitting and crevice corrosion is a plausible aging effect on stainless steel exposed to a chemically treated and demineralized water environment. However, in Table 2.3.3-11 of the LRA, the applicant did not identify any loss of material aging effect on the stainless steel components exposed to a chemically treated and demineralized water environment. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.11(b) requesting the applicant to provide its technical basis for excluding this applicable aging effect. In its response dated October 3, 2003, the applicant concurred that stainless steel in a treated water environment may be susceptible to loss of material due to pitting and crevice corrosion. The applicant added aging management references to address this aging effect/mechanism for the components in the station blackout system (diesels and auxiliaries), and the applicant credited the Closed-Cycle Cooling Water System Program (B.1.14). Since the applicant has identified loss of material due to pitting and crevice corrosion for the stainless steel components exposed to chemically treated and demineralized water, and has identified an appropriate AMP to manage this aging effect, the staff finds this acceptable.

The aging effects identified in the LRA for the station blackout system (diesels and auxiliaries) are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the station blackout system (diesels and auxiliaries):

- Bolting Integrity Program (Section 3.0.3.5)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- One-Time Inspection—Compressed Gas Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspections Program (Section 3.0.3.12)
- Structures Monitoring Program (Section 3.0.3.14)
- Fuel Oil Chemistry Program (Section 3.3.2.3.5)
- Lube Oil Monitoring Activities Program (Section 3.3.2.3.7)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.7, 3.0.3.10, 3.0.3.11, 3.0.3.12, 3.0.3.14, 3.3.2.3.5, and 3.3.2.3.7, respectively, of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the station blackout system (diesels and auxiliaries) will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.12 Diesel Generator Cooling Water System

<u>Summary of Technical Information in the Application</u>. The description of the diesel generator cooling water system can be found in Section 2.3.3.12 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Tables 2.3.3-12. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-12 of the LRA lists individual system components that are within the scope of license renewal and subject to AMR. The components include air handlers heating/cooling (DGB HVAC), closure bolting, NSR vents or drains, piping and valves, orifice bodies, tubing, pumps, thermowells, pulsation dampers, strainer screens, and strainer bodies.

The LRA identifies that copper, carbon steel, and aluminum components in open-cycle cooling water and warm, moist air environments are subject to the aging effects of cracking from mechanical fatigue and SCC, as well as loss of material from general, pitting, crevice, and galvanic corrosion, MIC, erosion or flow-accelerated corrosion, and wear. Copper components in a raw water environment are also subject to buildup of deposit from fouling. Loss of material due to general corrosion and wear is an applicable aging effect for high-strength, low-alloy steel components. The LRA identifies that carbon steel, stainless steel, brass, and bronze components in an air, moisture, humidity, and leaking fluid environment are subject to loss of material from general corrosion and pitting and crevice corrosion. Cast iron (lined or unlined) components in raw water or fresh water environments are subject to loss of material from selective leaching, general, pitting, crevice, and galvanic corrosion, erosion, and MIC. Additional aging effects for cast iron components in the same environments include flow blockage from biofouling, silting, and corrosion product buildup. The applicant identified flow blockage from biofouling as the only applicable aging effect for titanium components in raw water or fresh water environments. The LRA does not identify any aging effects for stainless steel components in an environment of air, moisture, and humidity less than 100 °C (212 °F) or for titanium components in an air, moisture, humidity, and leaking fluid environment.

Aging Management Programs

The following AMPs are utilized to manage the aging effects in the diesel generator cooling water system:

- Open-Cycle Cooling Water System Program (B.1.13)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Buried Piping and Tanks Inspection Program (B.1.25)
- Structures Monitoring Program (B.1.30)
- Heat Exchanger Test and Inspection Activities Program (B.2.6)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the diesel generator cooling water system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the diesel generator cooling water system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-12, 3.3-1, and 3.3-2 for the diesel generator cooling water system. During its review, the staff determined that additional information was needed.

The description in tem 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or an air, moisture, and humidity environment because these components "are not subject to any viable aging mechanism in the absence of aggressive chemical species." By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40 as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

In LRA Table 3.3-2, Reference No. 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions are subject to the aging effect of loss of material due to general corrosion and wear. However, the applicant does not include crack initiation and growth due to SCC or other mechanisms as an applicable aging effect/mechanism. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide its technical basis for not including this aging effect/mechanism. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.5 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the diesel generator cooling water system. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

The staff identified that LRA Table 3.3-2, Reference No. 3.3.2.16 lists loss of material from erosion or flow-accelerated corrosion as an applicable aging effect/mechanism. The Open-Cycle Cooling Water System Program (B.1.13) is identified as the applicable AMP. By letter dated August 4, 2003, the staff requested, in part (a) of RAI 3.3.2.4.12, the applicant to clarify whether erosion or flow-accelerated corrosion is the applicable aging mechanism for components in the diesel generator cooling water system identified in Table 2.3.3-12 in the LRA. If erosion is the applicable aging mechanism, and not flow-accelerated corrosion, the applicant was requested to state so explicitly in the LRA. Otherwise, the staff requested the applicant to clarify how the Open-Cycle Cooling Water System Program (B.1.13) will manage the aging effect of loss of material due to flow-accelerated corrosion.

Furthermore, the staff identified that NUREG-1800, Section 3.3.2.2.11, states that loss of material due to general, pitting, and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system. The Dresden UFSAR Section 9.5.5 states that the remaining part of the system's piping and valves traverse to and from the missile-protected diesel and reactor buildings via a reinforced concrete tunnel that runs below ground. By letter dated August 4, 2003, the staff requested, in part (b) of RAI 3.3.2.4.12, the applicant to clarify if there is any underground piping in the diesel generator cooling water system that is buried or inaccessible. If buried or inaccessible piping does exist, the staff requested the applicant to explain how such piping will be managed for loss of material during the period of extended operation.

In its response dated October 3, 2003, the applicant stated, with regard to part (a) of the RAI, that Exelon has reviewed LRA Table 3.3-2, Aging Management Reference 3.3.2.16, for loss of material due to erosion or flow-accelerated corrosion as an applicable aging effect/mechanism. Flow-accelerated corrosion is not the valid aging mechanism for heat exchangers in the scope of license renewal since heat exchangers are operated within their design flow and operating parameters. The applicant clarified that LRA Table 3.3-2, Aging Management Reference 3.3.2.16, should have only stated erosion as the aging mechanism, instead of erosion or flow-accelerated corrosion.

With regard to part (b) of the RAI, the applicant stated that the diesel generator cooling water system piping traverses to the crib house from the missile-protected diesel and turbine buildings via a reinforced concrete tunnel. However, the tunnel does not extend completely from the turbine building to the crib house. Portions of the diesel generator cooling water piping do run underground (buried) to the crib house. The applicant clarified that LRA Section 2.3.3.12, Table 2.3.3-12, should have included buried piping Aging Management Reference 3.3.1.16 under "Piping and Fittings" with pressure boundary as the component intended function. LRA Table 3.3-1, Aging Management Reference 3.3.1.16, discusses the aging management of buried piping and fittings for loss of material due to general, pitting, and crevice corrosion and MIC. Finally, the applicant stated that the Buried Piping and Tanks Inspection Program (B.1.25) will manage the aging of the diesel generator cooling water system buried piping and piping components.

The staff finds the applicant's response to RAI 3.3.2.4.12 acceptable because (1) the applicant clarified that LRA Table 3.3-2, Aging Management Reference 3.3.2.16, should have stated only erosion as the aging mechanism, instead of erosion or flow-accelerated corrosion, and (2) the applicant clarified that LRA Section 2.3.3.12, Table 2.3.3-12, should have included buried piping Aging Management Reference 3.3.1.16 under "Piping and Fittings" with pressure boundary as the component intended function. In addition, the applicant stated that the Buried Piping and

Tanks Inspection Program (B.1.25) is the applicable AMP. The staff considers the issues related to RAI 3.3.2.4.12 to be resolved.

The aging effects identified in the LRA for the diesel generator cooling water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the diesel generator cooling water system:

- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Heat Exchanger Test and Inspection Activities Program (Section 3.0.3.16)
- Structures Monitoring Program (Section 3.0.3.14)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. These AMPs are evaluated in Sections 3.0.3.6, 3.0.3.5, 3.0.3.10, 3.0.3.11, 3.0.3.12, 3.0.3.14, and 3.0.3.16, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the diesel generator cooling water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

The response to RAI 3.3-7 identified that the Heat Exchanger Testing and Inspection Program (B.2.6), the Bolting Integrity Program (B.1.12), and the Structures Monitoring Program (B.1.30) would be used to manage aging effects in the diesel generator cooling water system.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the diesel generator cooling water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.13 Diesel Fuel Oil System

Summary of Technical Information in the Application. The description of the diesel fuel oil system can be found in Section 2.3.3.13 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-13. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-13 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include closure bolting, filters/strainers, flame arresters, piping and fittings, piping and fittings (attached support), pumps, restricting orifices (Quad Cities only), sight glasses, tanks, tubing, valves, and valves (attached support).

The LRA identifies that high-strength, low-alloy steel closure bolting components exposed to outdoor ambient air are subject to the aging effect of loss of material due to general corrosion and wear. Cast iron components exposed to an air, moisture, and humidity environment are subject to the aging effect of loss of material due to pitting and crevice corrosion. Cast iron components exposed to diesel fuel oil are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Carbon steel components exposed to diesel fuel oil are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Carbon steel components exposed to outdoor ambient air are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Carbon steel components exposed to lubricating oil (with contaminants and/or water) are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Carbon steel components exposed to soil and ground water are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Stainless steel components exposed to diesel fuel oil are subject to the aging effect of loss of material due to pitting and crevice corrosion. Stainless steel components exposed to air, moisture, and humidity experience no aging effects. Glass components exposed to fuel oil or air, moisture, and humidity environments experience no aging effects. Fiberglass components exposed to fuel oil are subject to loss of intended function due to buildup of deposit and biofouling. Fiberglass components exposed to soil and groundwater experience no aging effects. Brass or bronze components exposed to diesel fuel oil are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Brass or bronze components exposed to air, moisture, and humidity experience no aging effects.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the diesel fuel oil system:

- Bolting Integrity Program (B.1.12)
- Fuel Oil Chemistry Program (B.1.21)
- One-Time Inspection Program (B.1.23)
- Buried Piping and Tanks Inspection Program (B.1.25)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the diesel fuel oil system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the diesel fuel oil system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.13, Table 2.3.3-13, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations for which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant did not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on the aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing the AMR item 3.3.1.5, “Specific Corrosion Mechanism,” and to explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the diesel fuel oil system. The staff’s evaluation of the applicant’s response is documented in Section 3.3.2.5.7 of this SER.

LRA Table 2.3.3-13 references items 3.3.1.5, 3.3.1.7, 3.3.2.29, and 3.3.2.139 for managing piping and fittings. None of these AMR references include an AMP for buried piping in the diesel fuel oil system. LRA AMP B.1.25 identifies a one-time visual inspection of the external surface of a buried piping section, but the system is not identified. LRA Section 3.3.1.1.4 indicates that a buried section of fire mains is included in the Buried Piping and Tanks Inspection Program. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.13 part (a) to request the applicant to explain how buried piping in the diesel fuel oil system will be managed, including a justification based on operating experience.

In its response dated October 3, 2003, the applicant stated that LRA Table 2.3.3-13, with a component group of “Piping and Fittings,” should have referred to Aging Management Reference 3.3.1.16, which addresses NUREG-1801, Item VII.H1.1-b, “Diesel Fuel Oil System Underground Piping and Fittings,” and addresses the aging effect of loss of material due to general, pitting, and crevice corrosion and MIC.

The staff finds the applicant’s response to part (a) adequate and acceptable because the applicant identified the aging effects of the diesel fuel oil system underground piping and fittings and appropriate AMPs.

The staff requested additional information to evaluate how the aging effects for filters and strainers are managed. Filters and strainers are included in Table 2.3.3-13 as passive components with a filter function. Table 3.3-1, Reference 3.3.1.7, identifies loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling as an aging effect for filters and strainers in the diesel generator fuel oil system. The Fuel Oil Chemistry and One-Time Inspection Programs are credited for managing the aging effect. In RAI 3.3.2.4.13 part (b), the applicant was requested to explain how the Fuel Oil Chemistry and One-Time Inspection Programs manage biofouling in the filter and strainer elements. The staff also asked the applicant to clarify if filter elements are considered replaceable or long-lived, passive components.

In its response dated October 3, 2003, the applicant stated that filter elements are replaced on a frequent basis and are therefore not considered long lived. The response clarified that biofouling is not considered an aging mechanism for strainers and is managed at its source within the fuel oil storage tanks. Further, the aging management of filter/strainers was evaluated in AMR Reference 3.3.1.7, with the NUREG-1801 component of “Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system.” The response identified that the Fuel Oil Chemistry Program manages biofouling in the fuel oil tanks and includes the following preventive actions:

- Periodic emergency and station blackout diesel generator, diesel driven fire pump, and Dresden isolation condenser makeup pump fuel oil samples are analyzed for the presence of water and particulates.

- Storage tank bottoms are periodically sampled for the presence of water.

- Fuel oil storage tank samples are routinely analyzed for biological growth.

- Samples of new fuel deliveries are analyzed for water, sediment, and the quality of the fuel being delivered.

- A biocide is added to new fuel oil when the fuel is delivered.

- Water and particulates are removed from the fuel whenever the fuel oil analysis acceptance criteria are approached or exceeded.

- Fuel oil storage tanks are periodically cleaned and inspected for evidence of internal corrosion.

- During normal operations, fuel oil day tanks are filled from the bulk fuel oil storage tanks to which the biocide has been added.

The staff finds the applicant’s response to RAI 3.3.2.4.13 part (b) adequate and acceptable because the applicant provided details on how the biofouling aging effect is managed by various activities in the Fuel Oil Chemistry and the One-Time Inspection Programs. The Fuel Oil Chemistry and the One-Time Inspection Programs are evaluated in Sections 3.3.2.3.5 and 3.0.3.10, respectively, of this SER.

The aging effects identified in the LRA for the diesel fuel oil system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs to manage the aging effects described above for the diesel fuel oil system:

- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection—Compressed Gas Program (Section 3.0.3.10)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- Structures Monitoring Program (Section 3.0.3.14)
- Fuel Oil Chemistry Program (Section 3.3.2.3.5)

With the exception of the Fuel Oil Chemistry Program, these AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.10, 3.0.3.12, and 3.0.3.14, respectively, of this SER. The Fuel Oil Chemistry Program is evaluated in Section 3.3.2.3.5 of this SER.

After evaluating the applicant’s AMR for each of the components in the diesel fuel oil system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the

LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

The response to RAI 3.3-7 clarified that the Bolting Integrity Program (B.1.12), the One-Time Inspection Program (B.1.23), and the Structures Monitoring Program (B.1.30) are to be used to manage aging effects in the diesel fuel oil system.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the diesel fuel oil system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.14 Process Sampling System

Summary of Technical Information in the Application. The description of the process sampling system can be found in Section 2.3.3.14 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-14. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-14 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include piping and fittings, tubing, valves, vents and drains, and closure bolting.

Carbon steel, stainless steel, brass, bronze, and low-alloy steel exposed to moist and humid air and leaking fluid are subject to loss of material due to corrosion. Loss of material is identified for carbon steel exposed to an external sheltered environment of moist and humid air. No aging effect is identified for stainless steel, aluminum, brass, bronze, and copper exposed to an external sheltered environment of moist and humid air. Carbon steel, stainless steel, brass, bronze, and copper exposed to an internal environment of moist air are subject to loss of material due to general, pitting, and crevice corrosion. Stainless steel exposed to saturated air is subject to loss of material due to pitting and crevice corrosion. No aging effect is identified for stainless steel in containment nitrogen. Carbon steel exposed to chemically treated demineralized water is subject to loss of material due to general, pitting, and crevice corrosion. Stainless steel exposed to chemically treated demineralized water is subject to cracking due to SCC.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the process sampling system:

- Bolting Integrity Program (B.1.12)
- Water Chemistry Program (B.1.2)
- One-Time Inspection Program (B.1.23)

- Compressed Air Monitoring Program (B.1.16)
- Structures Monitoring Program (B.1.30)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in Section 2.3.3.14 and Tables 2.3.3-14, 3.3-1, and 3.3-2 in the LRA and finds the applicant's identification of the applicable aging effects of carbon steel, stainless steel, brass, bronze, and low-alloy steel components acceptable. In addition, the applicant's conclusion that stainless steel components in a containment nitrogen environment experience no aging effects is also acceptable.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

The aging effects identified in the LRA for the process sampling system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the process sampling system.

- Bolting Integrity Program (Section 3.0.3.5)
- Water Chemistry Program (Section 3.0.3.2)
- One-Time Inspection Program (Section 3.0.3.10)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- Structures Monitoring Program (Section 3.0.3.14)

The Bolting Integrity Program, Water Chemistry Program, One-Time Inspection Program, Compressed Air Monitoring Program, and Structures Monitoring Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.2, 3.0.3.10, 3.0.3.8, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the process sampling system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the process sampling system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.15 Carbon Dioxide System

Summary of Technical Information in the Application. The description of the carbon dioxide system can be found in Section 2.3.3.15 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-15. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-15 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include closure bolting, piping and fittings (including thermowells and nozzles), valves, tubing, and tanks.

The LRA identifies that carbon steel components in sheltered environments are subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Loss of material due to general corrosion, as well as crack initiation and growth/cyclic loading or SCC, are applicable aging effects for high-strength, low-alloy steel components in an air, moisture, humidity, and leaking fluid environment. The LRA identified no aging effect on carbon steel, brass, or bronze components in a dry gas environment. No aging effect was identified for brass or bronze components in an environment of air, moisture, and humidity less than 100 $^{\circ}$C (212 $^{\circ}$F).

Aging Management Programs

The following AMPs are utilized to manage aging effects in the carbon dioxide system:

- Bolting Integrity Program (B.1.12)
- Fire Protection Program (B.1.18)

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

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the carbon dioxide system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-15, 3.3-1, and 3.3-2 for the carbon dioxide system. During its review, the staff determined that additional information was needed.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the carbon dioxide system. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

In item 3.3.2.260 of LRA Table 3.3-2, for the material/environment of brass or bronze/dry gas, the applicant has listed no applicable aging effect. The staff identified that in the discussion column the applicant explained that, "A moisture free gaseous environment (nitrogen) is not conducive to promoting aging degradation of brass or bronze components." By letter dated August 4, 2003, the staff requested, in part (a) of RAI 3.3.2.4.15, the applicant to clarify whether dry carbon dioxide should be included in this discussion, or to explain the applicability of this discussion to the carbon dioxide system.

The staff identified that in item 3.3.2.212 of LRA Table 3.3-2, the applicant identified an environment of dry gas for the tank component of the carbon dioxide system. In Section 2.3.3.15 of the LRA, the applicant described part of the Cardox unit as a liquid carbon dioxide tank. The staff also requested, in part (a) of RAI 3.3.2.4.15, the applicant to resolve the apparent discrepancy between a dry gas environment and liquid carbon dioxide.

The staff further identified that the applicant identified no aging effect for carbon steel, brass, or bronze components in a dry gas environment. Dry carbon dioxide is not a degrading environment for carbon steel, brass, or bronze components. But carbon steel components may be sensitive to the presence of moisture in the carbon dioxide environment. Moisture may induce corrosion and corrosion-erosion. The staff requested, in part (b) of RAI 3.3.2.4.15, the applicant to clarify the degree of dryness of the carbon dioxide environment. The staff asked the applicant to specify the activities in place to verify and maintain the degree of dryness of the carbon dioxide environment necessary to minimize aging degradation of carbon steel components during the period of subsequent operation, including after periods in which carbon dioxide must be replenished or refilled.

In its response dated October 3, 2003, the applicant stated that for part (a) of the RAI 3.3.2.4.15, Aging Management Reference 3.3.2.260 of LRA Table 3.3-2 explicitly addresses a nitrogen gaseous environment. This statement applies to dry gases in general, including dry carbon dioxide (see EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," Appendix D). The discussion column for Aging Management Reference 3.3.2.260 of LRA Table 3.3-2 should not have included the parenthetical reference to nitrogen in the second sentence. The applicant further stated that the discussion column of Aging Management Reference 3.3.2.212 in LRA Table 3.3-2 identifies an environment of dry gas for the tank component of the carbon dioxide system. The environment is further clarified in that section as “dry gas (moisture free),” indicating that the environment is free of water. LRA Section 2.3.3.15 (page 2-144) describes part of the Cardox unit as a liquid carbon dioxide tank. The description in this section is correct because the carbon dioxide in the tank is maintained in its pressurized liquid form. However, little or no moisture in the form of water is contained in the tank. Therefore, the applicant concluded that there is no discrepancy between the environments identified in Aging Management Reference 3.3.2.212 of LRA Table 3.3-2 and LRA Section 2.3.3.15.

In the same response dated October 3, 2003, to part (b) of the RAI 3.3.2.4.15, the applicant stated that the carbon dioxide environment at Dresden Station and Quad Cities Station is associated with the Cardox system. The carbon dioxide environment in this system is dry (anhydrous) carbon dioxide, which is at least 99.5 percent carbon dioxide. There are no activities specifically involving quantifying tank moisture levels. However, the applicant specified that tank moisture levels are maintained sufficiently low enough to preclude any appreciable amount of corrosion or corrosion-erosion by (1) performing tank filling operations with vendor assistance in accordance with vendor recommendations, (2) periodically monitoring tank pressure and temperature and condition, limiting the possibility of undetected leaks, and (3) periodically calibrating tank pressure and temperature instrumentation.

The staff finds the applicant’s response to part (a) of RAI 3.3.2.4.15 acceptable because the applicant agrees that the discussion column for Aging Management Reference 3.3.2.260 of LRA Table 3.3-2 should not have included the parenthetical reference to nitrogen in the second sentence. In addition, the applicant stated that there is little or no moisture in the form of water contained in the tank. The staff also finds that the applicant’s response to part (b) of RAI 3.3.2.4.15 acceptable because the applicant has specified the moisture level of the carbon dioxide and has shown that tank moisture levels are maintained sufficiently low enough to preclude any appreciable amount of corrosion or corrosion-erosion by specific procedures. The staff considers the issues related to RAI 3.3.2.4.15 to be resolved.

The aging effects identified in the LRA for the carbon dioxide system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the carbon dioxide system.

- Bolting Integrity Program (Section 3.0.3.5)
- Fire Protection Program (Section 3.3.2.3.3)

The Bolting Integrity Program is credited for managing the aging effects of components in several structures and systems and, therefore, is considered a common AMP. This AMP is evaluated in Section 3.0.3.5 of this SER. The Fire Protection Program is evaluated in Section 3.3.2.3.3 of this SER.

After evaluating the applicant’s AMR for each of the components in the carbon dioxide system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

The Fire Protection Program (B.1.18) is applicable to the carbon dioxide system since the applicant stated in the AMP (page b-38 of the LRA) that, "The program will provide for aging management of external surfaces of Dresden and Quad Cities carbon dioxide system components and Dresden halon system components for corrosion through periodic operability tests based on NFPA codes and visual inspections. Testing and inspections are implemented through predefined tasks and procedures." The applicant has also clarified the role of this AMP for the carbon dioxide system in its response to RAI 3.3-7 which is evaluated in Section 3.3.2.5.7 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the carbon dioxide system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.16 Service Water System

Summary of Technical Information in the Application. The description of the service water system can be found in Section 2.3.3.16 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-16. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-16 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include closure bolting, piping and fittings, valves, orifice bodies, tubing, pumps and pump casings, strainer screens, and strainer bodies.

The LRA identifies the following applicable aging effects for the service water system.
The applicant identified in the LRA that carbon steel in outdoor ambient conditions is subject to loss of material due to general, pitting, and crevice corrosion. Copper, brass, and bronze components in saturated air are subject to loss of material due to pitting and crevice corrosion. Loss of material due to general, pitting, crevice corrosion, MIC, and macroorganisms is an applicable aging effect on high-strength, low-alloy steel components in raw water (submerged). The LRA identifies that cast iron and carbon steel in an air, moisture, humidity, and leaking fluid environment are subject to loss of material due to general corrosion and/or pitting and crevice corrosion. Cast iron components in raw water, untreated salt water, or fresh water environments are subject to loss of materials due to selective leaching, general, pitting, crevice, and galvanic corrosion, erosion, and MIC. Additional aging effects for cast iron components in the same environments include flow blockage due to biofouling, silting, and corrosion product buildup. The applicant identified flow blockage due to biofouling as the only applicable aging effect for titanium components in raw water, untreated salt water, or fresh water environments.

The LRA identified no aging effects for stainless steel, brass, or bronze components in an environment of air, moisture, and humidity less than 100 °C (212 °F) or for titanium components in an air, moisture, humidity, and leaking fluid environment, as well as in raw water, untreated salt water, or fresh water. The applicant identified no aging effects for copper components in an environment of air, moisture, and humidity less than 100 °C (212 °F).

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the service water system:

- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Closed-Cycle Cooling Water System Program (B.1.14)
- Compressed Air Monitoring Program (B.1.16)
- Fire Water System Program (B.1.19)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Buried Piping and Tanks Inspection Program (B.1.25)

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

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the service water system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-16, 3.3-1, and 3.3-2 for the service water system. During its review, the staff determined that additional information was needed.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

The AMR of this system specifies References 3.3.2.208 and 3.3.2.179 for cast iron components in raw water. Reference 3.3.2.208 includes galvanic corrosion as a mechanism for loss of material, but Reference 3.3.2.179 does not. In RAI 3.3.2.4.16, by letter dated August 4, 2003, the staff asked the applicant to clarify whether the components covered by Reference 3.3.2.179 (pump casings) are also susceptible to galvanic corrosion and to provide the applicable AMP(s). In its response dated October 3, 2003, the applicant stated that, according to EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," Appendix B, galvanic corrosion is an applicable aging mechanism for cast iron components that are in contact with metals higher in the galvanic series. The applicant stated that Reference 3.3.2.208 is associated with cast iron strainer bodies in the Dresden CCSW and service water systems. These strainer bodies are in raw water environments and are in contact with strainer filters made of stainless steel, which is higher in the galvanic series than cast iron. Therefore, the applicant concluded that galvanic corrosion is an applicable aging effect for the strainer bodies. The applicant further stated that Reference 3.3.2.179 is associated with cast iron pump casings in raw water environments in the Dresden CCSW and service water systems. These pump casings are not in contact with any metals higher in the galvanic series; therefore, the applicant concluded that galvanic corrosion is not an applicable aging mechanism. On the basis of its review, since the pump casings are not in contact with metals higher in the galvanic series, the staff agrees with the applicant's conclusion that there is no galvanic corrosion of the pump casings. Therefore, the staff finds the applicant's response to RAI 3.3.2.4.16 acceptable.

The aging effects identified in the LRA for the service water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the service water system:

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- Fire Water System Program (Section 3.3.2.3.4)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)

These AMPs (with the exception of Fire Water System Program) are credited with managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. These common AMPs are evaluated in Sections 3.0.3.5, 3.0.3.6, 3.0.3.7, 3.0.3.8, 3.0.3.10, and 3.0.3.11, respectively, of this SER. The Fire Water System Program (B.1.19) is evaluated in Section 3.3.2.3.4 of this SER.

The staff identified that loss of material due to galvanic corrosion is location dependent. Adequate aging management may need to target susceptible locations for inspection and testing. By letter dated August 4, 2003, the staff asked the applicant to clarify whether the inspection and testing activities described in the Open-Cycle Cooling Water System Program (B.1.13) are targeted or opportunistic with respect to managing loss of material due to galvanic corrosion (RAI B.1.13). In its responses dated October 3, 2003, and December 17, 2003, the applicant stated that the Open-Cycle Cooling Water System Program manages galvanic corrosion through periodic inspections of in-scope components, as appropriate. The in-scope components include heat exchangers and strainer bodies. The applicant further stated that a new surveillance for periodic inspection of the strainer in the CCSW supply line to the main control room HVAC refrigeration condensing unit will be added to this program and will be implemented prior to the end of the current license. This is Commitment #13 of Appendix A of this SER. The applicant also updated the UFSAR Supplement for the Open-Cycle Cooling Water System Program to reflect this addition. The staff concludes that the use of periodic inspections performed as part of the Open-Cycle Cooling Water System Program is an appropriate method of managing the loss of material due to galvanic corrosion; therefore, the staff finds this acceptable.

After evaluating the applicant’s AMR for each of the components in the service water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the service water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.17 Reactor Building Closed Cooling Water System

Summary of Technical Information in the Application. The description of the reactor building closed cooling water system can be found in Section 2.3.3.17 of the LRA. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-17. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-17 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include closure bolting, flow elements, NSR vents or drains, piping and fittings, pumps, tanks, and valves. Components specific to Dresden only include heat exchanger, manifolds, thermowells, tubing , and orifice bodies. Components specific to Quad Cities only are heat exchanger (spatial interaction), piping and fittings (spatial interaction) (include flow elements), and valves (attached support).

Carbon steel and stainless steel components exposed to chemically treated demineralized water are subject to the aging effects of loss of material due to general, galvanic (carbon steel only), pitting, crevice, microbiologically influenced, erosion, or flow-accelerated corrosion and wear and crack initiation and growth due to fatigue and SCC. Carbon steel, stainless steel, brass, or bronze components exposed to warm and moist air are subject to the aging effect of loss of material due to corrosion. Brass and bronze components exposed to chemically treated demineralized water are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion and selective leaching, and crack initiation and growth due to fatigue and SCC. Stainless steel exposed to air, moisture, and humidity experiences no aging effects. Heat exchangers exposed to raw water are subject to the aging effect of loss of heat transfer function due to buildup of deposit and fouling.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the reactor building closed cooling water system:

- Water Chemistry Program (B.1.2)
- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Closed-Cycle Cooling Water System Program (B.1.14)
- Compressed Air Monitoring Program (B.1.16)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the reactor building closed cooling water system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the reactor building closed cooling water system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.17, Table 2.3.3-17, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations for which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or an air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40, as to whether pollutants such as oxygen, NO_x, $SO_{2,}$ or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and(3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

Loss of material due to general, pitting, and crevice corrosion may be an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. However, in several AMR references, the applicant identified crack initiation and growth due to SCC and IGSCC as the applicable aging effect/mechanism instead of loss of material due to general, pitting, and crevice corrosion. By letter dated August 4, 2003, the staff requested, in RAI 3.3-6, the applicant to provide clarification. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.6 of this SER.

The aging effects identified in the LRA for the reactor building closed cooling water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs with managing the aging effects described above for the reactor building closed cooling water system:

- Water Chemistry Program (Section 3.0.3.2)
- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited for managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for components in this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.5, 3.0.3.6, 3.0.3.7, 3.0.3.8, 3.0.3.10, 3.0.3.11, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant’s AMR for each of the components in the reactor building closed cooling water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor building closed cooling water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.18 Turbine Building Closed Cooling Water System

Summary of Technical Information in the Application. The description of the turbine building closed cooling water system can be found in Section 2.3.3.18 of the LRA. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-18. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-18 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include closure bolting, heat exchanger, piping and fittings, and valves.

Carbon steel and admiralty brass components exposed to raw water are subject to the aging effects of loss of material due to general, galvanic, microbiologically influenced, erosion, flow-accelerated, pitting, and crevice corrosion, wear, and selective leaching, and crack initiation and growth due to fatigue and SCC; carbon steel components exposed to chemically treated demineralized water less than 90° C (194 °F) are subject to the aging effect of crack initiation and growth due to fatigue and SCC.

Aging Management Programs

The LRA credited the following AMPs for managing the identified aging effects for the turbine building closed cooling water system:

- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Closed-Cycle Cooling Water System Program (B.1.14)
- Structures Monitoring Program (B.1.30)
- Selective Leaching of Materials Program (B.1.24)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the turbine building closed cooling water system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the turbine building closed cooling water system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.18, Table 2.3.3-18, and Tables 3.3-1 and 3.3-2 in the LRA. On the basis of its review, the staff finds that the applicant has correctly identified the applicable aging effects on the components consistent with industry experience for the combinations of materials and environments in the turbine building closed cooling water system.

The aging effects identified in the LRA for the turbine building closed cooling water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the turbine building closed cooling water system:

- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)

- Closed-Cycle Cooling Water System Program (Section 3.0.3.7)
- Structures Monitoring Program (Section 3.0.3.14)
- Selective Leaching of Materials Program (Section 3.0.3.11)

These AMPs are credited for managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.6, 3.0.3.7, 3.0.3.14, and 3.0.3.11, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the turbine building closed cooling water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ... will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.19 Demineralized Water Makeup System

Summary of Technical Information in the Application. The description of the demineralized water makeup system can be found in Section 2.3.3.19 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-19. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-19 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include closure bolting, NSR vents or drains, piping and fittings, piping and fittings (spatial interaction), piping and fittings (attached support), valves, and valves (spatial interaction). The components specific to Dresden only include pumps and restricting orifices. The components specific to Quad Cities only include flow elements (spatial interaction), piping and valves (attached support), pumps (spatial interaction), restricting orifices (spatial interaction), strainers (spatial interaction), and valves (attached support).

The LRA identifies that high-strength, low-alloy steel closure bolting components exposed to outdoor ambient conditions are subject to the aging effect of loss of material due to general corrosion and wear. Carbon steel, stainless steel, brass, or bronze components in the NSR vents or drains, piping, and valves system that are exposed to an air, moisture, humidity, and leaking fluid environment are subject to the aging effect of loss of material due to corrosion. Carbon steel and stainless steel components exposed to treated water are subject to the aging effect of loss of material due to general (carbon steel only), pitting, and crevice corrosion. Carbon steel components exposed to outdoor ambient conditions are subject to the aging effect of loss of material due to general, pitting, and crevice corrosion. Stainless steel components exposed to air, moisture, and humidity or outdoor ambient conditions experience no aging effects. Cast iron components exposed to treated water are subject to the aging effect of loss of material due to selective leaching. Cast iron components exposed to air, moisture, and humidity are subject to the aging effect of loss of material due to pitting and crevice corrosion. Aluminum components exposed to treated water less than 90 °C (194 °F) are subject to the aging effect of loss of material due to pitting and crevice corrosion. Aluminum components exposed to outdoor ambient conditions are subject to the aging effect of loss of material due to pitting corrosion. Brass or bronze components exposed to demineralized water are subject to the aging effect of loss of material due to pitting and crevice corrosion. Brass or bronze components exposed to air, moisture, and humidity experience no aging effects.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the demineralized water makeup system:

- Water Chemistry Program (B.1.2)
- BWR Stress Corrosion Cracking Program (B.1.7)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the demineralized water makeup system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the demineralized water makeup system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.19, Table 2.3.3-19, and Section 3.3.3, Table 3.3-2 in this SER. During its review, the staff determined that additional information was needed.

In LRA Table 3.3-2, Reference No. 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions are subject to the aging effect of loss of material due to general corrosion and wear. However, the applicant did not include crack initiation and growth due to SCC or other mechanisms as an applicable aging effect/mechanism. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide its technical basis for not including this aging effect/mechanism. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.5 of this SER.

Loss of material due to general, pitting, and crevice corrosion may be an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. However, in several AMR references, the applicant identified crack initiation and growth due to SCC and IGSCC as the applicable aging effect/mechanism instead of loss of material due to general, pitting, and crevice corrosion. By letter dated August 4, 2003, the staff requested, in RAI 3.3-6, the applicant to provide clarification. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.6 of this SER.

For several AMR items, the LRA was not clear as to how the applicant was verifying the effectiveness of the Water Chemistry Program. By letter dated August 4, 2003, the staff requested, in RAI 3.3-8, the applicant to clarify whether a one-time inspection should be performed for these components to verify the effectiveness of the Water Chemistry Program. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.8 of this SER.

The applicant uses the Bolting Integrity Program (B.1.12) to manage general corrosion on external surfaces of many auxiliary system nonbolting components. The staff notes that the Bolting Integrity Program description states, "The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment." This suggests that only the bolting material will be inspected for aging degradation. By letter dated August 4, 2003, the staff requested, in RAI 3.3-9, the applicant to explain (including the acceptance criteria and inspection interval) how the Bolting Integrity Program is used to manage general corrosion on external surfaces of nonbolting components, such as piping, valves, mufflers, and others. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.9 of this SER.

The LRA identifies that loss of material due to pitting and crevice corrosion may be an applicable aging effect on aluminum components exposed to outdoor ambient conditions or cast iron exposed to treated water. However, in Table 3.3-2, Reference No. 3.3.2.22, the applicant identified loss of material due to pitting corrosion as the only aging effect/mechanism on the aluminum components exposed to outdoor ambient conditions. Similarly, in Table 3.3-2, Reference No. 3.3.2.182, the applicant identified only loss of material due to selective leaching as the applicable aging effect/mechanism on cast iron exposed to treated water. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.19, the applicant to provide the technical basis for excluding the aging effect of loss of material due to crevice corrosion and/or pitting corrosion from the AMR.

In its response dated October 3, 2003, the applicant stated that according to the "Metals Handbook," Ninth Edition, Volume 13, the aging effect/mechanism that may affect aluminum components exposed to an outdoor ambient environment is loss of material due to pitting. Aluminum alloys have excellent resistance to atmospheric corrosion, and in many outdoor applications, such alloys do not require shelter, protective coatings, or maintenance. Corrosion of most aluminum alloys by weathering is restricted to mild surface roughening by shallow pitting, with no general thinning. Therefore, the applicant concluded that loss of material due to pitting is the only applicable aging effect on aluminum components exposed to an outdoor environment, as evaluated in Aging Management Reference 3.3.2.22. The applicant further stated that loss of material due to pitting and crevice corrosion of cast iron components is addressed by Aging Management Reference 3.3.2.300. Aging Management Reference 3.3.2.182 addresses the aging effect of loss of material due to selective leaching on cast iron exposed to a treated water internal environment. The applicant clarified that Aging Management Reference 3.3.2.300 addresses the aging effect of loss of material due to pitting and crevice corrosion on cast iron exposed to an external environment of air, moisture, and humidity less than 100 °C (212 °F).

On the basis of its review, the staff finds the applicant's response to RAI 3.3.2.4.19 acceptable because the applicant has shown that (1) loss of material due to pitting is the only applicable aging effect on aluminum components exposed to an outdoor environment, (2) Aging Management Reference 3.3.2.182 addresses the aging effect of loss of material due to selective leaching on cast iron exposed to a treated water internal environment, and (3) Aging Management Reference 3.3.2.300 addresses the aging effect of loss of material due to pitting and crevice corrosion on cast iron exposed to an external environment of air, moisture, and humidity less than100 °C (212 °F). The staff considers the issues related to RAI 3.3.2.4.19 to be resolved.

The aging effects identified in the LRA for the demineralized water makeup system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the demineralized water makeup system.

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress Corrosion Cracking Program (Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited for managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.3, 3.0.3.5, 3.0.3.10, 3.0.3.11, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the demineralized water makeup system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the demineralized water makeup. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the demineralized water makeup system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.20 Residual Heat Removal Service Water System (Quad Cities Only)

Summary of Technical Information in the Application. The description of the residual heat removal service water system can be found in Section 2.3.3.20 of the SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-20. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-20 of the LRA lists individual system components within the scope of license renewal and subject to AMR. The components include air handlers heating/cooling (Aux & RW HVAC), ducts and fittings, access doors, heat exchangers, and NSR vents or drains. The components specific to Quad Cities only include closure bolting, dampeners, equipment frames, orifice bodies, piping and fittings, piping and fittings (attached support), pulsation dampeners, pumps, sight glass (attached supports), strainer bodies, strainer screens, thermowells, tubing, tubing (attached supports), valves, and valves (attached support).

Air handlers with copper tubes, stainless steel tubesheets, and carbon steel end bells exposed to raw water or warm moist air are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion, erosion or flow-accelerated corrosion, wear, and cracking initiation and growth due to fatigue and SCC. Copper tubes in air handlers are subject to the aging effect of loss of heat transfer function due to buildup of deposit/fouling. Heat exchangers with stainless steel tubes, cast iron tubesheets, carbon steel or cast iron shells, and cast iron channel heads exposed to raw water on the tube side and torus water on the shell side are subject to the aging effects of loss of material due to general, galvanic, pitting, crevice, and microbiologically influenced corrosion, erosion or flow-accelerated corrosion, selective leaching, wear, and cracking initiation and growth due to fatigue and SCC. Heat exchanger tubes are subject to the aging effect of loss of heat transfer function due to buildup of deposit/fouling. Heat exchanger external surfaces exposed to air, moisture, humidity, and leaking fluids are subject to the aging effect of loss of material due to pitting and crevice corrosion. Carbon steel, stainless steel, brass, or bronze NSR vents or drains exposed to air, moisture, and leaking fluid are subject to the aging effect of loss of material due to corrosion. Brass or bronze, carbon steel, saran-lined steel, iron cast (lined), and stainless steel components exposed to air, moisture, humidity, and leaking fluid are subject to the aging effect of loss of material due to general (carbon steel, saran-lined steel), pitting, and crevice corrosion. Carbon steel components exposed to raw water are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion. Saran-lined steel components exposed to raw water are subject to the aging effect of loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and erosion. Saran-lined steel components exposed to raw water are subject to the aging effect of loss of intended function due to flow blockage caused by biofouling, silting, and corrosion product buildup. Iron cast (lined) components exposed to raw water are subject to the aging effect of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and selective leaching. Brass or bronze components exposed to an air, moisture, and humidity environment experience no aging effects. Cast iron components exposed to raw water are subject to the aging effect of loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and selective leaching. Cast iron components exposed to raw water are subject to the aging effect of loss intended function due to flow blockage caused by biofouling, silting, and corrosion product buildup. Cast iron components exposed to an air, moisture, and humidity environment are subject to the aging effect of loss of material due to pitting and crevice corrosion.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the residual heat removal service water system:

- Water Chemistry Program (B.1.2)
- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- One-Time Inspection Program (B.1.23)
- Selective Leaching of Materials Program (B.1.24)
- Buried Piping and Tanks Inspections Program (B.1.25)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the residual heat removal service water system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the residual heat removal service water system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.20, Table 2.3.3-20, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed. The issues addressed in the RAIs are related to this system, in addition to other systems, even though the RAIs are evaluated in other sections of this SER as specified in the following text.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations for which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, brass, and bronze components exposed to moist gas (moist nitrogen) or a moist air environment may experience the aging effect of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves exposed to either the containment nitrogen gas environment or an air, moisture, and humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40, as to whether pollutants such as oxygen, NO_x, SO_2, or CO are present, and if so, to what extent, in the containment gas or air, moisture, and humidity environments. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA only identifies loss of material due to general and pitting corrosion as a plausible aging effect for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to an air, moisture, and humidity environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of the cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

Loss of material due to general, pitting, and crevice corrosion may be an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. However, in several AMR references, the applicant identified crack initiation and growth due to SCC and IGSCC as the applicable aging effect/mechanism instead of loss of material due to general, pitting, and crevice corrosion. By letter dated August 4, 2003, the staff requested, in RAI 3.3-6, the applicant to provide clarification. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.6 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing the AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in the various auxiliary systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

For several AMR items, the LRA was not clear as to how the applicant was verifying the effectiveness of the Water Chemistry Program. By letter dated August 4, 2003, the staff requested, in RAI 3.3-8, the applicant to clarify whether a one-time inspection should be performed for these components to verify the effectiveness of the Water Chemistry Program. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.8 of this SER.

Loss of material due to selective leaching may be an applicable aging effect for copper alloy components exposed to a saturated air environment where water condensation may occur on the surfaces of these components. However, in LRA Table 3.3-2, Reference Nos. 52, 242, and 262, loss of material due to selective leaching was not identified as an applicable aging effect for copper alloy components in saturated air. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.8 requesting the applicant to provide the technical basis for excluding this aging effect from AMR. The staff's evaluation of the applicant's response is documented in Section 3.3.2.4.8 of this SER.

The aging effects identified in the LRA for the residual heat removal service water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the residual heat removal service water system:

- Water Chemistry Program (Section 3.0.3.2)
- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- One-Time Inspection Program (Section 3.0.3.10)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Buried Piping and Tanks Inspections Program (Section 3.0.3.12)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited for managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.5, 3.0.3.6, 3.0.3.10, 3.0.3.11, 3.0.3.12, and 3.0.3.14, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the residual heat removal service water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the residual heat removal service water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.21 Containment Cooling Service Water System (Dresden Only)

Summary of Technical Information in the Application. The description of the containment cooling service water system can be found in Section 2.3.3.21 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-21. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Components of the containment cooling service water system are described in Section 2.3.3.21 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3.3-21, 3.3-1, and 3.3-2 of the LRA list individual components of the system, including piping and fittings, buried piping, tubing, valves, pumps, thermowells, strainer bodies and screens, orifice bodies, heat exchangers, flow elements, duct and fittings, access doors, equipment frames, air handlers, and closure bolting.

Carbon steel, stainless steel, brass, bronze, and cast iron exposed to an external environment of high moisture and humidity air and leaking fluid in the pump vault are subject to loss of material due to corrosion. Loss of material is identified for cast iron exposed to the plant's indoor building environment (defined in the LRA as air, moisture, and humidity less than 100 °C (212 °F)). No aging effect is identified for stainless steel, brass, and bronze exposed to the plant's indoor building environment. Carbon steel submerged in raw water is subject to loss of material due to general, pitting, and crevice corrosion and MIC. Carbon steel in a buried environment is also subject to loss of material due to general, pitting, and crevice corrosion and MIC. Cast iron exposed to raw water is subject to loss of material due to general, pitting, crevice corrosion, MIC, and selective leaching. Copper and carbon steel heat exchanger components exposed to raw water on the tube side are subject to loss of material, cracking, and fouling. Copper and carbon steel heat exchanger components exposed to torus water (demineralized water) on the shell side are subject to loss of material and cracking.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the containment cooling service water system:

- Water Chemistry Program (B.1.2)
- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Selective Leaching of Materials Program (B.1.24)
- Structures Monitoring Program (B.1.30)
- Buried Piping and Tanks Inspection Program (B.1.25)

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

Staff Evaluation.

Aging Effects

The staff reviewed the information in Section 2.3.3.21 and Tables 2.3.3-21, 3.3-1, and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed.

The description in item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as an aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of material for the relevant components, as well as the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Aging management of the air handlers (heat exchangers) is addressed by Aging Management Reference Nos. 3.3.2.8 and 3.3.2.9. While these references discuss both the internal and external environment of the heat exchanger tubes, it was not clear whether the aging effects or the AMPs had been identified for both the internal and external environments. The tube internal environment is open-cycle cooling water (raw water) and the external environment is warm, moist air. The applicant identified loss of material and cracking as applicable aging effects, and the credited Open-Cycle Cooling Water System Program (B.1.13) with managing these aging effects. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.21(a), the applicant to provide justification for not identifying any aging effects for the components on the shell side exposed to warm, moist air, especially considering condensation on the tubes.

In its response dated October 3, 2003, the applicant stated that condensation is present on the tubes of the shell side of the air handlers (heat exchangers). Aging Management References 3.3.2.8 and 3.3.2.9 of LRA Table 3.3-2 address open/coil fin type air coolers. The materials are stainless steel, copper, aluminum, and carbon steel, and they are exposed to warm, moist air. Appendix G of "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," EPRI 1003056, which is applicable to air handlers in air environments, identifies loss of material due to wear, buildup of deposit due to fouling, and cracking due to fatigue as the applicable aging effects/mechanisms for stainless steel, copper, and aluminum air handling components in air environments. EPRI 1003056, Appendix D, which is applicable to carbon steel components in air/gas environments, identifies loss of material due to general corrosion, galvanic corrosion, and MIC as an aging effect/mechanism for carbon steel in air environments.

The applicant stated that Aging Management References 3.3.2.8 and 3.3.2.9, along with Aging Management Reference 3.3.2.7, include aging effects for both tube side and shell side surfaces. These references identify the above aging effects/mechanisms for the subject air handler surfaces in a warm, moist air environment. The applicant stated that the associated AMP, the Open-Cycle Cooling Water System Program (B.1.13), includes provisions for inspection of the external surfaces of the air handler cooling water components. On the basis of its review, the staff finds the applicant's response to RAI 3.3.2.4.21(a) acceptable because the applicant has identified the applicable aging effects and has provided an appropriate AMP to manage the aging effects.

The AMR of this system specifies References 3.3.2.208 and 3.3.2.179 for cast iron components in raw water. Reference 3.3.2.208 includes galvanic corrosion as a mechanism for loss of material, but Reference 3.3.2.179 does not. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.21(b), the applicant to clarify whether the components covered by Reference 3.3.2.179 (pump casings) are also susceptible to galvanic corrosion, and to provide the applicable AMP(s). In its response dated October 3, 2003, the applicant stated that, according to EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," Appendix B, galvanic corrosion is an applicable aging mechanism for cast iron components that are in contact with metals higher in the galvanic series. The applicant stated that Reference 3.3.2.208 is associated with cast iron strainer bodies in the Dresden containment cooling service water and service water systems. These strainer bodies are in raw water environments and are in contact with strainer filters made of stainless steel, which is higher in the galvanic series than cast iron. Therefore, the applicant concluded that galvanic corrosion is an applicable aging effect for the strainer bodies.

The applicant further stated that Reference 3.3.2.179 is associated with cast iron pump casings in raw water environments in the Dresden CCSW and service water systems. These pump casings are not in contact with any metals higher in the galvanic series; therefore, the applicant concluded that galvanic corrosion is not an applicable aging mechanism. On the basis of its review, since the pump casings are not in contact with metals higher in the galvanic series, the staff agrees with the applicant's conclusion that there is no galvanic corrosion of the pump casings. Therefore, the staff finds the applicant's response to RAI 3.3.2.4.16 acceptable.

The aging effects identified in the LRA for the containment cooling service water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the containment cooling service water system:

- Water Chemistry Program (Section 3.0.3.2)
- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Selective Leaching of Materials Program (Section 3.0.3.11)
- Structures Monitoring Program (Section 3.0.3.14)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)

The Bolting Integrity Program, Open-Cycle Cooling Water System Program, Water Chemistry Program, Selective Leaching of Materials Program, Structures Monitoring Program, and Buried Piping and Tanks Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.5, 3.0.3.6, 3.0.3.12, 3.0.3.11, 3.0.3.14, and 3.0.3.12, respectively, of this SER.

The staff identified that loss of material due to galvanic corrosion is location dependent. Adequate aging management may need to target susceptible locations for inspection and testing. By letter dated August 4, 2003, the staff asked the applicant to clarify whether the inspection and testing activities described in the Open-Cycle Cooling Water System Program (B.1.13) are targeted or opportunistic with respect to managing loss of material due to galvanic corrosion (RAI B.1.13). In its responses dated October 3, 2003, and December 17, 2003, the applicant stated that the Open-Cycle Cooling Water System Program manages galvanic corrosion through periodic inspections of in-scope components, as appropriate. The in-scope components include heat exchangers and strainer bodies. The applicant further stated that a new surveillance for periodic inspection of the strainer in the containment cooling service water supply line to the main control room HVAC refrigeration condensing unit will be added to this program and will be implemented prior to the end of the current license. The applicant also updated the UFSAR Supplement for the Open-Cycle Cooling Water System Program to reflect this addition. The staff concludes that the use of periodic inspections performed as part of the Open-Cycle Cooling Water System Program is an appropriate method of managing the loss of material due to galvanic corrosion; therefore, the staff finds this acceptable.

After evaluating the applicant's AMR for each of the components in the containment cooling service water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the containment cooling service water system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.22 Ultimate Heat Sink

Summary of Technical Information in the Application. The description of the ultimate heat sink can be found in Section 2.3.3.22 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Tables 2.3.3-22. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-22 of the LRA lists individual system components that are within the scope of license renewal and subject to AMR. The components include closure bolting, piping and fittings, stop logs, valves, including the ice melt gates (from the applicant's response to RAI 2.3.3.22-1), and pump casings.

The LRA identifies the following applicable aging effects for the ultimate heat sink. The LRA identifies that cast iron, low-alloy steel, and carbon steel components in an air, moisture, humidity, and leaking fluid environment are subject to loss of material from general corrosion, pitting, and crevice corrosion (for carbon steel and cast iron), as well as crack initiation and growth from cyclic loading and SCC for the low-alloy steel components. Cast iron components in raw water or untreated fresh water environments are subject to loss of material from selective leaching, general, pitting, and crevice corrosion and MIC. Carbon steel components in a submerged raw water environment are subject to the aging effect of loss of material from general, pitting, and crevice corrosion, MIC, and macroorganisms. The LRA does not identify any aging effects for carbon steel components encased in concrete. The applicant did not identify any aging effects for aluminum stop logs in the indoor environment (from the applicant's response to RAI 2.3.3.22-2).

Aging Management Programs

The LRA credited the following AMPs for managing the identified aging effects for the ultimate heat sink:

- Open-Cycle Cooling Water System Program (B.1.13)
- Bolting Integrity Program (B.1.12)
- Structures Monitoring Program (B.1.30)
- Selective Leaching of Materials Program (B.1.24)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the ultimate heat sink will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, of the components in the ultimate heat sink. The staff also reviewed the applicable UFSAR

Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-22, 3.3-1, and 3.3-2 for the ultimate heat sink. During its review, the staff determined that additional information was needed.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subject to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have material/environment combinations for which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing the AMR item 3.3.1.5, "Specific Corrosion Mechanism," and to explain how the AMP(s) manages that corrosion mechanism for components in the various auxiliary systems. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

The applicant uses the Bolting Integrity Program (B.1.12) to manage general corrosion on the external surfaces of many auxiliary system nonbolting components. The staff notes that the Bolting Integrity Program description states, "The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment." This suggests that only the bolting material will be inspected for aging degradation. By letter dated August 4, 2003, the staff requested, in RAI 3.3-9, the applicant to explain (including the acceptance criteria and inspection interval) how the Bolting Integrity Program is used to manage general corrosion on external surfaces of non-bolting components, such as piping, valves, mufflers, and others. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.9 of this SER.

Loss of material from erosion and flow blockage from biofouling, silting, and corrosion product buildup may also be applicable aging effects/aging mechanisms for some cast iron components in a raw water environment. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.22 (a), the applicant to clarify whether these are applicable aging effects/aging mechanisms for these components in the ultimate heat sink. If so, the staff requested the applicant to provide the applicable AMP(s). If not, the applicant was requested to provide the basis for excluding erosion and flow blockage as applicable aging effects/aging mechanisms, including applicable operating experience.

In addition, in Table 2.3.3-22 and in item 3.3.2.28 of Table 3.3-2 of the LRA, for the material/environment of carbon steel components encased in concrete, the applicant stated that there is no applicable aging effect. The staff notes that good design and construction practices are necessary to prevent steel corrosion in an environment of being embedded in concrete. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.22 (b), the applicant to provide specifics of the design and construction practices used for the carbon steel components encased in concrete in the ultimate heat sink, including applicable standards and operating experience.

In its response dated October 3, 2003, the applicant stated that for part (a) of the RAI 3.3.2.4.22, loss of material from erosion and flow blockage from biofouling, silting, and corrosion product buildup are not applicable aging effects/aging mechanisms for cast iron components in a raw water environment in the ultimate heat sink. Cast iron components within the scope of license renewal in the ultimate heat sink are pumps and valves with a pressure boundary component intended function. The aging effect/mechanism for these components is "Loss of material/General, pitting and crevice corrosion, selective leaching and microbiologically influenced corrosion." The applicant further stated that a review of plant operating history did not reveal any loss of intended function for cast iron components in the ultimate heat sink due to the erosion and flow blockage aging mechanisms. The applicant clarified that Aging Management Reference 3.3.2.172 addresses the aging management of the internal surfaces of cast iron components, and that Aging Management Reference 3.3.2.300 addresses the aging management of the external surfaces of cast iron components.

For part (b) of RAI 3.3.2.4.22, the applicant stated that EPRI TR-114881, "Aging Effects for Structures and Structural Components (Structural Tools)" identifies that "the high alkalinity of concrete (pH > 12.5) provides an environment around embedded steel and steel reinforcement which protects them from corrosion." EPRI TR-114881 further states that the corrosion rate is insignificant until a pH of 4.0 is reached. The concrete structures and structural members are designed and constructed in accordance with ACI-318-63 and ASTM standards which provide a good quality, dense, low permeability concrete that provides adequate concrete cover over the encased steel. The applicant further stated that a review of plant operating history did not reveal any loss of intended function for the carbon steel components encased in concrete in the ultimate heat sink.

The applicant clarified that Aging Management Reference 3.3.2.28 discusses the aging management of external surfaces of the carbon steel components (underground corrugated steel ice melting piping) encased in concrete, and further stated that Aging Management Reference 3.3.1.15 discusses the aging management of the internal surfaces of carbon steel components (underground corrugated steel ice melting piping) in a raw water environment.

On the basis of its review, the staff finds the applicant's response to RAI 3.3.2.4.22 acceptable because (1) the applicant showed that a review of plant operating history did not reveal any loss of intended function for cast iron components in the ultimate heat sink due to the erosion and flow blockage aging mechanisms, and (2) the applicant demonstrated that the concrete structures and structural members are designed and constructed in accordance with ACI-318-63 and ASTM standards. Further, the applicant showed that a review of plant operating history did not reveal any loss of intended function for the carbon steel components encased in concrete in the ultimate heat sink. The staff considers the issues related to RAI 3.3.2.4.22 parts (a) and (b) to be resolved.

The aging effects identified in the LRA for the ultimate heat sink are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the ultimate heat sink:

- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Bolting Integrity Program (Section 3.0.3.5)
- Structures Monitoring Program (Section 3.0.3.14)
- Selective Leaching of Materials Program (Section 3.0.3.11)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. These AMPs are evaluated in Sections 3.0.3.6, 3.0.3.5, 3.0.3.14, and 3.0.3.11, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the ultimate heat sink, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ultimate heat sink will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.23 Fuel Pool Cooling and Filter Demineralizer System (Dresden Only)

Summary of Technical Information in the Application. The description of the fuel pool cooling and filter demineralizer system can be found in Section 2.3.3.23 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-23. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Components of the fuel pool cooling and filter demineralizer system are described in Section 2.3.3.23 of the LRA as being within the scope of license renewal and subject to an AMR. Table 2.3.3-23 of the LRA lists individual components of the system including fittings, valves, sight glasses, and closure bolting.

Carbon steel and low-alloy steel exposed to external sheltered environment with warm, moist air is subject to loss of material due to corrosion. No aging effect is identified for stainless steel exposed to external sheltered environment with warm, moist air. Carbon steel exposed to internal environment of demineralized oxygenated water, wet gas, or warm, moist air is subject to loss of material due to general, pitting, and crevice corrosion. Stainless steel exposed to internal environment of chemically treated oxygenated water is subject to loss of material due to general, pitting, and crevice corrosion.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the fuel pool cooling and filter demineralizer system:

- Water Chemistry Program (B.1.2)
- One-time Inspection Program (B.1.23)
- Bolting Integrity Program (B.1.12)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effect of aging associated with the components of the fuel pool cooling and filter demineralizer system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the fuel pool cooling and filter demineralizer system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.23 and Tables 2.3.3-23, 3.3-1, and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed to complete its review.

The description in Item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as the aging effect/mechanism for carbon steel, stainless steel, brass, or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of the corrosion responsible for the aging effect of loss of material for the relevant components and the criteria for selecting these samples including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

NUREG-1801 identifies loss of material due to corrosion is an aging effect for shell-side components (shell and access cover, channel head, and tubes) of the heat exchanger of the fuel pool cooling and cleanup system exposed to closed-cycle cooling water. LRA Table 2.3.3-23 does not include any aging effect for the heat exchanger of the fuel pool cooling and cleanup system. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.23, the applicant to provide justification for not identifying any aging effect for the shell-side components of the heat exchanger of the fuel pool cooling and filter demineralizer system in LRA Table 2.3.3-23.

In its response dated October 3, 2003, the applicant stated that the applicant does not consider the Dresden heat exchangers associated with the fuel pool cooling and cleanup system to be within the scope of license renewal. The applicant explained that the fuel pool cooling and cleanup system is a non-safety-related closed-loop system that is normally in continuous operation. In normal operation, the fuel pool cooling and cleanup system interfaces directly with the spent fuel pool, which is a Class I structure, and during refueling operations it may be aligned to support filling or draining the reactor cavity and/or the equipment storage pool. The non-safety-related reactor building closed cooling water system provides the cooling medium for the fuel pool cooling heat exchangers, and the non-safety-related demineralized water makeup system is the normal makeup water supply for the fuel storage pool. Each of the two spent fuel pool cooling system return lines to the spent fuel pool have openings in the pipe about 6 inches below the pool surface to act as antisiphon devices by allowing air into the pipe to break the vacuum if siphoning begins. This precludes uncontrolled draining of the spent fuel pool in the event of a pipe failure. Additionally, the heat exchangers are not located near safety-related equipment that could be affected by failure of these components.

The applicant further explained that the complete loss of fuel pool cooling could result in overheating of fuel rods stored in the fuel pool if makeup systems were not activated and the fuel pool were allowed to boil away. However, this is not a design- or licensing-basis event and several hours would be available for restoration of makeup systems. Makeup systems available include the condensate transfer system, the demineralized water system, and the fire water system, any of which could be connected by hoses to provide makeup to the spent fuel pool. Calculations performed as part of the extended power uprate evaluation determined that with a complete loss of cooling to the spent fuel pool, it would take at least 8 hours for the Dresden fuel pool to reach 212 °F (100 °C) . This would provide adequate time to establish alternative sources of makeup water to the pool. Because failure of the fuel pool cooling system does not threaten to cause consequential failure of other safety-related systems or components, and because postulated failure of the fuel pool cooling system allows ample time to implement alternative makeup to the fuel pool, failure of the fuel pool cooling system is not considered a failure of a non-safety-related system whose failure could prevent satisfactory accomplishment of any of the safety-related functions identified in 10 CFR 54.4(a)(1).

The staff understands that the fuel pool cooling and cleanup system at Dresden is a non-safety-related closed-loop system that is normally in continuous operation. The design objectives of the system are to handle the spent fuel pool cooling load and to maintain pool water clarity. The only intended function of the system is to preclude adverse effects from failure of segments of piping and components on safety-related SSCs.

In its response dated October 3, 2003, the applicant stated that the fuel pool cooling and cleanup system (with the exception of the segments of piping discussed below) is not located near safety-related equipment that could be affected by failure of fuel pool cooling and cleanup system components. The applicant performed a walkdown of the system and determined that—

- The segment of line 2-1910B-6"-K red highlighted on boundary diagram LR-DRE-M-31 is in scope of license renewal because it is physically located such that leakage or spray from this line could spatially interact with safety-related primary containment isolation valve AOV 2-1601-23.

- The red-highlighted portion of the drain line (from globe valve 3-1901-11 to the 6"x4" reducer) as shown on boundary diagram LR-DRE-M-362 is physically located such that leakage from this line could spatially interact with safety-related primary containment isolation valve AOV 3-1601-23. Because of this spatial relationship, the highlighted portion of the line was determined to be in scope of license renewal.

On the basis of its review, the staff finds the applicant's response acceptable because the spent fuel pool cooling heat exchangers are not located near safety-related equipment and their failure does not threaten to cause consequential failure of other safety-related systems or components. Therefore, the spent fuel pool cooling heat exchangers are not in scope of license renewal and are not included in LRA Table 2.3.3.12. The staff considers issues related to RAI 3.3.2.4.23 to be resolved.

The aging effects identified in the LRA for the fuel pool cooling and filter demineralizer system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the fuel pool cooling and filter demineralizer system.

- Water Chemistry Program (Section 3.0.3.2)
- One-time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)
- Structures Monitoring Program (Section 3.0.3.14)

The Water Chemistry, One-time Inspection, Bolting Integrity, and Structures Monitoring Programs are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.10, 3.0.3.5, and 3.0.3.14 of this SER.

After evaluating the applicant's AMR for each of the components in the fuel pool cooling and filter demineralizer system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the fuel pool cooling and filter demineralizer system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by

10 CFR 54.21(a)(3).

3.3.2.4.24 Plant Heating System

Summary of Technical Information in the Application. The description of the plant heating system can be found in Section 2.3.3.24 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-24. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-24 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. The components include closure bolting, filters/strainers, NSR vents or drains, piping and valves (Dresden only), piping and fittings, pumps, sight glasses (Quad Cities only), tanks, thermowells (Dresden only), traps, tubing, and valves. All of these components are in the scope of license renewal due to the potential for spacial interactions.

The LRA identified the following applicable aging effects for the plant heating system. The LRA identifies that cast iron, low-alloy steel, carbon steel, stainless steel, and brass or bronze components in air, moisture, humidity, or leaking fluid environments are subject to loss of material from general corrosion (not for stainless steel), pitting and crevice corrosion, as well as crack initiation and growth from cyclic loading, and SCC for the low-alloy steel components. Cast iron, carbon steel, copper, and brass or bronze components in saturated steam/condensate environments are subject to loss of materials from general corrosion; while stainless steel components in the same environment are subject to the aging effects of loss of material from pitting and crevice corrosion. The LRA does not identify any aging effects for stainless steel, copper, and brass or bronze components in the air, moisture, and humidity less than 100 °C (212 °F) environment.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the plant heating system.

- Open-Cycle Cooling Water System Program (B.1.13)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)

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

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the plant heating system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-24, 3.3-1, and 3.3-2 for the plant heating system. During its review, the staff determined that additional information was needed to complete its review.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subjected to the aging effect of loss of material from galvanic corrosion. Many system components of the auxiliary system described by various items in Table 3.3-2 of the LRA have materials/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. However, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. By letter dated August 4, 2003, the staff issued RAI 3.3-1 pertaining to this issue. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER.

The description in Item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as aging effect/mechanism for carbon steel, stainless steel, and brass or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of materials for the relevant components and the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Carbon steel, stainless steel, and brass and bronze components exposed to moist gas (moist nitrogen) or moist air environment may experience aging effects of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects are identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valve components exposed to either the containment nitrogen gas environment or air, moisture, humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information on whether the pollutants such as oxygen, NO_x, SO_2, or CO are present, and, if so, to what extent in the containment gas or air, moisture, humidity environments to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

Loss of material from selective leaching may be an applicable aging effect/aging mechanism for cast iron and brass components in saturated steam/condensate, as well as air, moisture, humidity, and leaking fluid environments if stagnant liquids are present in these environments; however, the LRA only identifies a loss of material due to general corrosion for these components. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.24(a), the applicant to clarify whether selective leaching is applicable to components in the plant heating system and, if so, to provide the applicable AMP(s). In its responses dated October 3 and December 22, 2003, the applicant stated that these components are subject to loss of material due to general corrosion, and they may also be subject to loss of material due to selective leaching if stagnant liquids are present in these environments. The loss of material is managed by periodic inspections in stagnant flow areas. The applicant also stated that selective leaching in brass alloys results in either a uniform attack or a localized plug attack, while selective leaching of gray cast iron results in iron being dissolved, leaving a porous mass consisting of graphite, voids, and rust. The applicant stated that the inspection will detect the loss of material whether it is due to selective leaching or general corrosion. The staff finds that periodic inspections for loss of material will identify selective leaching if it is occurring; therefore, the staff finds this acceptable.

The aging effects identified in the LRA for the plant heating system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs to manage the aging effects described above for the plant heating system.

- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Periodic Inspection of Plant Heating System (Section 3.3.2.3.7)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. These AMPs are evaluated in Sections 3.0.3.6, 3.0.3.5, 3.0.3.10, and 3.3.2.3.7 of this SER.

The LRA credits a one-time inspection for aging management of a carbon steel tank in this system. By letter dated August 4, 2003, the staff asked for clarification related to whether all parts of the tank are accessible, or how the inaccessible parts of the tank would be managed. In its response dated October 3, 2003, the applicant stated that the tanks (grouped under Aging Management Reference 3.3.3.214) are not buried or embedded in a way that makes large areas of the tanks inaccessible for inspection. The applicant referred to its response to RAI B.1.23-2, which committed to perform periodic inspections of Dresden and Quad Cities plant heating system components using processes based on the One-Time Inspection Program. This is Commitment #46 in Appendix A of this SER.

Consistent with its response to RAI B.1.23-2, the applicant stated that one or more components in the plant heating system with material consisting of carbon steel exposed to an environment of saturated steam/condensate will be periodically inspected using the Period Inspection of Plant Heating System Program (B.2.8), which is described in the applicant’s letter dated January 26, 2004. The applicant further stated that the inspected component(s) will serve as a representative sample for all carbon steel components in the plant heating system, encompassing both the accessible parts of the plant heating system and any small areas of the tank where access may be difficult. The staff noted that the applicant planned to periodically inspect a representative sample of accessible locations, but that it was not clear that the accessible locations would be a leading indicator for the tank bottom. The staff noted that this system is only in scope for spatial interactions and a leak in the tank bottom may not pose a concern. Therefore, the staff asked the applicant to describe how the proposed inspections would bound the loss of material in the tank bottom, or justify that a leak in this area is not a concern. In its response dated December 22, 2003, the applicant stated that the plant heating steam system was included within the scope of license renewal at both sites because of the numerous instances in which heating steam components were found located above safety-related equipment. In these instances, the possibility exists in which failed plant heating steam components could spray water onto safety-related equipment located below. While not all heating steam components have the ability to spatially interact with safety-related equipment, a decision was made to include all of the plant system components within the scope of license renewal. The applicant further stated that the tanks in question are among those plant heating steam components that cannot spatially interact with safety-related equipment. Therefore, the applicant concluded that potential leakage from the plant heating system tanks does not jeopardize the functionality of any safety-related structures or components, and does not present a concern for loss of any safety-related intended functions during the period of extended operation. The staff concludes that the proposed inspections would adequately identify degradation of the plant heating system; therefore, the staff finds this acceptable.

After evaluating the applicant's AMR for each of the components in the plant heating system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the plant heating system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.25 Containment Atmosphere Monitoring System

Summary of Technical Information in the Application. The description of the containment atmosphere monitoring system can be found in Section 2.3.3.25 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Tables 2.3.3-25. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-25 of the LRA lists individual system components that are within the scope of license renewal and subject to an AMR. Table 2.3.3-25 lists all component groups in this category, components not evaluated in GALL and considered as plant-specific, in the containment atmosphere monitoring system. The components listed by the applicant in the Dresden/Quad Cities Nuclear Stations LRA for this category include closure bolting, filters/strainers, flexible hoses, NSR vents or drains, piping and valves (attached support), piping and fittings (attached support), piping and fittings, pumps, restricting orifices, sample pumps, tubing, valves, and valves (attached support).

The LRA identified the following applicable aging effects for the containment atmosphere monitoring system. The LRA identifies that low-alloy steel, carbon steel, stainless steel, and brass or bronze components in air, moisture, humidity, or leaking fluid environments are subject to loss of material from general corrosion (not for stainless steel), pitting, and crevice corrosion, as well as crack initiation and growth from cyclic loading, SCC for the low-alloy steel components. Stainless steel components in warm, moist air and wet gas environments, as well as moist containment atmosphere (air/nitrogen), steam, or demineralized water environment are subject to loss of materials from pitting and crevice corrosion. Elastomer neoprene and similar materials in both dry gas and warm, moist air environments are subject to the aging effect of hardening and loss of strength from elastomer degradation. The LRA does not identify any aging effect for stainless steel, or brass or bronze components in dry gas environment and in containment nitrogen environment (for stainless steel).

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the containment atmosphere monitoring system.

- One-Time Inspection Program (B.1.23)
- Bolting Integrity Program (B.1.12)

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

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the containment atmosphere monitoring system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Tables 2.3.3-25, 3.3-1, and 3.3-2 for the containment atmosphere monitoring system. During its review, the staff determined that additional information was needed to complete its review.

Carbon steel, stainless steel, and brass and bronze components exposed to moist gas (moist nitrogen) or moist air environment may experience aging effects of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, the applicant concluded that no aging effects are identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valve components exposed to either the containment nitrogen gas environment or air, moisture, humidity environment because these components are not subject to any viable aging mechanism in the absence of aggressive chemical species. By letter dated August 4, 2003, the staff issued RAI 3.3-3 requesting the applicant to provide information on whether the pollutants such as oxygen, NO_x, SO_2, or CO are present, and, if so, to what extent in the containment gas or air, moisture, humidity environments to justify the conclusions in Table 3.3-2, Reference Nos. 3.3.2.27 and 3.3.2.40. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

The aging effects identified in the LRA for the containment atmosphere monitoring system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the containment atmosphere monitoring system.

- One-Time Inspection Program (Section 3.0.3.10)
- Bolting Integrity Program (Section 3.0.3.5)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff's evaluation of these AMPs is documented in Sections 3.0.3.10 and 3.0.3.5 of this SER.

After evaluating the applicant's AMR for each of the components in the containment atmosphere monitoring system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the containment atmosphere monitoring system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.26 Nitrogen Containment Atmosphere Dilution System

Summary of Technical Information in the Application. The description of the nitrogen containment atmosphere dilution system can be found in Section 2.3.3.26 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-26. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-26 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include closure bolting, restricting orifices (Dresden only), tubing, and valves.

High-strength, low-alloy steel closure bolting components exposed to outdoor ambient conditions are subject to loss of materials due to general corrosion and wear; copper, brass, or bronze components exposed to dry gas or air, moisture, and humidity environment experience no aging effect; copper, brass, or bronze components exposed to outdoor ambient conditions are subject to aging effect of loss of materials due to pitting and crevice corrosion.

Aging Management Programs

The LRA credited the following AMP with managing the identified aging effects for the nitrogen containment atmosphere dilution system:

- Bolting Integrity Program (B.1.12)

A description of this AMP is provided in Appendix B of the LRA. The applicant concluded that the effect of aging associated with the components of the nitrogen containment atmosphere dilution system will be adequately managed by this AMP during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMP credited for managing the aging effects, in the components of the nitrogen containment atmosphere dilution system. The staff also reviewed the applicable UFSAR Supplement for the AMP to ensure that the program description adequately describes the AMP.

Aging Effects

The staff reviewed the information in Section 2.3.3.26, Table 2.3.3-26, and Table 3.3-2 in the LRA. During its review, the staff determined that additional information was needed to complete its review.

In LRA Table 3.3-2, Reference No. 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions are subject to aging effects of loss of material due to general corrosion and wear. However, the applicant did not include crack initiation and growth due to SCC or other mechanisms as applicable aging effects/mechanisms. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide technical basis for not including this aging effect/mechanism. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.5 of this SER.

In LRA Table 3.3-2, Reference Nos. 3.3.2.23 and 3.3.2.34, the applicant concluded that no aging effects were identified for the external surfaces of copper tanks and accumulators and the external surfaces of brass or bronze valves. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.3, the applicant to provide the technical basis (including the level of humidity and the level of pollutants) for this conclusion. The evaluation of the applicant's response is documented in Section 3.3.2.4.3 of this SER.

The aging effects identified in the LRA for the nitrogen containment atmosphere dilution system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMP to manage the aging effects described above for the nitrogen containment atmosphere dilution system.

- Bolting Integrity Program (Section 3.0.3.5)

This AMP is credited for managing the aging effects on components in several structures and systems and, therefore, is considered a common AMP. The staff has evaluated this common AMP and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMPs is documented in Section 3.0.3.5 of this SER.

After evaluating the applicant's AMR for each of the components in the nitrogen containment atmosphere dilution system, the staff evaluated the AMP listed above to determine if it is appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited the AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the nitrogen containment atmosphere dilution system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.27 Drywell Nitrogen Inerting System

Summary of Technical Information in the Application. The description of the drywell nitrogen inerting system can be found in Section 2.3.3.27 of the LRA. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-27. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-28 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include closure bolting, filters/strainers (Dresden only), flow elements, isolation barriers, piping and fittings, tanks (include vaporizers), thermowells, traps (Quad Cities only), tubing, and valves.

Aluminum, brass or bronze, carbon steel, or stainless steel components exposed to dry gas experience no aging effect. Carbon steel and stainless steel components exposed to warm, moist air are subject to aging effect of loss of material due to general (carbon steel only), pitting, and crevice corrosion. Brass or bronze components exposed to saturated air are subject to aging effect of loss of material due to pitting and crevice corrosion. Aluminum, copper, and stainless steel components exposed to air, moisture, and humidity environment experience no aging effect. Carbon steel components exposed to containment nitrogen experience no aging effect. Copper, brass, or bronze components exposed to outdoor ambient conditions are subject to aging effect of loss of material due to pitting and crevice corrosion. Aluminum components exposed to outdoor ambient conditions are subject to aging effect of loss of material due to pitting corrosion. Stainless steel exposed to outdoor ambient environments experience no aging effect.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the drywell nitrogen inerting system:

- Bolting Integrity Program (B.1.12)
- 10 CFR Part 50, Appendix J (B.1.28)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effect of aging associated with the components of the drywell nitrogen inerting system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the components of the drywell nitrogen inerting system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.27, Table 2.3.3-27, and Tables 3.3-1 and 3.3-2 in the LRA. During its review, the staff determined that additional information was needed to complete its review.

The description in Item 3.3.2.130 of Table 3.3-2 lists loss of material/corrosion as aging effect/mechanism for carbon steel, stainless steel, and brass or bronze components in an environment of air, moisture, humidity, and leaking fluid. However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of materials for the relevant components and the criteria for selecting these samples, including susceptible locations for inspections. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.2 of this SER.

Aluminum and aluminum alloy components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA, only identifies loss of material due to general and pitting corrosion as plausible aging effects for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to air, moisture, and humidity environments. By letter dated August 4, 2003, the staff requested, in RAI 3.3-4, the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of cooling coils. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

In LRA Table 3.3-2, Reference Nos. 3.3.2.23 and 3.3.2.34, the applicant concluded that no aging effects were identified for the external surfaces of copper tanks and accumulators and the external surfaces of brass or bronze valves. By letter dated August 4, 2003, the staff requested, in RAI 3.3.2.4.3, the applicant to provide the technical basis (including the level of humidity and the level of pollutants) for this conclusion. The evaluation of the applicant's response is documented in Section 3.3.2.4.3 of this SER.

In Table 3.3-2, Reference No. 124 of the LRA, the applicant identified carbon steel material exposed to warm, moist air as subject to aging effect of loss of material due to pitting and crevice corrosion. However, in Reference No. 273 for the same material/environment combination, the applicant identified loss of material due to general, pitting, and crevice corrosion as the applicable aging effect. By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.27 requesting the applicant to clarify why different AMR results were arrived at for components with the same material/environment combinations.

In its response dated October 3, 2003, the applicant stated that Aging Management Reference 3.3.2.124 assigned to Table 3.3-2 inadvertently omitted general corrosion. Table 3.3-2, Aging Management Reference 3.3.2.124 should have read "Loss of material/General, pitting and crevice corrosion." On the basis of its review, the staff finds the applicant's response adequate and acceptable because the applicant has added general corrosion to Reference No. 3.3.2.124 and the corresponding AMP.

The aging effects identified in the LRA for the drywell nitrogen inerting system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the drywell nitrogen inerting system.

- Bolting Integrity Program (Section 3.0.3.5)
- 10 CFR Part 50, Appendix J (Section 3.0.3.13)
- Structures Monitoring Program (Section 3.0.3.14)

These AMPs are credited with managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.5, 3.0.3.13, and 3.0.3.14 of this SER.

After evaluating the applicant's AMR for each of the components in the drywell nitrogen inerting system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the drywell nitrogen inerting system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.28 Safe Shutdown Makeup Pump System (Quad Cities Only)

Summary of Technical Information in the Application. The description of the safe shutdown makeup pump system can be found in Section 2.3.3.28 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3.3-28. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects

Table 2.3.3-28 of the LRA lists individual system components within the scope of license renewal and subject to an AMR. The components include air handlers heating/cooling (auxiliary and RW HVAC), access doors, closure bolting, ducts and fittings, closure bolts, equip frames, filters/strainers, piping and fittings (include spectacles), pumps, restricting orifices, and valves.

Piping and fittings (including spectacle flanges), pumps, restricting orifices, and valve components in the safe shutdown makeup pump system exposed to the reactor water environment are subject to loss of material due to general, pitting, and crevice corrosion. Ducts and fittings, access doors, closure bolts, equip frames, filters/strainers, piping and fittings (including spectacle flanges), pumps, and valve components in the safe shutdown makeup pump system exposed to warm, moist air environment are subject to loss of material due to general, pitting, and crevice corrosion, and MIC. Air handlers heating/cooling components with copper tubes, stainless steel tubesheets, and carbon steel end bells exposed to raw water on the tube side and warm, moist air on the shell (including the fin) side are subject to aging effects of loss of material due to general, galvanic, pitting, and crevice corrosion, MIC, erosion or flow-accelerated corrosion, and wear and cracking due to mechanical fatigue and SCC. Air handlers with tube sides exposed to raw water are also subject to aging effect of loss of intended function due to buildup of deposit and fouling. Aluminum fins and stainless steel components exposed to air, moisture, and humidity (less than100 °C) experience no aging effect.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the safe shutdown makeup pump system:

- Water Chemistry Program (B.1.2)
- BWR Stress-Corrosion Cracking Program (B.1.7)
- Bolting Integrity Program (B.1.12)
- Open-Cycle Cooling Water System Program (B.1.13)
- Fire Water System (B.1.19)
- One-Time Inspection Program (B.1.23)
- Structures Monitoring Program (B.1.30)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effect of aging associated with the components of the safe shutdown makeup pump system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, on components in the safe shutdown makeup pump system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.3.28, Table 2.3.3-28, and Table 3.3-2 in the LRA. During its review, the staff determined that additional information was needed to complete its review.

Aluminum and aluminum alloy components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, in Table 3.3-2, Reference No. 3.3.2.126 of the LRA, the applicant identified only loss of material due to general and pitting corrosion as plausible aging effects for aluminum components exposed to moist air. In Table 3.3-2, Reference No. 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to air, moisture, and humidity environments. By letter dated August 4, 2003, the staff issued RAI 3.3-4 requesting explanations on why different conclusions on aging effects were arrived at in Table 3.3-2, Reference Nos. 3.3.2.21 and 3.3.2.126 for the same material/environment combination and provide technical basis for not including loss of material due to crevice corrosion as an applicable aging effect. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.4 of this SER.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing the AMR Item 3.3.1.5 specific corrosion mechanism, and explain how the AMP(s) manages that corrosion mechanism for components in various systems, including the carbon dioxide system. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.7 of this SER.

LRA Table 2.3.3-28 includes filters/strainers with a filter function and references 3.3.1.19 in Section 3.3. It appears that Reference No. 3.3.1.19 applies to fire protection rather than the safe shutdown makeup pump system, and this reference does not indicate how the filter function is managed. LRA Section 2.3.3.28 indicates that the evaluation boundary includes the safe shutdown room cooler and its associated piping from the service water system (evaluated with the service water system). By letter dated August 4, 2003, the staff issued RAI 3.3.2.4.28 requesting the applicant to clarify if the strainer screens in the safe shutdown makeup pump system (such as the safe shutdown room cooler strainer) are evaluated with the service water system in Table 3.3-1, Reference No. 3.3.1-15, which credits the B.1.13 AMP. If the filters/strainers in the safe shutdown makeup pump system are not evaluated with the service water system, the applicant was requested to clarify how the strainer screens are managed. If the pump suction strainers (shown in boundary diagram LR-QDC-M-70) are temporary startup strainers that are replaced by a spool piece once in operation, the applicant was requested to so clarify. If these suction strainers are permanent, the applicant was requested to identify their appropriate AMR reference.

In its response dated October 3, 2003, the applicant stated that the safe shutdown room cooler strainer is not evaluated with the service water system. The applicant clarified that the strainer is evaluated with the safe shutdown makeup pump system, which was scoped as a subsystem of the fire protection system. The applicant identified that this strainer is cleaned on a monthly basis and the cleaning requirements are defined in a station procedure. This response also stated that the AMP associated with Aging Management Reference 3.3.1.19 is B.1.19, Fire Water System, and is appropriately assigned to this strainer.

The applicant further stated that the section of piping labeled "A spool piece for inline strainer" in the suction of the safe shutdown makeup pump is not a strainer. No additional aging management reference is required for this spool piece.

The staff finds that the applicant's response adequate and acceptable because the applicant has clarified that the safe shutdown room cooler strainer is evaluated with the safe shutdown makeup pump system, which was scoped as a subsystem of the fire protection system and this strainer is cleaned on a monthly basis.

The aging effects identified in the LRA for the safe shutdown makeup pump system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the safe shutdown makeup pump system.

- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Bolting Integrity Program (Section 3.0.3.5)
- Open-Cycle Cooling Water System Program (Section 3.0.3.6)
- Fire Water System (Section 3.3.2.3.4)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)

Except for the Fire Water System Program, these AMPs are credited with managing the aging effects on components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.3, 3.0.3.5, 3.0.3.6, 3.0.3.10, and 3.0.3.14 of this SER. The Fire Water System Program is evaluated in Section 3.3.2.3.4 of this SER.

After evaluating the applicant's AMR for each of the components in the demineralized water makeup system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

The response to RAI 3.3-7 clarified that AMPs B.1.12, Bolting Integrity Program, B.1.13, Open-Cycle Cooling Water Program, and B.1.30, Structures Monitoring Program are to be used to manage aging effects in the safe shutdown makeup pump system.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the demineralized water makeup system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.5 General Aging Management Review Issues

This section discusses the staff's evaluation of nine general AMR issues that are applicable to components in several auxiliary systems included in Section 3.3 of the LRA.

3.3.2.5.1 Galvanic Corrosion

This general AMR issue concerns aging management of loss of material due to galvanic corrosion in auxiliary systems. The concern is associated with components identified by the applicant in LRA Table 3.3-2 that are not addressed in GALL.

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subjected to the aging effect of loss of material from galvanic corrosion. Many systems/components of the auxiliary systems described by various items in Table 3.3-2 of the LRA have materials/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. By letter dated August 4, 2003, the staff requested, in RAI 3.3-1, the applicant to provide the technical basis, including plant operating experience, for determining whether loss of material due to galvanic corrosion is an applicable aging effect/mechanism for the applicable components included in the auxiliary systems.

In its response dated October 3, 2003, the applicant stated that design and installation techniques were utilized at Dresden and Quad Cities, including galvanic corrosion control mechanisms. The applicant clarified that, following good industry practices for the design of power plant piping systems and heat exchangers, materials that would be in electrical contact were selected from groups as close as possible in the galvanic series. Further, the applicant stated that wherever practical, dissimilar metals were electrically insulated by the use of insulated flanges or dielectric unions, and coatings were applied in many cases to address potential galvanic corrosion concerns. The applicant concluded that, in general, these techniques have been successful in preventing occurrences of galvanic corrosion. The applicant further stated that there have been a few occurrences of galvanic corrosion identified in the operating experience history of Dresden and Quad Cities piping systems and heat exchangers due to design errors, and that these problems have been resolved through design modifications.

In its response, the applicant stated that LRA Appendix B, B.2.6, "Heat Exchanger Test and Inspection Activities," manages the "loss of materials" aging effect for both the control room and diesel generator building air handling units by performing periodic inspections. The applicant further stated that corrosion would be detected during these periodic inspections, regardless of the mechanism involved. The staff was concerned that different types of corrosion (pitting, crevice, galvanic, etc.) may be prevalent in different susceptible locations and requested the applicant to clarify that periodic inspections for both the control room and diesel generator building air handling units are conducted on locations that include those susceptible to galvanic corrosion. By letter dated December 22, 2003, the applicant responded by stating that locations that are potentially susceptible to galvanic corrosion are the copper cooling coil interfaces with the aluminum cooling fins, the locations where the copper tubing penetrates the galvanized steel housing, and the galvanized steel tube support interfacing with the copper cooling coils. The applicant stated that these locations are inspected as part of the periodic visual inspections. The staff finds that the applicant's response is acceptable because the applicant has specifically identified locations in the air handling units that are susceptible to galvanic corrosion and that these locations are to be inspected as part of the periodic visual inspections.

The staff also identified a concern that AMP B.2.6 does not appear to include the diesel generator building air handling units and requested the applicant to address this concern. By letter dated December 17, 2003, the applicant clarified that the response to RAI 3.3-1 should have read, "The air handlers identified in Aging Management Reference 3.3.2.14 of LRA Table 3.3-2 are the Quad Cities Units 1 and 2 station blackout diesel generator battery room heat exchangers." The staff verified that these heat exchangers are included as components managed by AMP B.2.6, "Heat Exchanger Test and Inspection Activities," and, therefore, this concern is considered resolved. The staff considers all issues related to RAI 3.3-1 to be closed.

On the basis of its review, the staff finds the applicant's response adequate and acceptable because the applicant has demonstrated that (1) loss of material due to galvanic corrosion is controlled by following good design and installation practices, (2) these techniques have been successful in preventing the occurrence of galvanic corrosion, (3) the few occurrences of galvanic corrosion in the Dresden and Quad Cities operating experience have been resolved through design modifications that follow good design practices, and (4) appropriate AMPs, such as B.2.6, are credited for managing galvanic corrosion in heat exchangers.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to galvanic corrosion. 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).

3.3.2.5.2 Corrosion Mechanisms and Sampling of One-Time Inspections

For HVAC—main control room system, shutdown cooling system, and control rod drive hydraulic system, the applicant identified in AMR Reference No. 3.3.2.130 of Table 3.3-2 the material environment combination and applicable aging effects on components of NSR vents or drains, piping, and valves. The description in Reference No. 3.3.2.130 lists "Loss of material/corrosion" as aging effect/mechanism for carbon steel, stainless steel, and brass or bronze components in an environment of "Air, moisture, humidity and leaking fluid." However, the LRA does not specifically identify which type of corrosion is responsible for the loss of material. The type of corrosion is important because it determines the susceptible locations to be inspected. For example, the appropriate susceptible locations for inspection for general, crevice, galvanic, and pitting corrosion may not be the same. In addition, the staff noted that in the One-Time Inspection AMP (B.1.23), which is credited with managing the aging effects on these components, the applicant stated that this AMP will inspect a sample of the NSR vents or drains, piping, and valves in the shutdown cooling system (Dresden only) and the control rod drive hydraulic system for general, crevice, galvanic, and pitting corrosion. By letter dated August 4, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a specific description of the types of corrosion responsible for the aging effect of loss of materials for the relevant components and the criteria for selecting these samples including susceptible locations for inspections.

In its response dated October 3, 2003, the applicant stated that the aging mechanism description for Aging Management Reference 3.3.2.130 of LRA Table 3.3-2 should have been "General, pitting, and crevice corrosion," and the inspections to be performed as part of the One-Time Inspection Program B.1.23 will include the appropriate inspection information. The applicant also provided criteria used for selection of susceptible inspection locations. The staff's evaluation of these criteria is discussed in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds the applicant's response to RAI 3.3.2 acceptable because (1) it appropriately identified the aging mechanisms for the loss of materials due to corrosion, including its associated AMP, and (2) the staff found AMP B.1.23 to be acceptable as described in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of corrosion mechanisms and sampling of one-time inspections. The applicant's AMR results are otherwise consistent with 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).

3.3.2.5.3 Corrosion on Carbon Steel, Stainless Steel, Brass, and Bronze

Carbon steel and stainless steel components exposed to moist gas (moist nitrogen) or moist air environment may experience aging effects of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60 percent. However, in Table 3.3-2, Reference No. 3.3.2.27 (for carbon steel), and Reference No. 3.3.2.40 (for stainless steel) of the LRA, the applicant concluded that no aging effects were identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves components exposed to either the containment nitrogen gas environment or air, moisture, humidity environment because these components "are not subject to any viable aging mechanism in the absence of aggressive chemical species." In addition, the LRA does not identify any aging effect for stainless steel, brass or bronze components in "the air, moisture, and humidity < 100°C environment" for components in the containment atmosphere monitoring system. The staff noted that the LRA identifies stainless steel components in apparently similar environments (such as warm, moist air, wet gas, and moist containment atmosphere in items Reference Nos. 3.3.2.166, 3.3.2.299, 3.3.2.195) as being subjected to loss of materials from pitting and crevice corrosion.

By letter dated August 4, 2003, the staff requested, in RAI 3.3-3, the applicant to clarify whether the pollutants, such as oxygen, NO_x, SO_2, or CO, are present and if so, to what extent in the containment gas or air, moisture, humidity environments to justify the conclusions in Table 3.3-2, items Reference Nos. 3.3.2.27 and 3.3.2.40. In addition, the staff requested the applicant to clarify why the LRA identifies stainless steel components in apparently similar environments (such as warm, moist air, wet gas, and moist containment atmosphere in items Reference Nos. 3.3.2.166, 3.3.2.299, 3.3.2.195) as being subjected to loss of materials from pitting and crevice corrosion.

In its response dated October 3, 2003, the applicant stated that AMR Reference 3.3.2.27 of LRA Table 3.3-2 is for the external surfaces of carbon steel components in containment nitrogen environments. The conclusion in Aging Management Reference 3.3.2.27 that there was no aging effect for carbon steel components exposed to containment nitrogen environments was based on information provided in Appendix E of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056 regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for carbon steel in a nonaggressive environment. A review of Dresden and Quad Cities operating experience was conducted as part of the AMR for external surfaces. No site operating experience involving age-related degradation of the external surfaces of carbon steel components in nitrogen environments was identified.

Aging Management Reference 3.3.2.40 of LRA Table 3.3-2 is for the external surfaces of stainless steel components in indoor (sheltered) environments. The conclusion in Aging Management Reference 3.3.2.40 that there was no aging effect for stainless steel components exposed to air, moisture, and humidity less than 100 °C (212 °F) was also based on information provided in EPRI 1003056, Appendix E, regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for stainless steel in the absence of aggressive chemical species. No site operating experience involving age-related degradation of the external surfaces of stainless steel components in indoor (sheltered) environments was identified for Dresden or Quad Cities.

In the same letter, the applicant stated that pollutants in the form of oxygen, NO_x, SO_2, or CO are present in the containment gas and air, moisture, humidity environments at minimal levels. The nitrogen concentration of the containment gas environment is controlled, monitored, and maintained at above 96 percent. The air, moisture, humidity environment is for areas that are controlled indoor (sheltered) environments. EPRI 1003056, Appendix E, assumes that the level of contaminants in external environments cannot be concentrated to levels that will promote corrosion unless subjected to factors such as cyclic (wet-dry) condensation, contaminated insulation, accidental contamination, or leakage. Neither of the environments associated with Aging Management References 3.3.2.27 and 3.3.2.40 of LRA Table 3.3-2 are subjected to these factors. However, LRA Table 3.3-2 does include items addressing materials in aggressive environments. For example, Aging Management Reference 3.3.2.26, which involves external surfaces of carbon steel components in air, moisture, humidity, and leaking fluid environments, identifies loss of material due to general, pitting, and crevice corrosion as applicable aging effects/mechanisms. The staff identified that EPRI Report 1003056, Appendix E also indicates that copper and copper alloys are only susceptible to crevice, pitting, and selective leaching if exposed to an aggressive environment. For aggressive environments, AMP B.1.23 is credited for managing crevice and pitting corrosion and AMP B.1.24 is credited for managing selective leaching in copper and copper alloys.

The staff reviewed the applicant's response to the issues raised in RAI 3.3-3. On the basis of its review, the staff finds the applicant's response acceptable because (1) the applicant assured that pollutants in the form of oxygen, NO_x, SO_2, or CO are present in the containment gas and air, moisture, humidity environments at minimal levels, (2) the applicant has properly clarified that both of the environments associated with Aging Management References 3.3.2.27 and 3.3.2.40 of LRA Table 3.3-2 confirm to the assumptions in the EPRI 1003056, Appendix E (i.e., the level of contaminants in external environments cannot be concentrated to levels that will promote corrosion unless subjected to factors such as cyclic (wet-dry) condensation, contaminated insulation, accidental contamination, or leakage), and (3) the applicant verified that there is no site operating experience involving age-related degradation of the external surfaces of carbon steel components in nitrogen environments or stainless steel components in indoor (sheltered) environments for Dresden or Quad Cities.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of corrosion on carbon steel, stainless steel, brass, and bronze. 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).

3.3.2.5.4 Corrosion of Aluminum and Aluminum Alloys

Aluminum and aluminum alloy components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, AMR Reference No. 3.3.2.126 of Table 3.3-2 of the LRA, only identifies loss of material due to general and pitting corrosion as plausible aging effects for aluminum components exposed to moist air. In Table 3.3-2, Ref No 3.3.2.21 of the LRA, the applicant concluded that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to air, moisture, and humidity environments.

By RAI 3.3-4, the staff asked the applicant to (1) explain the different conclusions on aging effects described above, (2) provide the technical basis for not including loss of material due to crevice corrosion as an applicable aging effect, and (3) clarify if there is any condensate on the aluminum fins of cooling coils.

In its response dated October 3, 2003, the applicant stated that the difference between the conclusions made in Aging Management References 3.3.2.126 and 3.3.2.21 of LRA Table 3.3-2 is that Aging Management Reference 3.3.2.126 involves component internal surfaces and Aging Management Reference 3.3.2.21 involves component external surfaces in indoor (sheltered) environments.

Regarding whether crevice corrosion is a plausible aging effect on aluminum exposed to moist air, in its response dated October 3, 2003, the applicant stated that the aging mechanisms associated with Aging Management Reference 3.3.2.126 were derived from information provided in Chapter 20 of Uhlig's Corrosion Handbook, 2nd Edition. This source did not identify crevice corrosion as a viable aging mechanism for internal surfaces of aluminum and aluminum alloy components in moisture and humidity environments. Therefore, crevice corrosion was excluded as a viable aging mechanism for this item.

Pertaining to the issue on whether there is any condensate on the aluminum fins of cooling coils and the technical basis for conclusion in Table 3.3-2, Reference No. 3.3.2.21 of the LRA, in its response dated October 3, 2003, the applicant stated that the external surfaces of aluminum fins of cooling coils are exposed to condensate. The conclusion in Aging Management Reference 3.3.2.21 that there was no aging effect on aluminum components of air handler heating cooling systems exposed to air, moisture, and humidity environments was based on information provided in Appendix E of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for aluminum alloys in a nonaggressive environment. The subject aluminum components are not exposed to an aggressive environment. Furthermore, although aluminum is a reactive metal, it develops an aluminum oxide film that protects it from further corrosion. Therefore, no viable aging effect exists in an indoor environment with variable humidity and temperature less than 100 °C (212 °F) for this item. The applicant stated that a review of Dresden and Quad Cities operating experience was conducted as part of the AMR for external surfaces and no operating experience involving age-related degradation of the external surfaces of aluminum fins in air, moisture, and humidity environments was identified.

The staff reviewed the applicant's response to the issues raised in RAI 3.3.4. On the basis of its review, the staff finds the applicant's response acceptable because (1) the applicant provided information on the differences between the environments in Reference Nos. 3.3.2.126 and 3.3.2.21 of the LRA, (2) the applicant asserted that the environment the aluminum alloy components were exposed to is not an aggressive environment and satisfies the conditions assumed in EPRI 1003056, Appendix E, Section 4.1, and (3) no operating experience involving age-related degradation of the external surfaces of aluminum fins in air, moisture, and humidity environments was identified.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of corrosion of aluminum and aluminum alloys. 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).

3.3.2.5.5 Stress-Corrosion Cracking

In LRA Table 3.3-2, Ref No 3.3.2.18, the applicant stated that high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions are subject to aging effects of loss of material due to general corrosion and wear. However, the applicant did not include crack initiation and growth due to SCC or other mechanisms as applicable aging effects/mechanisms. By letter dated August 4, 2003, the staff requested, in RAI 3.3-5, the applicant to provide the technical basis for not including crack initiation and growth due to SCC as applicable aging effects/mechanisms for high-strength, low-alloy steel closure bolting components in the outdoor ambient conditions.

In its response dated October 3, 2003, the applicant stated that for closure bolting in the high-pressure or high-temperature portions of systems, the applicable aging effect is crack initiation and growth due to SCC. The bolts associated with LRA Table 3.3-2, Aging Management Reference 3.3.2.18, are on the portion of piping with low pressure and low temperature, which are not subject to cyclic loading.

The applicant further stated that EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, Appendix F, Closure bolting, states that "stress corrosion cracking is not an applicable aging effect for bolting material with a tensile strength of less than 150 ksi." The bolts used are ASTM A193 Grade B7 with a tensile strength of 125 ksi. EPRI 1003056 states, "The use of appropriate materials (such as ASTM A193, Gr. B7) for bolting also reduces the potential for SCC of fasteners by maintaining fastener minimum yield strengths below threshold values found in ["Degradation and Failure of Bolting in Nuclear Power Plants," EPRI NP-5796]."

The applicant concluded that for bolting in the low-pressure or low-temperature portion of the system (in the outdoor ambient condition), loss of material due to general corrosion or wear is the only applicable aging effect and is covered by LRA Table 3.3-2, Aging Management Reference 3.3.2.18.

On the basis of its review, the staff concurs with the applicant's assertion that for bolting in the low-pressure, low-temperature portion of the system (in the outdoor ambient condition), which is not subject to cyclic loading, SCC is not an applicable aging effect; therefore, the staff finds this acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of SCC. 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).

3.3.2.5.6 General, Pitting, and Crevice Corrosion on Carbon Steel Components Exposed to Chemically Treated Demineralized Water

Loss of material due to general, pitting, and crevice corrosion may be an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. However, in several AMR references, the applicant identified crack initiation and growth due to SCC and IGSCC as the applicable aging effects/mechanisms instead of loss of material due to general, pitting, and crevice corrosion. By letter dated August 4, 2003, the staff requested, in RAI 3.3-6, the applicant to provide clarification.

In its response dated October 3, 2003, the applicant clarified that the loss of material due to general, pitting, and crevice corrosion is addressed through AMR Reference 3.3.1.13, since this AERM is covered by the GALL Report. The AMR references in question address crack initiation growth of carbon steel in a nitrite-based chemically treated water environment. EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, identifies this as an applicable aging effect/mechanism. The GALL does not address this environment; therefore, the applicant included additional AMR references in LRA Table 3.3-2.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of general, pitting, and crevice corrosion on carbon steel components exposed to chemically treated demineralized water. 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).

3.3.2.5.7 Detailed Breakdown on the Aging Management Programs for Loss of Material Due to General, Pitting, and Crevice Corrosion, and MIC

For various in-scope components of the auxiliary systems, the applicant uses Reference No. 3.3.1.5 of Table 3.3-1 to describe the aging management of these components. Reference No. 3.3.1.5 refers to Section 3.3.1.1.7 of the LRA for further evaluation of loss of material due to general, microbiologically influenced, pitting, and crevice corrosion. This section also describes the AMPs that will be used to manage the above AERM for the various components; however, the staff noted that the descriptions in Section 3.3.1.1.7 of the LRA of how AMPs would manage the aging effects were not always consistent with the LRA description of the AMPs. The staff also noted that the LRA did not provide sufficient information on which corrosion mechanisms were applicable to the various equipment, or how the AMPs were adequate for these particular mechanisms. By letter dated August 4, 2003, the staff requested, in RAI 3.3-7, the applicant to clarify which specific AMP(s) is applicable for managing the AMR item 3.3.1.5 specific corrosion mechanism, and explain how the AMP(s) manage that corrosion mechanism for components in various auxiliary systems.

In its response dated October 3, 2003, the applicant explained this aging management will be evaluated using several AMPs, as follows:

Bolting Integrity Program (B.1.12): This program includes routine system walkdowns that manage system component external surfaces. These walkdowns check both the general external surface condition of the system components and also the leakage integrity of the components and bolted joints.

Structures Monitoring Program (B.1.30): This program uses a spaces approach, which inspects a sampling of piping and component supports and the adjacent exposed piping and component surfaces. This sampling provides confirmation that external surface aging degradation of like materials in like environments are not occurring.

One-Time Inspection Program—Compressed Gas (B.1.23): This program uses VT-3 visual inspections on a sample of components that represent or bound the piping system components within the scope of license renewal to verify that there is no unacceptable loss of material or elastomer degradation in the compressed gas systems.

Heat Exchanger Testing and Inspection Program (B.2.6): This program provides condition monitoring, inspection, and performance testing activities to manage the aging effects of loss of material, cracking, and buildup of deposits in heat exchangers.

One-Time Inspection Program—Ventilation System (B.1.23): This program uses VT-3 visual inspections of a representative sample of ventilation system ductwork, equipment frames and housings, valves, debris screens, access doors, and closure bolting to confirm that there is no penetrating corrosion, which could indicate an unacceptable loss of material condition. Drip pan drain piping will be inspected for corrosion that could result in a pipe wall perforation.

Open-Cycle Cooling Water Program (B.1.13): This program uses visual and NDE inspection of components for detection of degradation and corrosion coupons for determining general corrosion rates. This program also uses performance testing for flow rates, temperatures, and pressures, and visual inspections for fouling and silting.

Buried Piping and Tanks Inspection Program (B.1.25): This program manages loss of material (general, pitting, crevice, and MIC) through the use of piping and component coatings and wrappings, periodic inspections, and pressure testing. The condition of the coatings, which provide a mitigative function, is inspected whenever buried components are uncovered during station excavation activities. Since this could be infrequent, additional periodic leak testing and component inspections are being credited. These include ISI leakage testing for buried Class 3 piping, operational pressure monitoring for buried fire protection piping, periodic fuel oil storage tank inspections, ”one-time” UTs of the buried fuel oil storage tank internals and the internal bottom surface of an outdoor aluminum tank (such as a CCST), and a ”one-time” inspection of buried piping.

Fire Protection Program (B.1.18): This program provides for managing the effects of aging of the external piping and component surfaces of the station halon (Dresden only) and cardox systems (both stations). The program is based on NFPA 12A and 72E standards and provides for periodic system operability testing. While performing the operability testing, it is recommended that visual aging degradation inspections also be performed.

One-Time Inspection Program—NSR/SR Inspection (B.1.23): This program uses a visual inspection of a representative sample of component material—environment “pairs” for the presence of general, crevice, galvanic, and pitting corrosion to provide assurance that corrosion of system components is not occurring or is occurring at an acceptable rate.

The staff’s evaluation of these programs appears in the following sections of this SER:

- Bolting Integrity Program (Section 3.0.3.5)
- Structures Monitoring Program (Section 3.0.3.14)
- One-Time Inspection Program (Section 3.0.3.10)
- Heat Exchanger Testing and Inspection Program (Section 3.0.3.16)
- Open-Cycle Cooling Water Program (Section 3.0.3.6)
- Buried Piping and Tanks Inspection Program (Section 3.0.3.12)
- Fire Protection Program (Section 3.3.2.3.3)

The applicant’s response dated October 3, 2003, also provided minor revisions and/or clarifications of the system-specific AMR related to loss of material due to general, pitting, and crevice corrosion, and MIC. These revisions/clarifications are addressed in the applicable system writeups in Sections 3.3.2.4.1 to 3.3.2.4.28 of this SER.

The staff finds that the applicant’s response to RAI 3.3-7 is acceptable because it has clarified the management of loss of material due to general, pitting, and crevice corrosion, and MIC for auxiliary system components.

On the basis of its review, 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).

3.3.2.5.8 Verification of Water Chemistry Program

For several AMR items, LRA was not clear whether the applicant was verifying the effectiveness of the Water Chemistry Program. By letter dated August 4, 2003, the staff requested, in RAI 3.3-8, the applicant to clarify whether a one-time inspection should be performed for these components to verify the effectiveness of the chemistry program. In its responses to the staff’s RAI, the applicant clarified the aging management of the components and/or justified why inspections were not needed.

In its October 3, 2003, letter, the applicant stated that for AMR Item 3.3.2.120, the component group “heat exchanger” also credits the Open-Cycle Cooling Water Program. The activities in this AMP involve chemistry control, performance monitoring, periodic inspections, and periodic flushing in order to control biofouling, verify heat transfer, monitor degradation, and to ensure compliance with the CLB for affected heat exchangers. Performance monitoring, periodic inspections, and flushing will verify the effectiveness of the chemistry program to ensure that significant degradation is not occurring and the component intended function would be maintained. The staff finds this acceptable because the Open-Cycle Cooling Water Program activities will verify the effectiveness of the Water Chemistry Program.

For AMR Item 3.3.2.186, the applicant’s October 3, 2003, letter noted that GALL Program

Section XI.M2, “Water Chemistry Program,” states that the Water Chemistry Program is effective in removing impurities from intermediate and high-flow areas. It also states that the Water Chemistry Program may not be effective in low-flow or stagnant-flow areas. In low-flow or stagnant-flow areas, verification of the effectiveness of the chemistry program is undertaken to ensure that significant degradation is not occurring and the component intended function will be maintained. In addition, the applicant stated that the component group “flow orifices” is not typically in low-flow or stagnant areas. The applicant, therefore, concluded that verification of the effectiveness of the chemistry program through a one-time inspection, B.1.23, is not required. The staff was concerned that the term “typically” was not definitive and requested the applicant to clarify whether any restricting orifices are in low-flow or stagnant flow-areas and to discuss why a One-Time Inspection Program is not needed to verify the effectiveness of the Water Chemistry Program for these restricting orifices.

The applicant’s response dated December 17, 2003, stated that the review of Item 3.3.2.186 determined that this component was inadvertently included and will be removed from the LRA scope. The response also stated that the clean demineralized water and makeup demineralized water systems did not identify any restricting orifices that are in a low-flow or stagnant-flow area based on the system function. The applicant added that AMR references 3.3.2.72 and 3.3.2.188 will be managed with one-time inspection to verify the effectiveness of the chemistry program. The staff finds that the applicant’s response is acceptable because the inspection will verify the effectiveness of the chemistry program. The staff considers all issues related to RAI 3.3-8 to be closed.

For AMR Item 3.3.2.257, the applicant’s October 3, 2003, letter stated that the components are brass or bronze valves in clean demineralized water hose stations that are in scope of license renewal for spatial interaction component intended function. The applicant stated that one-time inspections are performed for carbon and stainless steel components to verify the effectiveness of the chemistry program, and indicated that these would be leading indicators of the loss of material in the brass and bronze valves. The staff agrees that inspections of the carbon and stainless steel components would provide a leading indicator; therefore, the staff agrees that inspections of the brass or bronze valves are not required to verify the effectiveness of the Water Chemistry Program.

On the basis of its review, the staff finds the applicant’s response adequate and acceptable because the inspections and activities described above will verify the effectiveness of the Water Chemistry AMP in preventing the identified aging effects.

3.3.2.5.9 Aging Management of Nonbolting Components Using Bolting Integrity Program

The applicant uses the Bolting Integrity Program (B.1.12) to manage general corrosion on external surfaces of many auxiliary system nonbolting components. The staff notes that the Bolting Integrity Program description states, “The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment,” suggesting that only the bolting material will be inspected for aging degradation. By letter dated August 4, 2003, the staff requested, in RAI 3.3-9, the applicant to explain (including the acceptance criteria and inspection interval) how the Bolting Integrity Program is used to manage general corrosion on external surfaces of nonbolting components, such as piping, valves, mufflers, and others.

In its response dated October 3, 2003, the applicant stated that Chapter XI of NUREG-1801, Generic Aging Lessons Learned, does not contain any program to monitor the effects of aging for the exterior surface of auxiliary system components. As such, Exelon made the decision to include the aging management for nonbolting components, such as piping, valves, and mufflers, within the Bolting Integrity Program. The Bolting Integrity Program (B.1.12) consists of visual inspections, which rely on detection of visible leakage during preventive maintenance and routine walkdowns (routine observation activities). The routine walkdowns are also credited for detecting aging degradation (general corrosion) on the external surfaces of system piping and piping components. Finally, the applicant stated that depending on the accessibility of the systems or components, walkdown inspection intervals vary from quarterly to every refueling outage, and the presence of component external surface corrosion requires engineering evaluation.

The staff finds that the applicant has adequately explained how the Bolting Integrity Program is used to manage general external corrosion for auxiliary system components. The staff's evaluation of the Bolting Integrity Program is presented in Section 3.0.3.5 of this SER.

On the basis of its review, 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).

3.4 Steam and Power Conversion Systems

This section addresses the aging management of the components of the steam and power conversion systems (SPCS) group. The systems that make up the SPCS group are described in the following SER sections:

- main steam system (2.3.4.1)
- feedwater system (2.3.4.2)
- condensate and condensate storage systems (2.3.4.3)
- main condenser (2.3.4.4)
- main turbine and auxiliary systems (2.3.4.5)
- turbine oil (Quad Cities only, 2.3.4.6)
- main generator and auxiliaries (Quad Cities only, 2.3.4.7)

As discussed in Section 3.0.1 of this SER, the components in the SPCS are described in several LRA tables. LRA Table 3.4-1 discusses the treatment of SPCS components that are evaluated in the GALL Report. LRA Tables 3.1-1 and 3.2-1 discuss the treatment of components that the GALL Report evaluates as part of the RCS and ESF systems groups, respectively; however, several of these components are scoped under SPCS at Dresden and Quad Cities (these components are evaluated in Sections 3.1 and 3.2 of this SER, respectively). LRA Tables 2.3.4-1 through 2.3.4-7 show all of the components in each system, regardless of whether they are addressed in the GALL Report. For those system components that are addressed in the GALL Report, LRA Tables 2.3.4-1 through 2.3.4-7 refer to LRA Tables 3.1-1, 3.2-1, or 3.4-1 for additional information.

3.4.1 Summary of Technical Information in the Application

In LRA Section 3.4, the applicant described its AMRs for the SPCS.

The description of the systems that comprise the SPCS group can be found in Section 2.3.4 of the LRA.

The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.4-1 through 2.3.4-7.

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

The applicant's review of industry operating experience included a review of operating experience through 2002. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL.

The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with Exelon's Operating Experience Program.

3.4.2 Staff Evaluation

In Section 3.4 of the LRA, the applicant described its AMR for the SPCS. The staff reviewed Section 3.4 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the SPCS components that are determined to be within the scope of license renewal and subject to an AMR.

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

In LRA Section 3.4, the applicant provided brief descriptions of the SPCS and summarized the results of its AMR of the SPCS.

Table 3.4-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.4 that are addressed in the GALL Report.

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion Systems Evaluated in Chapter VII of the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping and fittings in main feedwater line, steam line and AFW piping (PWR only)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation (see 3.4.2.2.1 below).
Piping and fittings, valve bodies and bonnets, pump casing, tanks, tubes, tubesheets, channel head and shell (except main steam system)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.2), and One-Time Inspection (B.1.23)	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.4.2.2.2 below).
External surface of carbon steel components	Loss of material due to general corrosion	Plant specific	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)	Consistent with GALL with exceptions. GALL recommends further evaluation (see Section 3.4.2.2.4 below).
Carbon steel piping and valve bodies	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (B.1.11)	Consistent with GALL with exceptions (see Section 3.4.2.1 below).
Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water Chemistry	Water Chemistry (B.1.2)	Consistent with GALL with exceptions (see Section 3.4.2.1 below).
Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC	Bolting Integrity	Bolting Integrity (B.1.12)	Consistent with GALL with exceptions (see Section 3.4.2.1 below).
Heat exchangers and coolers/condensers serviced by open-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-Cycle Cooling Water System	Not applicable	The components identified in GALL are not within the scope of license renewal.
Heat exchangers and cooler/ condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-Cycle Cooling Water System	Not applicable	The components identified in GALL are not within the scope of license renewal.

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
External surface of aboveground condensate storage tank	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Aboveground Carbon Steel Tanks	Not applicable	The GALL specifies carbon steel, however, Dresden and Quad Cities have tanks constructed of aluminum.
External surface of buried condensate storage tank and AFW piping	Loss of material due to general, pitting, and crevice corrosion and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Not applicable	The components identified in GALL are not applicable.

The staff's review of the SPCS for the Dresden and Quad Cities LRA is contained within four sections of this SER. Section 3.4.2.1 is the staff review of components in the SPCS that the applicant indicates are consistent with GALL and do not require further evaluation. Section 3.4.2.2 is the staff review of components in the SPCS that the applicant indicates are consistent with GALL and GALL recommends further evaluation. Section 3.4.2.3 is the staff evaluation of AMPs that are specific to the SPCS systems group. Section 3.4.2.4 contains an evaluation of the adequacy of aging management for components in each system in the SPCS group and includes an evaluation of components in the SPCS that the applicant indicates are not in GALL.

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant's claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The applicant discussed this TLAA in LRA Section 4.3.3.2, “Reactor Coolant Pressure Boundary Piping and Components Designed to USAS B31.1, ASME Section III Class 2 and 3, or ASME Section VIII Class B and C.” The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER.

3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

The SRP recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of carbon steel piping and fittings, valve bodies and bonnets, pump casings, pump suction and discharge lines, tanks, tubesheets, channel heads, and shells (except for main steam system components), and for loss of material due to crevice and pitting corrosion for stainless steel tanks and heat exchanger/cooler tubes to verify the effectiveness of the Water Chemistry Program. The SRP states that an acceptable verification program consistent of a one-time inspection of select components and susceptible locations in the system. The GALL Water Chemistry Program relies on monitoring and control of water chemistry, based on the guidelines in BWRVIP-29 (EPRI TR-103515) for water chemistry in BWRs, to manage the effect of loss of material due to general, pitting, or crevice corrosion. However, corrosion may occur at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the Chemistry Control Program be verified to ensure that corrosion is not occurring.

The staff reviewed the applicant’s proposed program to ensure that corrosion is not occurring and that the component intended function will be maintained during the period of extended operation. If the applicant proposed a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the staff verified that the applicant’s selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards.

Section 3.4.1.1.2 of the LRA states that an inspection of selected components exposed to a stagnant flow water environment will be conducted in accordance with the One-Time Inspection Program (B.1.23) to verify that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. The LRA states that examinations will be conducted on carbon and stainless steel components in an area where typically stagnant flow is present but occasionally there is flow, which will cause replenishment of the oxygen supply. Specifically, inspections will be conducted on the HPCI torus suction check valves, the HPCI booster pumps, and the CRD scram valves. The carbon steel HPCI torus suction check valves are exposed to torus water and will undergo a visual exam followed by an ultrasonic exam if significant corrosion is observed, while the carbon steel HPCI booster pumps and the stainless steel CRD scram valves are exposed to condensate storage tank water and will undergo a visual examination. The applicant concluded that these components provide representative samples of the aging effects seen in SPCS.

The staff concurs with the applicant’s approach of using the One-Time Inspection Program to sample similar materials and environments to provide representative samples for the SPCS components. The staff's review of the One-Time Inspection Program is in Section 3.0.3.10 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general, pitting, and crevice corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

3.4.2.2.3 Loss of Material Due to General Corrosion

The GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion for external surfaces of all carbon steel structures and components, including closure bolting, exposed to operating temperatures less than 212 °F. Such corrosion may be due to air, moisture, or humidity. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

Section 3.4.1.1.3 of the LRA states that aging management of the external surface of the main steam, feedwater, condensate, and condensate storage system components in a sheltered environment with moist, warm air will be managed either by the Structures Monitoring Program (B.1.30) or by system engineer walkdowns performed by the Bolting Integrity Program (B.1.12) aging management activities. The staff's review of these programs is in Section 3.0.3.14 and 3.0.3.5 of this SER, respectively.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general corrosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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 Aging Management Program for the Steam and Power Conversion System Components

The applicant credits nine AMPs to manage the aging effects associated with components in the SPCS group. Of the nine, all but one of the AMPs are credited with managing aging for components in other system groups (common AMPs). The staff's evaluation of the common AMPs is provided in Section 3.0.3 of this SER. The common AMPs credited with managing aging for SPCS components are listed below along with the corresponding SER section numbers.

- ASME Section XI Inservice Inspection Program, Subsection IWB, IWC, & IWD (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)

- Compressed Air Monitoring Program (Section 3.0.3.8)
- One-Time Inspection Program (Section 3.0.3.10)
- Structures Monitoring Program (Section 3.0.3.14)

The staff's evaluation of the SPCS-specific AMP is provided below.

3.4.2.3.1 Generator Stator Water Chemistry Activities (B.2.7)

Summary of Technical Information in the Application. The description of the Generator Stator Water Chemistry Activity AMP can be found in Appendix B, Section B.2.7, "Generator Stator Water Chemistry Activities (Quad Cities Only)," of the LRA. The program is designed to prevent aging by maintaining a high purity level of the stator water cooling, in accordance with General Electric guidelines for stator water cooling water systems. The applicant stated that continuous conductivity monitoring and resin-bed filtration are used to maintain the water quality. The applicant further stated that no age-related degradation of the stator water cooling system components within the scope of license renewal has been observed.

The applicant concluded that the Generator Stator Water Cooling Water Chemistry Activities program provides reasonable assurance that the intended functions of the Quad Cities stator water cooling system components will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation. In LRA Section AMP, B.2.7, "Generator Stator Water Chemistry Activities (Quad Cities Only)," the applicant described its program for managing the loss of material aging effects to piping and associated components in the main steam and main generator and auxiliaries systems within the scope of license renewal. This program is not based on a GALL program; therefore, the staff reviewed the program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on management of aging effects through incorporation of the following 10 elements from RLSB-1: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.0.4 of this SER, and the evaluation of the remaining seven elements is provided below. The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] Section B.2.7 of the LRA states that this program is used to manage loss of material and cracking of stainless steel components in the stator water cooling system, which is only in scope at Quad Cities. The staff's review indicates that this is consistent with the components that credit this AMP in the AMR tables; therefore, the staff finds this acceptable.

[Preventative or Mitigative Actions] The LRA describes the Generator Stator Water Chemistry Activities program as a mitigative program. This program relies on maintaining water chemistry parameters in accordance with General Electric guidelines for preventing the identified aging effects. The LRA states that the program mitigates loss of material through chemistry control. The LRA also states that SCC is prevented because the water impurity levels are low and because the system operating temperature is less than 140^{o}F. The staff agrees that maintaining the stator water chemistry within the General Electric guidelines will effectively mitigate the identified aging effects: therefore, the staff finds this acceptable.

[Parameters Monitored or Inspected] LRA Section B.2.7 states that the stator water cooling system water is continuously monitored for purity by a conductivity cell, and that water chemistry data is periodically logged. The staff finds these to be appropriate parameters to monitor for managing the water chemistry; therefore, the staff finds this acceptable.

[Detection of Aging Effects] LRA Section B.2.7 states that the Generator Stator Water Chemistry Activities program is a preventative program and does not include actions to detect aging effects (other than corrective actions if parameters are outside the required band). Since the program is designed to prevent aging, and since the water is maintained at high purity levels in accordance with the General Electric guidelines, the staff finds this acceptable.

[Monitoring and Trending] As stated above, the water conductivity is continuously monitored via an on-line conductivity monitor. In addition, chemistry data is periodically logged. The staff finds this monitoring and trending to be appropriate for maintaining the water chemistry within the required parameters; therefore, the staff finds this acceptable.

[Acceptance Criteria] Section B.2.7 of the LRA states that the water chemistry acceptance criteria are in accordance with the General Electric guidelines. In its October 3, 2003, response to RAI 3.0-1 related to the definitions of the environments used in the LRA, the applicant provided additional information related to the conductivity, dissolved oxygen, silica, and copper levels for this system. Since the water chemistry is maintained in accordance with the General Electric guidelines, the staff finds this acceptable.

[Operating Experience] Section B.2.7 of the LRA states that no age-related degradation of stator water systems components within the scope of license renewal has been observed. In addition, in a conference call on November 26, 2003, the applicant stated that the plant operating experience is consistent with industry operating experience (nuclear and non-nuclear applications) with General Electric generators stator water cooling systems. The applicant concludes that the current water chemistry activities have proven effective. The staff finds that the operating experience supports the conclusion that the Generator Stator Water Chemistry Activities program is effective at preventing aging of the stator water cooling system components; therefore, the staff finds this acceptable.

<u>Conclusion</u>. On the basis of its review of the applicant's program, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.4.2.4 Aging Management Review of the Steam and Power Conversion Systems

The staff reviewed the components listed in LRA Tables 2.3.4-1 through 2.3.4-7 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below. The staff also reviewed the UFSAR Supplements for the AMPs credited with managing aging in the SPCS components to determine whether the program description adequately described the program.

The following sections provide the results of the staff's evaluation of the adequacy of aging management for components in each SPCS.

3.4.2.4.1 Main Steam System

Summary of Technical Information in the Application. The description of the main steam system can be found in Section 2.3.4.1 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-1, 3.1-1, 3.2-1, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-1 in the LRA lists the components for the main steam system as closure bolting, dampeners, filters/strainers, flow elements, NSR vents or drains, piping and valves, thermowells, tubing, valves, piping and fittings, restricting orifices, accumulators, flexible hoses, rupture discs, and vacuum breakers.

The LRA identified the following applicable aging effects for the main steam system:

Low-alloy steel exposed to air with metal temperature up to 288 °C (550 °F) is subject to cumulative fatigue damage due to fatigue. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to general corrosion. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as experiencing crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air, moisture, humidity and leaking fluid is subject to loss of material due to corrosion. Carbon steel exposed to moist containment atmosphere (air/nitrogen), steam, or demineralized water experiences loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to 288 °C (550 °F) steam is subject to cumulative fatigue damage due to fatigue. Carbon steel exposed to moist containment air, steam, or 288 °C (550 °F) steam is identified as subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to steam or 288 °C (550 °F) steam experiences wall thinning due to accelerated corrosion. Carbon steel exposed to 288 °C (550 °F) reactor coolant water is subject to crack initiation and growth due to stress-corrosion cracking, intergranular stress-corrosion cracking, thermal, and mechanical stress. Carbon steel exposed to containment nitrogen or air, moisture, and humidity where the surface is >100 °C (212 °F) experiences no aging effects.

Stainless steel exposed to moist containment atmosphere (air/nitrogen), steam, or demineralized water experiences loss of material due to general, pitting, and crevice corrosion. Stainless steel exposed to 288 °C (550 °F) reactor coolant water or steam is identified as experiencing crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to saturated air or warm moist air is subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to corrosion. Stainless steel external surfaces exposed to air, moisture, and humidity <100 °C (212 °F), or air, moisture, and humidity where the surface temperature is >100 °C (212 °F), and containment nitrogen experience no aging effects.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are subjected to loss of material due to corrosion.

Elastomers, neoprene, and similar material exposed to saturated air or containment nitrogen experiences hardening and loss of strength due to elastomer degradation.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the main steam system:

- ASME Section XI Inservice Inspection Program, Subsection IWB, IWC, & IWD (B.1.1)
- Water Chemistry Program (B.1.2)
- BWR Stress-Corrosion Cracking Program (B.1.7)
- Flow-Accelerated Corrosion Program (B.1.11)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)
- Compressed Air Monitoring Program (B.1.16)
- Structures Monitoring Program (B.1.30)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the main steam system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.4.1 and Tables 2.3.4-1, 3.1-1, 3.2-1, 3.4-1, and 3.4-2 of the LRA. During its review, the staff determined that additional information was needed to complete its review.

By letter dated August 4, 2003, the staff requested additional information, per RAI 3.4.1-1, to resolve a discrepancy in Table 3.4-2, AMR Reference 3.4.2.51. In this reference, the discussion column addresses crevice and pitting corrosion in a treated water environment, while the aging effect/mechanism addresses crack initiation and growth/stress-corrosion cracking and intergranular stress-corrosion cracking in a 288 °C steam environment. The staff asked the applicant to verify that the aging effect is loss of material or to include the BWR Stress-Corrosion Cracking Program. In its response dated October 3, 2003, the applicant stated that the discussion in Table 3.4-2, Reference 3.4.2.51, should have read "NUREG-1801 does not address stress-corrosion cracking of stainless steel in a steam environment," indicating that the reference is to cracking, not loss of material. Further, the applicant stated that GALL Program XI.M7, "BWR Stress Corrosion Cracking," is not being used because it is applicable to stainless steel piping components that are part of the reactor coolant pressure boundary exposed to reactor coolant at or above temperature of 93 °C. The components associated with Reference

3.4.2.51 are main steam system valves with an environment of 288 °C steam. Therefore, the applicant stated that the appropriate AMP is the Water Chemistry Program (B.1.2), which mitigates the effects of cracking in stainless steel by reducing the presence of impurities such as sulfates and chlorides. The staff finds that the applicant has resolved the typographical error. In addition, the staff agrees that GALL Program XI.M7 is not applicable to the components or environment addressed by this reference, since historically intergranular stress-corrosion cracking of stainless steel in a steam environment has not been problematic, as indicated by systems referenced in the GALL for which intergranular stress-corrosion cracking has been identified. Further, the staff agrees that the Water Chemistry Program is appropriate for managing the aging effect for these components; therefore, the staff finds this acceptable.

By letter dated August 4, 2003, the staff requested additional information, per RAI 3.4.1-2, to clarify the information related to AMR Reference 3.2.1.3. The discussion column refers to Section 3.2.1.1.3 of the LRA; however, Section 3.2.1.1.3 does not address the main steam system. By letter dated October 3, 2003, the applicant stated that the difference results from the use of GALL terminology. In GALL, the safety relief discharge piping is classified as part of the automatic depressurization system, which is scoped in the ECCS group. However, at Dresden and Quad Cities, the safety relief discharge piping is classified as part of the main steam system. The staff finds the applicant's clarification to be acceptable. The staff notes that this clarification is also applicable to the applicant's use of AMR Reference 3.2.1.5, which also addresses the safety relief discharge piping. The GALL recommends further evaluation for these AMR references. The staff's evaluation of these AMR references is in Sections 3.2.2.2.2 and 3.2.2.2.3 of this SER.

For flexible hoses in the main steam system, the LRA uses Ref. No. 3.4.2.18, which addresses elastomers of neoprene and similar materials in a containment nitrogen environment, and identifies no aging effects. Environmental conditions such as temperature and radiation can affect the aging of neoprene and similar materials. Therefore, in RAI 3.2.4.1-3, the staff asked the applicant clarify the environment with respect to temperature, radiation levels, and time when the containment is not or has not been inerted, to justify that the neoprene hoses do not require aging management. In its response dated October 3, 2003, the applicant stated that the flexible hoses in question are in the main steam system attached to the air accumulators for the MSIVs, and the LRA should have shown the aging effect/aging mechanism as hardening and loss of strength due to elastomer degradation, and the aging management program credited should have been B.1.23, "One-Time Inspection." The staff asked for further information on the environmental conditions, including temperature and radiation levels, to justify the use of a one-time inspection. In its response dated January 26, 2004, the applicant stated that they believe the hoses are constructed of stainless steel with an overall stainless steel outer braided jacket. In the one-time inspection, the applicant will verify that the hoses are stainless steel and inspect for mechanical damage. If the hoses are found to be elastomer, they will be replaced with stainless steel hoses. The applicant further clarified that the internal environment is saturated air up to 135 °F, the outside environment is containment nitrogen up to 135 °F with up to 90 percent relative humidity, and the 60-year radiation dose is 1.65E07 Rads. The staff finds that a one-time inspection of stainless steel flexible hoses in the above environment is acceptable, since no significant degradation is expected to occur. The staff also finds that replacement of the elastomer hoses with stainless steel hoses alleviates the concern on elastomer degradation; therefore, the staff finds this acceptable. This is part of Confirmatory Item B.1.23-1.

The aging effects identified in the LRA for the main steam system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the main steam system:

- ASME Section XI Inservice Inspection Program, Subsection IWB, IWC, & IWD (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-time Inspection Program (Section 3.0.3.10)
- Compressed Air Monitoring Program (Section 3.0.3.8)
- Structures Monitoring Program (Section 3.0.3.14)

After evaluating the applicant's AMR for each of the components in the main steam system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Tables 3.1-1, 3.2-1, and 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

For the component "NSR vents or drains, piping and valves" addressed by AMR Reference 3.4.2.30, the applicant has identified that the material-environment includes carbon steel exposed to air, moisture, humidity, and leaking fluid. In its response to RAI B.1.23-2(b), the applicant implies that the loss of material due to corrosion is expected to be sufficiently slow that a one-time inspection can be used for aging management. The applicant has not provided sufficient information to justify the use of a one-time inspection. This is part of Open Item B.1.23-2.

On the basis of its review, with exception of Open Item B.1.23-2, the staff finds that the AMPs credited in the LRA for the main steam system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, pending satisfactory resolution of Open Item B.1.23-2, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.2 Feedwater System

Summary of Technical Information in the Application. The description of the feedwater system can be found in Section 2.3.4.2 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-2, 3.1-1, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-2 in the LRA lists the following components for the feedwater system—closure bolting, NSR vents or drains, piping and fittings, and valves.

The LRA identified the following applicable aging effects for the feedwater system:

High-strength, low-alloy steel exposed to air with metal temperature up to 288 °C (550 °F) experiences cumulative fatigue damage. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is subject to loss of material due to general corrosion. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is identified as experiencing crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to air, moisture, humidity, and leaking fluid is identified as subject to loss of material due to corrosion. Carbon steel exposed to 288 °C (550 °F) reactor coolant water is subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Carbon steel exposed to 288 °C (550 °F) reactor coolant water or up to 225 °C (437 °F) reactor coolant water, or treated water experiences cumulative fatigue damage due to fatigue. Carbon steel exposed to treated water is subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to 288 °C (550 °F) reactor coolant water or up to 225 °C (437 °F) reactor coolant water, or treated water experiences wall thinning due to accelerated corrosion. Carbon steel exposed to air, moisture, and humidity where surface temperature is >100 °C (212 °F), and containment nitrogen experiences no aging effects.

Stainless steel exposed to 288 °C (550 °F) reactor coolant water is identified as subject to crack initiation and growth due to stress-corrosion cracking and intergranular stress-corrosion cracking. Stainless steel exposed to 288 °C (550 °F) reactor coolant water is subject to cumulative fatigue damage due to fatigue. Stainless steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to corrosion. Stainless steel exposed to treated water is identified as subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, and humidity <100 °C (212 °F); air, moisture and humidity where surface temperature is >100 °C (212 °F); and containment nitrogen experiences no aging effects.

Cast austenitic stainless steel exposed to 288 °C (550 °F) reactor coolant water is subject to cumulative fatigue damage due to fatigue.

Brass and bronze exposed to air, moisture, humidity, and leaking fluid are subject to loss of material due to corrosion.

Aging Management Programs

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

- ASME Section XI Inservice Inspection Program, Subsection IWB, IWC, & IWD (B.1.1)

- Water Chemistry Program (B.1.2)
- BWR Stress-Corrosion Cracking Program (B.1.7)
- Flow-Accelerated Corrosion Program (B.1.11)
- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the feedwater system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified in the LRA for the feedwater system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

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

- ASME Section XI Inservice Inspection Program, Subsection IWB, IWC, & IWD (Section 3.0.3.1)
- Water Chemistry Program (Section 3.0.3.2)
- BWR Stress-Corrosion Cracking Program (Section 3.0.3.3)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)

After evaluating the applicant's AMR for each of the components in the feedwater system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Tables 3.1-1 and 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the feedwater system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.3 Condensate and Condensate Storage Systems

Summary of Technical Information in the Application. The description of the condensate and condensate storage systems can be found in Section 2.3.4.3 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-1, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-3 in the LRA lists the following components for the condensate and condensate storage systems—closure bolting, piping and fittings, tanks, thermowells, tubing, and valves.

The LRA identified the following applicable aging effects for the condensate and condensate storage system.

Low-alloy steel exposed to containment nitrogen experiences crack initiation and growth from cyclic loading. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is subject to loss of material due to general corrosion. High-strength, low-alloy steel exposed to outdoor ambient conditions is identified as experiencing loss of material due to general corrosion and wear.

Carbon steel exposed to treated water is subject to loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to treated water is subject to loss of material due to general and pitting corrosion. Carbon steel exposed to treated water is identified as subject to wall thinning due to accelerated corrosion. Carbon steel exposed to outdoor ambient conditions experiences loss of material due to general, pitting, and crevice corrosion. Carbon steel exposed to soil and ground water is subject to loss of material due to general, pitting, crevice, and microbiologically influenced corrosion.

Stainless steel exposed to treated water is subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to outdoor ambient conditions, or soil or ground water, experiences loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, and humidity <100 °C (212 °F) experiences no aging effects.

Aluminum exposed to <90 °C (194 °F) treated water experiences loss of material due to pitting and crevice corrosion. Aluminum exposed to outdoor ambient conditions, or soil or ground water, experiences loss of material due to pitting. Aluminum exposed to outdoor ambient conditions experiences cracking due to stress-corrosion cracking. Aluminum exposed to air, moisture, and humidity <100 °C (212 °F) experiences no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the condensate and condensate storage systems:

- Water Chemistry Program (Section 3.0.3.2)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects, and the AMPs credited for managing the aging effects, in the condensate and condensate storage systems. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The staff reviewed the information in Section 2.3.4.3 and Tables 2.3.4-3, 3.4-1, and 3.4-2 of the LRA. During its review, the staff determined that additional information was needed to complete its review.

In RAI 3.4.3-1, issued on August 4, 2003, the staff asked why the high-strength, low-alloy steel closure bolting in outdoor ambient conditions, covered by AMR Reference 3.4.2.2, are only subject to loss of material due to general corrosion and wear. The GALL report, Chapter VIII H.2-a&b, lists carbon steel low-alloy steel closure bolting in air, moisture, humidity, and leaking fluid environments as being subject to loss of material due to general corrosion and crack initiation, and growth due to cyclic loading and/or stress-corrosion cracking. This GALL reference is used for other closure bolting in SPCS, as identified by Reference 3.4.1.6. By letter dated October 3, 2003, the applicant responded that GALL Chapter VIII, H.2-b, refers to closure bolting in high-pressure or high-temperature systems. For bolting in the high-pressure or high-temperature portions of SPCS, the applicable aging effects are listed in Reference 3.4.1.6. The applicant stated that the bolts associated with LRA Reference 3.4.2.2 are on the piping to the condensate storage tanks, which is low-pressure and low-temperature piping not subject to cyclic loading. The applicant further stated that the bolts used are ASTM A193, Grade B7 with a tensile strength of 125 ksi. EPRI 1003056, "Non-Class 1 Mechanical Guideline and Mechanical Tools," Appendix F, "Closure Bolting," states that stress-corrosion cracking is not an applicable aging effect for bolting material with a tensile strength of less than 150 ksi. The applicant concluded that for bolting in the low-pressure, low-temperature portion of the condensate and condensate storage system, loss of material due to general corrosion or wear is the only applicable aging effect. The staff concurs that, based on the applicant's clarification of the location, operating environment, and bolting materials, the bolting in question would not be subject to crack initiation and growth due to cyclic loading and/or stress-corrosion cracking. The staff concludes that the applicant has identified the appropriate aging effects for this bolting; therefore, the staff finds this acceptable.

The aging effects identified in the LRA for the condensate and condensate storage systems are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the condensate and condensate storage systems:

- Water Chemistry Program (Section 3.0.3.2)
- Flow-Accelerated Corrosion Program (Section 3.0.3.4)
- Bolting Integrity Program (Section 3.0.3.5)

- One-Time Inspection Program (Section 3.0.3.10)

After evaluating the applicant's AMR for each of the components in the condensate and condensate storage systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for these systems. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the condensate and condensate storage systems will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.4 Main Condenser

Summary of Technical Information in the Application. The description of the main condenser can be found in Section 2.3.4.4 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-4 and 3.4-2.

Aging Effects

Table 2.3.4-4 in the LRA lists the following components for the main condenser—main condenser hotwells, false floors, main condenser tubes, tubesheets, main condenser waterboxes, and hatches.

The LRA identified the following applicable aging effects for the main condenser:

Carbon steel and stainless steel exposed to steam or open-cycle cooling water (raw water side) experience no aging effects. Carbon steel exposed to air, moisture, and humidity <100 °C (212 °F) also experiences no aging effects.

Aging Management Programs

The LRA did not credit any AMPs for the main condenser system because the applicant did not identify any aging effects requiring management.

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the main condenser.

Aging Effects

The staff reviewed the information in Section 2.3.4.4 and Tables 2.3.4-4 and 3.4-2 of the LRA.

During its review, the staff determined that additional information was needed to complete its review.

In RAI 3.4.4-3, sent by letter dated August 4, 2003, the staff asked the applicant to explain the conclusion that the components in the main condenser do not require aging management. The material-environment combinations include carbon steel in steam, carbon steel in raw water, stainless steel in raw water, and carbon steel in air, moisture, and humidity <100 °C. All of these material-environment combinations are subject to aging degradation; however, the applicant determined that no aging management was required. The staff asked the applicant to provide justification. In its response dated October 3, 2003, the applicant stated that the license renewal intended function of the main condenser is to provide post accident containment, holdup, and plate-out of iodine for MSIV bypass leakage. This intended function is dependent on the condenser's surface area, volume, and leakage integrity, and that aging degradation would only impact the leakage integrity. The applicant argued that leakage integrity sufficient to perform the post accident intended function is continuously confirmed by normal plant operation because the main condenser must perform a significant pressure boundary function (maintain vacuum) in support of normal plant operation. Therefore, the applicant concluded that there are no creditable aging effects that would affect the intended function of the main condenser, and no AMP is required. The staff has reviewed the applicant's response and concurs that the condenser's intended function is continually verified during normal plant operation. Therefore, the staff finds that there are no aging effects that require management for the main condenser.

By letter dated August 4, 2003, the staff requested two clarifications of apparent inconsistencies between the component groups listed in LRA Table 2.4.4-4 and Table 3.4-2. The applicant clarified the component groups that were included in the AMR references. Since all main condenser components are associated with appropriate AMR references, the staff finds the clarifications to be acceptable.

The aging effects identified in the LRA for the main condenser are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant did not identify any AMPs for the main condenser. The staff finds this acceptable because there are no aging effects that require management for the main condenser.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.5 Main Turbine and Auxiliary Systems

Summary of Technical Information in the Application. The description of the main turbine and auxiliary systems can be found in Section 2.3.4.5 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-5, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-5 in the LRA lists the following components for the main turbine and auxiliary systems—closure bolting, piping and fittings, tubing, valves, and accumulators.

The LRA identified the following applicable aging effects for the main turbine and auxiliary systems:

Low-alloy steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to general corrosion. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is subject to crack initiation and growth due to cyclic loading stress-corrosion cracking.

Stainless steel exposed to turbine EHC fluid is identified as subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed air, moisture, and humidity <100 °C (212 °F) experiences no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the main turbine and auxiliary systems:

- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the main turbine and auxiliary systems. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified in the LRA for the main turbine and auxiliary systems are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the main turbine and auxiliary systems:

- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Lubricating Oil Monitoring Activities (Section 3.0.3.16)

After evaluating the applicant's AMR for each of the components in the main turbine and auxiliary systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for these systems. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

In RAI B.1.23-2, the staff questioned the use of a one-time inspection as the only aging management activity for components exposed to an environment of EHC oil. The staff's concern was that proper maintenance of oil chemistry is critical to preventing any aging effects in this environment. In its response dated January 26, 2004, the applicant stated that monitoring of the EHC oil, which is already performed at the stations, will be credited under AMP B.2.5, "Lubricating Oil Monitoring Activities." The staff finds that monitoring and controlling the EHC oil quality will prevent significant aging of the system components in this environment; therefore, the staff finds the use of a one-time inspection as a verification to be acceptable. The staff's review of the Lubricating Oil Monitoring Activities program and the One-Time Inspection program are addressed in SER Sections 3.0.3.16 and 3.0.3.10, respectively. This is part of Confirmatory Item B.1.23-1.

On the basis of its review, pending satisfactory resolution of Open Item B.1.23-2, the staff finds that the AMPs credited in the LRA for the main turbine and auxiliary systems will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, pending satisfactory resolution of Open Item B.1.23-2, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.6 Turbine Oil System (Quad Cities Only)

Summary of Technical Information in the Application. The description of the turbine oil system can be found in Section 2.3.4.6 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-6, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-6 in the LRA lists the following components for the turbine oil system—closure bolting, filters/strainers, piping and fittings, valves, pump casing, and tanks.

The LRA identified the following applicable aging effects for the turbine oil system:

Low-alloy steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to general corrosion. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is subject to crack initiation and growth due to cyclic loading stress-corrosion cracking.

Carbon steel exposed to generator hydrogen seal oil is identified as subject to loss of material due to pitting and crevice corrosion.

Cast iron exposed to generator hydrogen seal oil and air, moisture, and humidity <100 °C (212 °F) experiences loss of material due to pitting and crevice corrosion.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the turbine oil system:

- Bolting Integrity Program (B.1.12)
- One-Time Inspection Program (B.1.23)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the turbine oil system. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified in the LRA for the turbine oil system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the turbine oil system:

- Bolting Integrity Program (Section 3.0.3.5)
- One-Time Inspection Program (Section 3.0.3.10)
- Lubrication Oil Monitoring Activities (Section 3.0.3.16)

After evaluating the applicant's AMR for each of the components in the turbine oil system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

In RAI B.1.23-2, the staff questioned the use of a one-time inspection as the only aging management activity for components exposed to an environment of generator hydrogen seal oil. The staff's concern was that proper maintenance of oil chemistry is critical to preventing any aging effects in this environment. In its response dated January 26, 2004, the applicant stated that monitoring of the generator hydrogen seal oil, which is already performed at the stations, will be credited under AMP B.2.5, "Lubricating Oil Monitoring Activities." The staff finds that monitoring and controlling the generator hydrogen seal oil quality will prevent significant aging of the system components in this environment; therefore, the staff finds the use of a one-time inspection as a verification to be acceptable. The staff's review of the Lubricating Oil Monitoring Activities program and the One-Time Inspection program are addressed in SER Sections 3.0.3.16 and 3.0.3.10, respectively. This is part of Confirmatory Item B.1.23-1.

On the basis of its review, with exception of Open Item B.1.23-2, the staff finds that the AMPs credited in the LRA for the turbine oil system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, pending satisfactory resolution of Open Item B.1.23-2, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.7 Main Generator and Auxiliaries (Quad Cities Only)

Summary of Technical Information in the Application. The description of the main generator and auxiliaries can be found in Section 2.3.4.7 of this SER. The components, aging effects, and AMPs are provided in LRA Tables 2.3.4-7, 3.4-1, and 3.4-2.

Aging Effects

Table 2.3.4-7 in the LRA lists the following components for the main generator and auxiliaries—closure bolting, piping and fittings, pumps, valves, heat exchangers, housings, and tanks.

The LRA identified the following applicable aging effects for the main generator and auxiliaries:

Low-alloy steel exposed to air, moisture, humidity, and leaking fluid experiences loss of material due to general corrosion. Low-alloy steel exposed to air, moisture, humidity, and leaking fluid is subject to crack initiation and growth due to cyclic loading stress-corrosion cracking.

Stainless steel exposed demineralized water or stator liquid cooling is identified as subject to loss of material due to pitting and crevice corrosion. Stainless steel exposed to air, moisture, and humidity <100 °C (212 °F) experiences no aging effects.

Aging Management Programs

The LRA credited the following AMPs with managing the identified aging effects for the main generator and auxiliaries:

- Bolting Integrity Program (B.1.12)
- Main Generator Stator Cooling Water Chemistry Program (B.2.7)

Staff Evaluation. This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in the main generator and auxiliaries. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects

The aging effects identified in the LRA for the main generator and auxiliaries are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs to manage the aging effects described above for the main generator and auxiliaries:

- Bolting Integrity Program (Section 3.0.3.5)
- Main Generator Stator Cooling Water Chemistry Program (Section 3.4.2.3.1)

After evaluating the applicant's AMR for each of the components in the main generator and auxiliaries, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.4-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report or that the AMPs credited are appropriate for the identified aging effects. For the components identified in LRA Table 3.4-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ... will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5 Containment, Structures, and Component Supports

This section addresses the aging management of the structures and structural components. The structures that make up this group are described in the following SER sections:

- primary containment—(Section 2.4.1)
- reactor building—(Section 2.4.2)
- main control room and auxiliary electric equipment room—(Section 2.4.3)
- turbine building—(Section 2.4.4)
- diesel generator building—(Section 2.4.5)
- station blackout building and yard structures—(Section 2.4.6)
- isolation condenser pump house (Dresden only)—(Section 2.4.7)
- makeup demineralizer building (Dresden only)—(Section 2.4.8)
- radwaste floor drain surge tank—(Section 2.4.9)
- miscellaneous foundations—(Section 2.4.10)
- crib house—(Section 2.4.11)
- Unit 1 crib house (Dresden only)—(Section 2.4.12)
- station chimney—(Section 2.4.13)
- crane and hoists—(Section 2.4.14)
- component supports commodity group—(Section 2.4.15)
- insulation commodity group—(Section 2.4.16)

As discussed in Section 3.0.1 of this SER, the structures and structural components subject to an AMR are included in one of two LRA tables. Table 3.5-1 of the LRA consists of structures and structural components that are evaluated in the GALL Report. The "Discussion" column of this table references LRA Section 3.5.1.1 for further evaluations of aging management, as recommended by GALL, and also references LRA Section 3.5.1.2 for aging management programs or evaluations that are different from GALL. Table 3.5-2 of the LRA consists of structures and structural components that are not evaluated in the GALL Report.

3.5.1 Summary of Technical Information in the Application

The applicant presents the results of its AMRs for the containment, structures, and component supports in LRA Section 3.5. The applicant's description of the containment, structures, and component supports can be found in LRA Section 2.4. The passive, long-lived components in these structures that are subject to an AMR are identified in LRA Tables 2.4-1 through 2.4-16. The "Aging Management Ref" column in these tables identifies the corresponding row of LRA Table 3.5-1 or Table 3.5-2 that contains the applicable AMR results.

3.5.2 Staff Evaluation

In LRA Section 3.5, the applicant summarized the results of its AMR for structures and structural components. The staff reviewed LRA Section 3.5 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for structures and structural components that are determined to be within the scope of license renewal and subject to an AMR.

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

In LRA Section 3.0, under the heading "Operating Experience," the applicant stated the following:

> A review of plant-specific operating experience was conducted to identify aging effects requiring management. Industry-wide operating experience since the preparation of NUREG-1801 was also reviewed to identify aging effects requiring management. These reviews concluded that the aging effects identified by plant-specific and industry-wide operating experience were consistent with those identified in NUREG-1801. Ongoing review of plant-specific and industry operating experience is performed in accordance with corrective action programs and operating experience programs.

The applicant has not identified the source material utilized in the plant-specific operating experience review or in the industry-wide operating experience review. The applicant was requested in RAI 3.5-2 to submit details of its operating experience review, including the time frame covered by the review, the information sources used, and any key findings that led to exclusion of aging effects identified in NUREG-1801.

In its response to RAI 3.5-2, the applicant stated the following:

> The operating experience reviews included a search of the Dresden and Quad Cities Corrective Action databases, which contain Condition Reports (CR) and the predecessor program Problem Identification Forms (PIF) (from 1993 to present), the work control database which contains maintenance work orders and modifications (from 1984 to present), and a search of the NRC website for regulatory correspondence, such as Generic Letters, Information Bulletins, and Information Notices (from April 2001, the date NUREG-1801 was issued, to the present). Additionally, the EPRI Electrical, Mechanical, and Structural Tools were used to identify relevant industry operating experience.
>
> The Dresden and Quad Cities License Renewal Application (LRA) identifies the exceptions to aging effects identified by NUREG-1801 in the Chapter 3 Tables under the Discussion column. These tables provide the basis for excluding the aging effect or a reference to further discussion of why the aging effect is not applicable.

The staff finds the applicant's response to be acceptable and considers RAI 3.5-2 resolved. Tables 3.5-1, 3.5-2, 3.5-3, and 3.5-4 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Table 3.5-1 for the components addressed in the GALL Report.

Table 3.5-1. Staff Evaluation for Structures and Structural Components in NUREG-1801 (GALL): Common Components of All Types of PWR and BWR Containment

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Penetration sleeves, penetration bellows, and dissimilar metal welds (LRA Ref No 3.5.1.1)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Further evaluation of cumulative fatigue damage is provided in LRA Section 3.5.1.1.4 and LRA Section 4.6. (See SER Section 3.5.2.2.1.)
Penetration sleeves, bellows, and dissimilar metal welds (LRA Ref No 3.5.1.2)	Cracking due to cyclic loading, or crack initiation and growth due to SCC	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Containment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Sections 3.5.2.3.1.
Penetration sleeves, penetration bellows, and dissimilar metal welds (LRA Ref No 3.5.1.3)	Loss of material due to corrosion	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Contain-ment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Section 3.5.2.3.1.
Personnel airlock and equipment hatch (LRA Ref No 3.5.1.4)	Loss of material due to corrosion	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Contain-ment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Section 3.5.2.3.1.

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Personnel airlock and equipment hatch (LRA Ref No 3.5.1.5)	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanism	Containment Leak Rate Test and plant technical specifications	Containment Leak Rate Test (B.1.28) and plant technical specifi-cations	Consistent with NUREG-1801. (See SER Section 3.5.2.1.)
Seals, gaskets, and moisture barriers (LRA Ref No 3.5.1.6)	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Contain-ment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Section 3.5.2.3.1

Table 3.5-2: PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Concrete elements: foundation, walls, dome (LRA Ref No 3.5.1.7)	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and corrosion of embedded steel	Containment ISI	Not applicable	Not applicable for a Mark I steel containment
Concrete elements: foundation (LRA Ref No 3.5.1.8)	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	Not applicable	Not applicable for a Mark I steel containment
Concrete elements: foundation (LRA Ref No 3.5.1.9)	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Not applicable	Not applicable for a Mark I steel containment
Concrete elements: foundation, dome, and wall (LRA Ref No 3.5.1.10)	Reduction of strength and modulus due to elevated temperature	Plant specific	Not applicable	Not applicable for a Mark I steel containment
Prestressed containment: tendons and anchorage components (LRA Ref No 3.5.1.11)	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21(c)	Not applicable	Not applicable for a Mark I steel containment

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Steel elements: liner plate, containment shell (LRA Ref No 3.5.1.12)	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Containment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Sections 3.5.2.4.1, 3.5.2.3.1, and 3.5.2.2.1
Steel elements: vent header, drywell head, torus, downcomers, pool shell (LRA Ref No 3.5.1.13)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Further evaluation of cumulative fatigue damage is provided in SER Section 3.5.2.2.1
Steel elements: protected by coating (LRA Ref No 3.5.1.14)	Loss of material due to corrosion in accessible areas only	Protective Coating Monitoring and Maintenance	Protective Coating Monitoring and Maintenance (B.1.32)	Consistent with NUREG-1801, with exceptions evaluated in SER Section 3.5.2.4.1
Prestressed containment: tendons and anchorage components (LRA Ref No 3.5.1.15)	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	Not applicable	Not applicable for a Mark I steel containment
Concrete elements: foundation, dome, and wall (LRA Ref No 3.5.1.16)	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	Not applicable	Not applicable for a Mark I steel containment
Steel elements: vent line bellows, vent headers, downcomers (LRA Ref No 3.5.1.17)	Cracking due to cyclic loads or crack initiation and growth due to SCC	Containment ISI and Containment Leak Rate Test	Containment ISI (B.1.26) and Containment Leak Rate Test (B.1.28)	Consistent with NUREG-1801, with exceptions evaluated in SER Sections 3.5.2.3.1 and 3.5.2.2.1
Steel elements: suppression chamber liner (LRA Ref No 3.5.1.18)	Crack initiation and growth due to SCC	Containment ISI and Containment Leak Rate Test	Not applicable	Not applicable for a Mark I steel containment
Steel elements: drywell head and downcomer pipes (LRA Ref No 3.5.1.19)	Fretting and lockup due to wear	Containment ISI	Not applicable	Applicant states that material does not exist at Dresden or Quad Cities

Table 3.5-3: Class I Structures

Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
All groups except Group 6: accessible interior/exterior concrete and steel components (LRA Ref No 3.5.1.20)	All types of aging effects	Structures Monitoring	Structures Monitoring (B.1.30)	Consistent with NUREG-1801 with exceptions evaluated in SER Section 3.5.2.2.2
Groups 1–3, 5, 7–9: inaccessible concrete components, such as exterior walls below grade and foundation (LRA Ref No 3.5.1.21)	Aging of inaccessible concrete areas due to aggressive chemical attack and corrosion of embedded steel	Plant specific	Plant specific	Further evaluation of aging management of inaccessible areas is described in LRA Section 3.5.1.1.7. (See SER Section 3.5.2.2.2.)
Group 6: all accessible/in-accessible concrete, steel, and earthen components (LRA Ref No 3.5.1.22)	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	Inspection of Water-Control Structures (B.1.31) or FERC/US Army Corps of Engineers dam inspections and maintenance	Consistent with NUREG-1801, with exceptions evaluated in SER Sections 3.5.2.4.2 and 2.4.11
Group 5: liners (LRA Ref No 3.5.1.23)	Crack initiation and growth from SCC and loss of material due to crevice corrosion	Water Chemistry Program and Monitoring of Spent Fuel Pool Water Level	Water Chemistry Program (B.1.2) and Monitoring of Spent Fuel Pool Water Level.	Consistent with NUREG-1801. (See SER Section 3.5.2.1.)
Group 1–3, 5, 6: all masonry block walls (LRA Ref No 3.5.1.24)	Crack due to restraint, shrinkage, creep, and aggressive environment	Masonry Wall	Masonry Wall (B.1.29)	Consistent with NUREG-1801. (See SER Section 3.5.2.1.)
Group 1–3, 5, 7–9: foundation (LRA Ref No 3.5.1.25)	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	Structures Monitoring (B.1.30)	Consistent with NUREG-1801 Further evaluation is described in LRA Section 3.5.1.1.1 (See SER Section 3.5.2.2.1.)
Group 1–3, 5–9: foundation (LRA Ref No 3.5.1.26)	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Structures Monitoring (B.1.30)	Consistent with NUREG-1801 Further evaluation is described in LRA Section 3.5.1.1.1. (See SER Section 3.5.2.2.1.)
Group 1–5: concrete (LRA Ref No 3.5.1.27)	Reduction of strength and modulus due to elevated temperature	Plant specific	Plant specific.	Further evaluation is described in LRA Section 3.5.1.1.2. (See SER Section 3.5.2.2.1.)

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Groups 7, 8: liners (LRA Ref No 3.5.1.28)	Crack initiation and growth from SCC and loss of material due to crevice corrosion	Plant specific	Plant specific.	Exceptions to NUREG-1801 described in SER Section 3.5.2.4.2

Table 3.5-4: Component Supports

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
All Groups—support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc. (LRA Ref No 3.5.1.29)	Aging of component support	Structures Monitoring	Structures Monitoring (B.1.30)	Consistent with NUREG-1801. (See SER Section 3.5.2.1.)
Groups B1.1, B1.2, and B1.3—support members: anchor bolts, welds (LRA Ref No 3.5.1.30)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Further evaluation of cumulative fatigue damage is provided in SER Section 3.5.2.2.3.
All Groups—support members: anchor bolts, welds	Loss of material due to boric acid corrosion	Boric Acid Corrosion	Not applicable	Not applicable for BWR
Groups B1.1, B1.2, and B1.3—support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators (LRA Ref No 3.5.1.31)	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	ISI (B.1.27)	Consistent with NUREG-1801, with exceptions evaluated in SER Section 3.5.2.4.5
Group B1.1—high-strength low-alloy bolts (LRA Ref No 3.5.1.32)	Crack initiation and growth due to SCC	Bolting Integrity	Bolting Integrity (B.1.12).	Consistent with NUREG-1801, with exceptions evaluated in SER Sections 3.5.2.4.5 and 3.0.3

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant's claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

3.5.2.2.1 Containments

<u>Aging of Inaccessible Concrete Areas</u>. The GALL Report recommends further evaluation of programs to manage aging effects in inaccessible concrete areas of PWR and BWR containments. Possible effects due to leaching of calcium hydroxide and aggressive chemical attack are cracking, spalling, and increases in porosity and permeability. Possible effects due to corrosion of embedded steel in PWR concrete and steel containments, BWR Mark II concrete containments, and Mark III concrete and steel containments are cracking, spalling, loss of bond, and loss of material. Both Dresden and Quad Cities have BWR Mark I steel containments; therefore, aging of inaccessible concrete areas does not apply.

<u>Cracking, Distortion, and Increases in Component Stress Level due to Settlement and Reduction of Foundation Strength Due to Erosion of Porous Concrete Subfoundations, If Not Covered by Structures Monitoring Program</u>. The GALL Report recommends aging management of (1) cracking, distortion, and increases in component stress level due to settlement for PWR concrete and steel containments, BWR Mark II concrete containments, and BWR Mark III concrete and steel containments, and (2) reduction of foundation strength due to erosion of porous concrete subfoundations for all types of PWR/BWR containments. If a dewatering system is relied upon for control of settlement and erosion, then proper functioning of the dewatering system should be monitored for the period of extended operation. The GALL Report also recommends further evaluation of cracks, distortion, and increase in component stress level due to settlement for Groups 1–3, 5, and 7–9 Class I structures and reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1–3 and 5–9 Class I structures.

Both Dresden and Quad Cities have BWR Mark I steel containments. The applicant addresses aging related to settlement and erosion of porous concrete subfoundation for the reactor building (GALL Group 2 structure). For Groups 1–3, 5, and 7–9 structures, the applicant states in LRA Section 3.5.1.1.1 that cracks, distortion, and increase in component stress level due to settlement are not applicable to Dresden and Quad Cities concrete structures, and no aging management is required. The Dresden and Quad Cities licensing basis does not include a program to monitor concrete for settlement nor is a dewatering system in place. Dresden and Quad Cities structures are founded on rock or naturally compacted soil with no documented changes in groundwater conditions or a history of settlement. Dresden and Quad Cities evaluations of Information Notices 97-11 and 98-26 concluded that no porous materials were used.

In LRA Table 3.5-1, Reference No. 3.5.1.25 and 3.5.1.26, the applicant credits the Structures Monitoring Program (B.1.30) for managing aging due to settlement and erosion of porous concrete subfoundation and indicates "Consistent with NUREG-1801." This appears to be inconsistent with the further evaluations presented in LRA Section 3.5.1.1.1. The applicant was requested in RAI 3.5-3 to clarify this apparent inconsistency.

In its response to RAI 3.5-3, the applicant stated the following:

> Exelon concurs with the staff assessment of LRA Table 3.5-1, Aging Management References 3.5.1.25 and 3.5.1.26. Each reference should have stated the aging management evaluations were "Exception to NUREG-1801" as defined in section 3.0 of the LRA.

Since the applicant in its response to RAI 3.5-3 has addressed the inconsistency, the staff finds the applicant's response to be acceptable and considers RAI 3.5-3 resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of cracking, distortion, and increase in component stress level due to settlement or reduction of foundation strength due to erosion of porous concrete subfoundations, if not covered by the Structures Monitoring Program, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

<u>Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature</u>. The GALL Report recommends further evaluation of programs to manage reduction of strength and modulus of concrete structures due to elevated temperature for PWR concrete and steel containments, BWR Mark II concrete containments, and BWR Mark III concrete and steel containments. The GALL Report notes that the implementation of Subsection IWL examinations and 10 CFR 50.55a would not be able to detect the reduction of concrete strength and modulus due to elevated temperature and also notes that no mandated aging management exists for managing this aging effect. The GALL Report also recommends further evaluation of loss of strength and modulus of concrete structures due to elevated temperatures for Groups 1–5 structures.

The GALL Report recommends that a plant-specific evaluation be performed if any portion of the concrete components exceeds specified temperature limits (for example, general temperature 66 °C (150 °F) and local area temperature 93 °C (200 °F). The staff verifies that the applicant's discussion in the renewal application indicates that the affected components are not exposed to temperatures that exceed the temperature limits (operating temperature less than 66 °C (150 °F), local area temperature less than 93 °C (200 °F)). For concrete components that operate above these temperature limits, the staff reviews the applicant's proposed programs to ensure that the effects of elevated temperature will be managed during the period of extended operation.

Both Dresden and Quad Cities have Mark I steel containments; therefore, aging of concrete due to elevated temperature does not apply to the containments. For Groups 1–5 structures, the applicant states in LRA Section 3.5.1.1.2 that reduction of strength and modulus due to elevated temperature is not applicable for Dresden and Quad Cities concrete structures, and no aging management is required since Dresden and Quad Cities normal operating temperatures are less than 150 °F general and less than 200 °F local. The staff requested in RAI 3.5-4 that the applicant (1) clarify whether the local concrete temperature or the local ambient air temperature was compared to the 200 °F limit and (2) describe what provisions exist to ensure that the concrete surrounding hot piping penetrations does not exceed 200 °F.

In response to RAI 3.5-4, the applicant stated the following:

> The Dresden and Quad Cities Groups 1–5 concrete structures were installed in accordance with ACI 349-85, Code Requirements for Nuclear Safety Related Concrete Structures, Appendix A. The operating temperature limits associated with these structures are consistent with the guidance provided in NUREG 1801 (which states that temperatures shall not exceed 150 °F except for local areas which are allowed to have increased temperature not to exceed 200 °F).
>
> All hot pipe penetrations at Dresden and Quad Cities Nuclear Power Stations are designed such that the local area ambient temperature near the surrounding concrete does not exceed 200 °F. Hot pipe air gaps through wall penetrations are large enough by design to maintain the area concrete temperature below 200 °F. Dresden and Quad Cities normal operating ambient temperature limits do not exceed 150 °F. The following provisions exist to ensure that the local area temperature near concrete surrounding the hot piping penetrations do not exceed 200 °F.
>
> Penetration sleeves are designed and installed to maintain the area concrete temperature below 200 °F, based on the penetrating piping temperature.
>
> The Drywell Coolers support the Primary Containment by maintaining the Primary Containment bulk temperature within limits during normal operation (an average temperature of approximately 135 °F).

The staff finds that appropriate design provisions to ensure that concrete does not exceed prescribed American Concrete Institute code limits are identified in the applicant's response. However, the statement "The Dresden and Quad Cities Groups 1–5 concrete structures were installed in accordance with ACI 349-85, Code Requirements for Nuclear Safety Related Concrete Structures, Appendix A" appears to be incorrect, given the dates of first commercial operation for these units. Although the staff finds that the applicant has implemented the appropriate design provisions to ensure that the concrete does not exceed the ACI code limits, the applicant was requested to identify the correct code of record and the temperature limits prescribed in that code. In a letter dated December 5, 2003, the applicant stated that Dresden and Quad Cities Groups 1–5 concrete structures were designed to ACI 318-63, Building Code requirements for reinforced concrete. The ACI 318-63, Building Code does not address susceptibility of concrete to aging effects associated with elevated temperatures. Appendix A to ACI 349-85 is specifically cited by NUREG-1801 as providing temperature criteria to be used in determining the susceptibility of concrete to aging effect. The applicant used the criteria of ACI 349-85 code to assess the temperature aging effect for Dresden and Quad Cities concrete.

The staff finds the applicant’s response acceptable and considers RAI 3.5-4 resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of reduction of strength and modulus of concrete structures due to elevated temperatures, as recommended in the GALL report. Since the applicant’s AMR results are otherwise consistent with 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).

Loss of Material Due to Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate. The GALL Report identifies programs to manage loss of material due to corrosion of the steel containment shell or the steel liner plate for all types of PWR and BWR containments. The AMP consists of ASME Section XI, Subsection IWE, and the requirements of 10 CFR 50.55a for inaccessible areas. Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel containment shells, piping, and valves penetrating or attaching to the containment.

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

Section 3.5.1.1.3 of the LRA provides information on the AMR of loss of material due to corrosion in inaccessible areas of the steel containment shell for both Dresden and Quad Cities. The applicant provided the following information to address the criteria defined in the GALL Report:

- Corrosion of containment steel elements in inaccessible areas will be confirmed as insignificant in accordance with AMP ASME Section XI, Subsection IWE (B.1.26).

- Since Dresden Unit 3 had more water leakage in the sand pocket area than Quad Cities and Dresden Unit 2, ultrasonic test examinations were performed on Dresden Unit 3 sand pocket area in 1988. The examinations indicated that significant corrosion was not occurring, and it was concluded that corrosion is insignificant at Dresden Unit 2 and Quad Cities as well. A UT examination of the same locations at Dresden Unit 3 is conducted as an augmented inspection in accordance with AMP ASME Section XI, Subsection IWE (B.1.26) to confirm that significant corrosion is not occurring.

- A general visual inspection of the moisture barrier at the junction of the steel drywell shell and the concrete floor is performed once each inspection period in accordance with AMP ASME Section XI, Subsection IWE (B.1.26).

- Dresden and Quad Cities documentation demonstrates that concrete meeting the requirements of ACI 318-63 and the guidance of ACI 201.2R-77 was used for the concrete in contact with the embedded drywell shell at the sand pocket location. The concrete is monitored for penetrating cracks that provide a path for water seepage in accordance with Structures Monitoring Program (B.1.30).

In RAI 3.5-5, the staff requested the following additional information regarding this review:

(a) How was it determined that Dresden Unit 3 had more leakage in the drywell sand pocket area than Dresden Unit 2 and Quad Cities?

(b) Define the quantitative basis for concluding that "significant corrosion was not occurring" in Dresden Unit 3.

(c) What is the technical basis for concluding that corrosion in the sand pocket area is insignificant at Dresden Unit 2 and Quad Cities?

(d) What controls exist on all four units to limit future leakage into the sand pocket areas, and how will the leakage be monitored?

(e) What were the results of the augmented inspection of the sand pocket area for Dresden Unit 3, which was scheduled for the second half of 2002?

(f) How often will the augmented UT inspection of the sand pocket area be conducted for Dresden Unit 3, and what is the basis for not conducting similar inspections for Dresden Unit 2 and Quad Cities?

(g) It is stated that a general visual inspection of the moisture barrier at the junction of the steel drywell shell and the concrete floor is performed once each inspection period in accordance with the B.1.26 AMP. Is the inspection conducted each inspection period for all four units? If not, explain why not.

(h) Confirm that the concrete floor inside the drywell of all four units (1) meets "the requirements of ACI 318-63 and the guidance of ACI 201.2R-77" and (2) "is monitored for penetrating cracks that provide a path for water seepage in accordance with Structures Monitoring Program (B.1.30)." This is the staff's interpretation of the fourth paragraph of LRA Section 3.5.1.1.3.

In response to RAI 3.5-5, the applicant stated the following:

> (a) Dresden Unit 3 had significant quantities of water introduced to the drywell annulus to extinguish a fire in the drywell expansion foam. Additionally, the sand pocket drain lines were found to be clogged at Dresden Units 2 and 3 when performing the initial investigation in response to Generic Letter 87-05. When the drain lines were unclogged, there was water present in the sand pocket region of both units. At Quad Cities, both units had three of the four drain lines essentially dry and unplugged. This information was provided to the NRC in response to Generic Letter 87-05 and is the only information that could be found in the current licensing basis. Additional information provided in responses (b) through (h) below provide justification for concluding that Dresden Unit 3 is the most limiting of the units with respect to leakage.
>
> (b) The design of the containment vessel is such that margin exists between the required shell thickness and the actual thickness of steel plate provided. A reevaluation of the required shell thickness (based on loads and data compatible with the original certified containment vessel stress report by Chicago Bridge & Iron Company) was performed on the containment shell in the region of the sand pocket. The thickness of the plates in the sand pocket region may be reduced to approximately 1/4-inch below nominal and still be within ASME Code allowable stress limits.

In response to IE Information Notice 86-99 and NRC Generic Letter 87-05, an extensive review was conducted of the potential for drywell steel corrosion in the area of the containment sand pocket. This review included an evaluation of the actual plate thickness at Dresden Unit 3. Ultrasonic Test (UT) results indicated that in over 18 years of operation of Dresden Unit 3, no detrimental corrosion occurred in the drywell steel plate at the sand pocket level. This conclusion was further supported by the fact that all of the thickness measurements were greater than the nominal 1.0625-inch thickness. The initial drywell plate thickness measurements along with subsequent thickness measurements are shown in the table below. The initial thickness measurements supported the conclusion that significant corrosion was not occurring.

Dresden Unit 3 Drywell Liner UT Thickness Measurements (Sand Pocket Region)

Sample Location	1988 Measurement Inches	1997 Measurement Inches	1999 Measurement Inches	2000 Measurement Inches	2002 Measurement Inches
112.5.1.1A	1.12	1.15	1.1	1.12	1.13
112.5.1.1B	1.12	1.12	1.09	1.08	1.09
112.5.1.2A	1.1	1.12	1.12	1.09	1.07
112.5.1.2B	1.08	1.08	1.08	1.12	1.13
157.5.1.1A	1.14	1.2	1.15	1.17	1.18
157.5.1.1B	1.14	1.16	1.14	1.15	1.11
157.5.1.2A	1.14	1.18	1.14	1.14	1.13
157.5.1.2B	1.12	1.16	1.11	1.1	1.12
202.5.1.1A	1.08	1.09	1.1	1.11	1.13
202.5.1.1B	1.08	1.1	1.08	1.1	1.11
22.5.1.1A	1.1	1.12	1.08	1.12	1.09
22.5.1.1B	1.14	1.1	1.12	1.15	1.12
22.5.1.2A	1.18	1.14	1.09	1.07	1.09
22.5.1.2B	1.1	1.12	1.1	1.06	1.04
292.5.1.1A	1.18	1.16	1.1	1.08	1.1
292.5.1.1B	1.12	1.16	1.12	1.1	1.12
292.5.1.2A	1.12	1.12	1.08	1.09	1.10
292.5.1.2B	1.26	1.12	1.12	1.14	1.15
337.5.1.1A	1.2	1.17	1.15	1.16	1.15
337.5.1.1B	1.08	1.11	1.1	1.09	1.09
337.5.1.2A	1.12	1.14	1.12	1.08	1.04
337.5.1.2B	1.24	1.12	1.09	1.06	1.08

(c) In response to IE Information Notice 86-99 and NRC Generic Letter 87-05, an extensive review was conducted of the potential for drywell steel corrosion in the area of the containment sand pocket. This review included an evaluation of the actual plate thickness at Dresden Unit 3. Ultrasonic Test (UT) results indicated that in over 18 years of operation of Dresden Unit 3, no detrimental corrosion occurred in the drywell steel plate at the sand pocket level. This conclusion was further supported by the fact that all of the thickness measurements were greater than the nominal 1.0625-inch thickness. These results have been obtained in spite of the fact that substantial moisture has previously been found in the sand pocket.

Since the as-found material thickness in Dresden Unit 3 was greater than or equal to design thicknesses, there was no reason to expect a reduction in thickness on Dresden Unit 2. A surveillance procedure had been established to monitor sand pocket drain lines during refuel activities and analysis of water samples taken from the lines reflected a non-corrosive environment.

At Quad Cities, the drywell sand pocket detail is identical to the Dresden detail. The moisture found at the [in the] sand pocket drains during inspections around the same time period as Dresden in the late 1980s was considered negligible in comparison to Dresden Unit 3. Therefore, it was not expected that any corrosion had occurred at either Quad Cities unit and the ongoing surveillance program will ensure active assessment of future potential problems. No leakage through the drywell liners was detected during the most recent refuel outage inspections following cavity flood-up. Accordingly, Quad Cities continues to be bounded by the routine UT results from Dresden Unit 3.

(d) No special controls exist at either station for limiting leakage. Formal inspections occur at each station during refuel outages that monitor for leakage from the sand pocket drains following reactor cavity flood-up. Corrective action is taken based on the results of these inspections.

(e) The results of the last four Dresden Unit 3 drywell wall thickness measurements are provided in the table shown above in the response to question (b). The augmented inspection completed in October 2002 on Dresden Unit 3 was evaluated as acceptable with no drywell liner degradation noted. The design of the containment vessel is such that margin exists between the required shell thickness and the actual thickness of steel plate provided. The thickness of the plates in the sand pocket region may be reduced to approximately 1/4-inch below nominal (1.0625 inch) and still be within ASME Code allowable stress limits. As shown in the table, all of the thickness measurements remain above the minimum wall thickness allowed.

(f) The augmented UT inspection for Dresden Unit 3 is currently completed every refueling outage. The frequency of future examinations will be evaluated based on inspection results. This inspection was specially configured to accommodate UT inspections by drilling 22 core holes for UT measurements. As long as Dresden Unit 3 remains the bounding condition for corrosion potential, there is no need to drill holes and conduct routine UT measurements on the remaining three units.

(g) A general visual inspection of the moisture barrier at the junction of the steel drywell shell and the concrete floor is performed once each inspection period for Dresden Units 2 and 3 and once each inspection interval for both Quad Cities units. The difference in the two inspection periods is attributed to the ASME Section XI Code edition in effect at each plant. Dresden performs this inspection in accordance with the 1998 Edition of ASME Section XI and Relief Request MCR-02. Quad Cities performs the [inspection] in accordance with the 1992 Edition of ASME Section XI, 1992 Addenda, Table IWE-2500-1. The original Quad Cities drywell moisture barriers in both units were replaced during outages in the year 2002 due to age degradation

(h) The concrete floor inside the drywell of all four units (1) was designed per ACI 318-63 and meets the guidance of ACI 201.2R-77 and (2) is periodically monitored for penetrating cracks that provide a path for water seepage, in accordance with the Structures Monitoring Program (B.1.30).

The staff's detailed evaluation of parts (a) through (f) of this RAI response is documented in the Dresden SER Section 4.7.2.2, TLAA for Degradation Rates of Inaccessible Exterior Drywell Plate Surfaces. The staff finds the applicant's response to parts (g) and (h) of RAI 3.5-5 to be acceptable on the basis that it is consistent with the guidance provided in the GALL Report for aging management of the inside surface of the embedded portion of the containment shell.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to corrosion in inaccessible areas of the steel containment shell or liner plate, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature. The GALL Report identifies loss of prestress due to relaxation, shrinkage, creep, and elevated temperature for PWR/BWR Mark II prestressed concrete containments as a TLAA to be performed for the period of license renewal.

As the applicant notes in LRA Section 3.5.1.1.9, both Dresden and Quad Cities have BWR Mark I steel containments; therefore, this aging effect does not apply.

Cumulative Fatigue Damage. If included in the CLB, fatigue analyses of containment steel liner plates and steel containment shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent headers and downcomers are TLAAs as defined in 10 CFR 54.3. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c).

In LRA Section 3.5.1.1.4, the applicant states that fatigue analyses of BWR Mark I and Mark II containment steel elements, penetration sleeves, and penetration bellows are TLAAs as defined in 10 CFR 54.3. Dresden and Quad Cities are Mark I containments. Cumulative fatigue damage of BWR Mark I containment steel elements, penetration sleeves, and penetration bellows is required to be evaluated in accordance with 10 CFR 54.21(c). The TLAA evaluation of cumulative fatigue damage is addressed in LRA Section 4.6. The staff evaluation of this TLAA is addressed in SER Section 4.6.

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

In LRA Section 3.5.1.1.4, the applicant addressed cracking due to cyclic loading as a TLAA for both Dresden and Quad Cities (see the discussion in SER Section 3.5.2.2.1). In LRA Section 3.5.1.1.5, the applicant provided the following information to address the criteria defined in the GALL Report related to cracking due to SCC:

> For Mark 1 containment steel elements and stainless steel containment penetrations (NUREG-1801, Items II.B1.1.1-d, and II.B4.1-d), stress corrosion cracking (SCC) is a concern for dissimilar metal welds, exposed to a corrosive environment. These components are in a sheltered environment, outside containment and inside the reactor building, and are not exposed to a corrosive environment. Therefore, existing requirements for Appendix J leak rate testing (B.1.28) and containment ISI plan surface inspections, in accordance with ASME Section XI, Subsection IWE (B.1.26), are adequate to detect cracking. In addition, other factors associated with SCC with regard to temperature, pressure, and concentrated chlorides are not at threshold levels at the installed locations.
>
> ASME Section XI, Subsection IWE weld examination categories E-B and E-F have been removed from the ASME Section XI, 1998 Edition. Both of these weld categories are considered to be part of the containment boundary surface in the current Dresden Containment Inservice Inspection (CISI) Program (ASME Section XI, Subsection IWE 1998 Edition) and Quad Cities CISI Programs and are

subject to the examination requirements of Category E-A.

Based on information provided in LRA Section 2.4 and referenced UFSAR sections, stainless steel expansion bellows are utilized in (1) primary containment mechanical penetrations, (2) vent line-to-suppression chamber connections, (3) the reactor vessel-to-drywell refueling seal, and (4) the drywell-to-reactor building refueling seal. The LRA specifically identifies the containment penetration and vent line bellows. The staff recognizes that loss of material due to general corrosion is not an applicable aging effect for stainless steel. However, stainless steel bellows and associated dissimilar metal welds are potentially susceptible to cracking due to SCC when exposed to certain environmental conditions. Degradation of stainless steel bellows has occurred at nuclear power plants; consequently, close attention to loss of intended functions is warranted.

In LRA Section 3.5.1.1.5, the applicant has indicated that the stainless steel bellows at Dresden and Quad Cities do not require augmented aging management beyond general visual examination conducted under IWE Examination Category E-A and Appendix J leak rate testing. The staff position is that the potential for cracking exists; that a crack would not be detected by a general visual examination (i.e., VT-3) before intended function is compromised; and that more detailed examination (e.g., IWE 1992 Examination Categories E-B and E-F) is warranted.

To complete its evaluation of the applicant's conclusion that augmented inspection of stainless steel bellows and associated dissimilar metal welds is not necessary at Dresden and Quad Cities, the applicant was requested, in RAI 3.5-6, to submit the following information for all four units covered by this LRA:

(a) a detailed description of plant-specific operating experience for all stainless steel bellows (including any not within the scope of license renewal that serve a similar function in a similar environment), identifying all specific incidences of degradation, how degradation was detected, the root cause, corrective actions taken, and current inspection procedures

(b) the environment (temperature, pressure, humidity, presence of aggressive agents) to which stainless steel bellows are exposed, both on a continuing basis and on a periodic or intermittent basis

(c) identification of the applicable aging effects requiring management for stainless steel bellows at Dresden and Quad Cities

(d) the detailed technical basis, including identification of supporting reference material, for concluding that Appendix J leak rate testing and IWE Examination Category E-A general visual inspection are sufficient for managing aging of stainless steel bellows

In its response to RAI 3.5-6, the applicant stated the following:

> Expansion bellows are used at Quad Cities and Dresden on primary containment mechanical penetrations, vent line-to-suppression chamber connections, on extraction steam piping that penetrates the turbine casings, and as a refueling cavity area seal during flood up for refueling. The information that follows is provided to address stainless steel bellows assemblies and their attachment welds.

(a) The refueling bellows are made of stainless steel and are not in scope of license renewal. Justification for excluding the refueling bellows from the scope of license renewal is discussed in the response to RAI 2.4.3. The refueling bellows experience a different environment and have a different function. As such, they are excluded from further discussion.

Extraction steam piping bellows are made of Inconel and experience different environments than the primary containment penetration bellows. Additionally, the extraction steam piping bellows are not included in the scope of license renewal. For these reasons, they are excluded from further discussion.

Expansion bellows are installed on the Dresden and Quad Cities primary containment mechanical penetrations on the following process lines. The list includes the vent line-to-suppression chamber connections. All of the mechanical penetration expansion bellows are in scope of license renewal.

(1) Main Steam (4 per unit)
(2) Steam Line Drain (1 per unit)
(3) Feedwater (2 per unit)
(4) RCIC Steam Supply (1 per unit, at Quad Cities only)
(5) Isolation Condenser Steam Supply (1 per unit, at Dresden only)
(6) Isolation Condenser Condensate (2 per unit, at Dresden only)
(7) Shutdown Cooling Suction (2 per unit, at Dresden only)
(8) RHR Suction from Reactor (1 per unit, at Quad Cities only)
(9) LPCI Injection (2 per unit, at Dresden only)
(10) RHR Injection (2 per unit, at Quad Cities only)
(11) Reactor Water Clean Up Supply (1 per unit)
(12) HPCI Steam Supply (1 per unit)
(13) RBCCW Supply (1 per unit)
(14) RBCCW Return (1 per unit)
(15) Vent from Drywell (1 per unit)
(16) Vent to Drywell (1 per unit)
(17) Core Spray Injection (2 per unit)
(18) Standby Liquid Control Injection (1 per unit)
(19) Head spray (1 per unit, at Dresden only)
(20) Drywell to Suppression Chamber Vent Lines (8 per unit)

There have been no recordable indications identified on any bellows assemblies or attachment welds at either Dresden or Quad Cities utilizing Examination Category E-A, Containment Surfaces, of ASME Boiler and Pressure Vessel Code, Subsection IWE.

Degradation was detected on 16 bellows assemblies at Dresden and 8 bellows assemblies at Quad Cities over the history of plant operation while conducting 10 CFR Part 50, Appendix J, testing. The degradation was significant enough to require bellows replacement. Fifteen of the 16 degraded bellows assemblies at Dresden were replaced. One penetration with a degraded bellows assembly at Dresden was sealed inside containment as part of an unrelated modification to remove the return line to the vessel for the control rod drive water. For this reason, replacement of the sixteenth bellows was unnecessary. The eight degraded bellows assemblies at Quad Cities were replaced.

The root cause of the bellows assembly degradation was attributed to cracking due to transgranular stress corrosion cracking (TGSCC). Several degraded bellows that were replaced were metallurgically analyzed. Quad Cities Unit 1 X-16A bellows, replaced in 1984, was found to be contaminated with “magnesium salts.” The corrosive species responsible for the crack initiation on Quad Cities Unit 1 X-25 bellows was identified as chlorides, fluorides, and sulfides. Since operating conditions do not introduce these materials, it has been concluded they were most probably introduced during construction. Additionally, the method of bellows manufacturing introduces residual stresses in the bellows. Bellows are cold-formed from cylinders fabricated from sheet stainless steel.

A listing of identified degraded bellows assemblies, Unit, and date replaced is provided below. A discussion of current inspection procedures is included in part (d) to this question.

Site, Unit	Penetration	Date
Dresden, Unit 2	X-113 (Reactor Water Clean Up Supply)	September, 1990
Dresden, Unit 3	X-105A (Main Steam)	December, 1991
Dresden, Unit 3	X-107B (Feedwater)	March, 1992
Dresden, Unit 2	X-125 (Vent from Drywell)	May, 1993
Dresden, Unit 2	X-149A (Core Spray Injection)	May, 1993
Dresden, Unit 2	X-149B (Core Spray Injection)	May, 1993
Dresden, Unit 2	X-144 (Control Rod Drive Water Return)	Sealed inside drywell
Dresden, Unit 3	X-111A (Shutdown Cooling Suction)	May, 1994
Dresden, Unit 3	X-125 (Vent from Drywell)	May, 1994
Dresden, Unit 3	X-138 (Standby Liquid Control Injection)	May, 1994
Dresden, Unit 3	X-149B (Core Spray Injection)	May, 1994
Dresden, Unit 2	X-108A (Isolation Condenser Steam Supply)	February, 1997
Dresden, Unit 2	X-116A (LPCI Injection)	February, 1997
Dresden, Unit 2	X-126 (Vent to Drywell)	February, 1997
Dresden, Unit 2	X-116B (LPCI Injection)	January, 2003
Dresden, Unit 2	X-124 (RBCCW Return)	January, 2003
Quad Cities, Unit 2	X-16B (Core Spray Injection)	September, 1983
Quad Cities, Unit 1	X-16A (Core Spray Injection)	September, 1984
Quad Cities, Unit 1	X-16B (Core Spray Injection)	November, 1989
Quad Cities, Unit 1	X-12 (RHR Suction from Reactor)	March, 1991
Quad Cities, Unit 1	X-25 (Vent from Drywell)	March, 1991
Quad Cities, Unit 2	X-14 (Reactor Water Clean Up Supply)	May, 1993
Quad Cities, Unit 1	X-7B (Main Steam)	August, 1994
Quad Cities, Unit 2	X-12 (RHR Suction from Reactor)	December, 1996

(b) The bellows assemblies are exposed to two environments; inside containment (either drywell or suppression chamber air space) on the inner surface of the bellows, and outside containment on the outer surface of the bellows. Neither environment contains aggressive agents. The environments are further described as follows.

<u>Inside Containment</u>
The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135 F during normal operations. The relative humidity in the drywell ranges from 20% - 90%. During normal operation, the drywell pressure is maintained at approximately one psig. The suppression chamber air space above the water level, is also inerted to maintain the oxygen content below 4% by volume during normal operation. The air temperature follows the normal, maximum operating suppression chamber water temperature of 95 F and the relative humidity is between 20 and 90%. During normal operation, the

suppression chamber pressure is maintained at approximately zero psig. Periodically, each entire containment is subjected to a pressure of 48 psig during the performance of a 10 CFR Part 50, Appendix J, Type A, Primary Containment Integrated Leak Rate Test (ILRT).

Outside Containment
The Reactor Building (outside the drywell, suppression chamber, and steam tunnel) normal operating area temperatures range from 65 F to 103 F for Dresden and 65 °F to 104 °F for Quad Cities, with relative humidity ranging from 20% - 90%.

(a) The applicable aging effects requiring management for stainless steel bellows assemblies at Dresden and Quad Cities are cumulative fatigue damage (NUREG 1801 line II.B4.1-b and LRA Reference 3.5.1.1) and crack initiation and growth due to SCC (NUREG 1801 line II.B4.1-d and LRA Reference 3.5.1.2).

(b) Based on Dresden and Quad Cities operating experience, there is potential for cracking in the bellows assemblies, but not in the dissimilar welds associated with the assemblies. 10 CFR Part 50, Appendix J testing has been effective in identifying past bellows assembly degradation due to cracking.

The primary containment mechanical penetration expansion bellows assemblies originally installed at Quad Cities and Dresden were each constructed of two-plies of Type 304 Stainless Steel, formed together into a cylindrical corrugated bellows assembly. 10 CFR Part 50, Appendix J Type B LLRT testing was performed on them by pressurizing the volume between the plies. In 1990, Quad Cities discovered that it was not always possible to quantify the bellows assembly leakage rate due to the design and construction of the bellows assemblies. This was reported to the NRC by Exelon and then communicated by the NRC to the industry in IN 92-20. An exemption for certain Type B LLRT testing requirements for Quad Cities and Dresden was requested from the NRC in 1991 and was granted in February, 1992. A revision to the exemption was requested in October 1994, and was granted in February 1995. The exemptions apply to the original two-ply bellows assemblies. As they are replaced, the new bellows fall under the full Type B LLRT testing requirements.

Replacement bellows are single ply. This ply becomes the primary containment pressure boundary. Transition rings are added to the bellows assemblies to allow for the installation of an outer bellows over the first one. The installation of this outer bellows allows for the performance of a Type B LLRT test. Replacement bellows are cold-formed during fabrication, as were the original bellows. To minimize the potential for contamination, installation instructions for the replacement bellows include cleaning the entire outer surface of the inner bellows after welding of the transition rings, and cleaning of the entire inner and outer surfaces of the outer bellows before it is welded.

Degraded bellows assemblies identified since 1991 were identified utilizing the methodology developed to comply with the exemptions. Briefly, this testing methodology is:

(a) All two-ply bellows assemblies are pressurized between the plies. Any bellows assembly with leakage measuring 0.5 scfh are further tested with helium.

(b) The bellows assembly is pressurized between the plies with helium, and the inner and outer plies are sniffed with a helium sniff detector.

(c) If helium is detected through both plies, the outer ply is examined with penetrant and/or snoop testing. All flaws are measured and mapped.

(d) All indications are evaluated by Engineering to assess current and projected leakage rates, and for structural integrity.

(e) The 1992 exemption required a Type A ILRT upon completion of all two-ply testing. The 1995 revision provides the option of performing a test in accordance with Type B LLRT requirements on all bellows assemblies with leaks through both plies, or performing a Type A ILRT.

(f) The 1992 exemption required that all two-ply bellows assemblies with demonstrated leakage through both plies be replaced during the subsequent refueling outage. There is reasonable assurance that the leaking bellows assemblies will not degrade excessively during this period because TGSCC is characterized by the slow development and propagation of cracks. The 1995 revision provides the option of performing a test in accordance with Type B LLRT requirements to demonstrate license limits are met or replacing the bellows assemblies. The bellows assembly welds at Dresden and Quad Cities are inspected utilizing Examination Category E-A, Containment Surfaces, of ASME Boiler and Pressure Vessel Code, Subsection IWE.

Based on the applicant's response to part (a) of this RAI, there are a total of 120 bellows within the scope of license renewal (32 for each Dresden unit; 28 for each Quad Cities unit). Of the 120 total, 24 bellows have been identified as degraded due to transgranular stress-corrosion cracking (TGSCC) over the period September 1990 through January 2003 and have been replaced (23) or taken out of service (1). The applicant states in part (d) of its response, "Degraded bellows assemblies identified since 1991 were identified utilizing the methodology developed to comply with the exemptions."

Since there are 96 original bellows still in place, and the period of extended operation will begin in approximately 10 years, it is not clear to the staff that reliance on Appendix J Leak Rate Testing and IWE Examination Category E-A to manage aging for license renewal is sufficient, without an additional commitment to continue the pressurized testing methodology described in (1) through (6) under part (d) of the RAI response. In a letter dated December 5, 2003, the applicant stated that it would credit the pressurized testing methodology summarized above in steps (1) through (6) under part (d) of the RAI 3.5.6 response for aging management of bellows during the period of extended operation. This is part of Commitment #26 in Appendix A of this SER. The staff finds the applicant's response acceptable and considers RAI 3.5-6 resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of cracking due to cyclic loading and SCC, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

Conclusions. The staff has reviewed the applicant's evaluation of the issues for which the GALL Report recommends further evaluation of structural components in containment. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed and that the subject aging effects will be adequately managed for the period of extended operation.

3.5.2.2.2 Class I Structures

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

Technical details of the aging management issue are presented in SER Section 3.5.2.2.1 for items (5), (6) and (8).

The applicant states in LRA Section 3.5.1.1.6 that the Structures Monitoring Program (B.1.30) is required to manage the following structural aging effects for accessible concrete areas:

- loss of material and cracking due to freeze-thaw of concrete
- increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide of concrete
- increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack of concrete
- expansion and cracking due to reaction with aggregates of concrete
- cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel [in] concrete

The applicant has included inspection of accessible concrete areas in the scope of its Structures Monitoring Program; therefore, the GALL Report recommends no further evaluation. In LRA Section 3.5.1.1.6, the applicant also states that no aging management is required for inaccessible areas:

1. For loss of material and cracking due to freeze-thaw of concrete in inaccessible areas, no aging management is required. Dresden and Quad Cities are located in severe weathering conditions. Dresden and Quad Cities have documented evidence to show that the concrete air content is between 3% and 6%. Plant inspections did not show freeze-thaw degradation. Therefore, loss of material and cracking due to freeze-thaw of concrete in inaccessible areas are not applicable and no aging management is require.

2. For increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide of concrete in inaccessible areas, no plant-specific aging management is required. Dresden and Quad Cities concrete is not exposed to flowing water and there is documented evidence that the concrete used was constructed in accordance with the recommendations in ACI 201.2R-77 for durability. Therefore, increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide of concrete in inaccessible areas are not applicable and no plant-specific aging management is required.

3. For expansion and cracking due to reaction with aggregates of concrete in inaccessible areas, no aging management is required. Dresden and Quad Cities documented evidence demonstrates that the concrete used meets the requirements of ACI 201.2R-77 with no evidence of reactive aggregates. Therefore, expansion and cracking due to reaction with aggregates of

concrete in inaccessible areas are not applicable and no aging management is required.

4. For the drywell radial beam lubrite baseplates, aging management of loss of material due to galvanic corrosion, lock-up or wear of lubrite baseplates will be performed by One-Time Inspection (B.1.23). The torus saddle support lubrite baseplates will be visually inspected to verify unacceptable loss of material due to galvanic corrosion, lock-up or wear has not occurred. The drywell radial beam lubrite baseplates and torus saddle support lubrite baseplates are comprised of the same materials and are exposed to similar environments. The drywell radial beam lubrite baseplates are not accessible for inspection; therefore the inspection of the torus saddle support lubrite baseplates will be used as a representative inspection for aging of the drywell radial beam lubrite baseplates.

The staff finds that the technical bases for the conclusions in items (1) through (3) above are consistent with the GALL Report and, therefore, require no further evaluation.

Concerning loss of material in drywell radial beam lubrite baseplates (item (4) above), the staff requested, in RAI 3.5-7, the following additional information:

(a) Describe the prior operating experience of the torus saddle support lubrite baseplates. Under what program have they been inspected? Are lubrite baseplates used at any other locations in Dresden and Quad Cities? If so, what has been the operating experience?

(b) The torus saddle support lubrite baseplates are covered under GALL Item III B1.3.2-a, and it is expected that they would be managed by ASME Section XI, Subsection IWF. This GALL item is part of LRA Table 3.5-1, Reference No. 3.5.1.31, which states that Dresden and Quad Cities is consistent with GALL, with one exception. The only exception discussed in LRA Table 3.5-1 for this item pertains to aging of downcomer bracing. Explain why aging management of loss of material due to galvanic corrosion, lockup or wear of the torus saddle support lubrite baseplates will be performed by One-Time Inspection (B.1.23) and not by ASME Section XI, Subsection IWF (B.1.27).

(c) What is the sample size for the inspection of the torus saddle support lubrite baseplates that will be used to confirm the condition of the inaccessible drywell radial beam lubrite baseplates?

(d) Confirm that all radial beam lubrite baseplates inside the drywell are inaccessible, and explain the conditions that make them inaccessible.

(e) Discuss the environments that the torus saddle support lubrite baseplates and the drywell radial beam lubrite baseplates are exposed to and explain why they are considered to be similar.

In its response to RAI 3.5-7, the applicant stated the following:

Exelon has reviewed the LRA Section 3.5.1.1.6 and the following additional information is provided for clarification.

(a) The torus saddle support lubrite baseplates have not been inspected to date and are currently not included in the ASME Section XI, Subsection IWF aging management program. Exelon will revise this program to include the torus saddle support lubrite baseplates. However, this program will not be revised before the end of the current 10-year ISI program interval expires. To ensure that a baseline inspection is performed before the current operating license expires, a one-time inspection of the torus saddle support lubrite baseplates will be performed. This initial inspection will be performed under aging management program, B.1.23, One-Time Inspection. It will be replaced by aging management program B.1.7, ASME Section XI, Subsection IWF, once it has been revised and approved by the NRC.

A historical review of the Exelon corrective action program did not identify any problems with the torus saddle support lubrite baseplates. These plates are used on the torus column supports and other piping systems and component supports to reduce friction between sliding supports and the bearing plates.

(b) As stated above in item (a), torus saddle support lubrite baseplates will be managed by ASME Section XI, Subsection IWF, and are addressed under NUREG 1801 Item III.B.1.3.1-a in the aging management review. The torus saddle support lubrite baseplates are addressed in LRA Section 2.4.15, Table 2.4-15, under Component Group "Sliding Surfaces". LRA Table 3.5-1, Aging Management Reference 3.5.1.31, discusses the aging management of the saddle support lubrite baseplate. A sample of the torus saddle support lubrite baseplates has been selected for a one time inspection that is representative of the inaccessible drywell radial beam lubrite baseplates. The lubrite baseplates are addressed in LRA Section 2.4.1, Table 2.4-1, under Component Group "Beam Seats" requiring aging management.

(c) The one-time inspection of the torus saddle support lubrite baseplate sample will consist of one saddle support baseplate located in a dry area of the Reactor Building basement. An additional inspection will be performed on a saddle support lubrite baseplate in an area that has experienced water exposure, if such a location can be found. Otherwise, a second dry area inspection will be performed.

(d) The drywell lubrite bearing plates are hidden behind the base plates of the radial floor beams located on the main floor of the drywell. These radial floor beams are located between the reactor vessel biological shield and the drywell shell and provide structural support for the main floor grating and major components located on that elevation. Removal of the radial floor beams would jeopardize the structural integrity of the attached equipment. For this reason, the primary containment radial lubrite beams are considered inaccessible.

(e) The drywell radial beam lubrite baseplates are exposed to the Inside Drywell Environment. The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135 °F during normal operation. The relative humidity in the drywell ranges from 20% - 90%.

The torus saddle support lubrite baseplates are exposed to the Outside Drywell Environment which is identical to that found in the Reactor Building. The Reactor Building (which includes the area containing the torus saddle supports) normal operating area temperatures range from 65 F to 103 F for Dresden and 65 F to 104 F for Quad Cities with relative humidity ranging from 20% - 90%.

The drywell radial beam lubrite baseplates are exposed to a milder environment than the torus saddle support lubrite baseplates because of the lack of oxygen in the nitrogen-inerted environment. The temperature of the Inside Drywell Environment is constant during power operation, reducing the likelihood of condensation accumulation on the steel components. The higher temperature itself is not detrimental to the steel components. For this reason, the torus saddle support lubrite baseplates are considered to be representative and bounding of the drywell radial beam lubrite base plates.

Given the inaccessibility of the radial beam seats, the staff considers the applicant's approach to be an acceptable alternative to direct inspection. This is part of Commitment #23 of Appendix A of this SER. RAI 3.5-7 is resolved. However, the staff has a number of questions, arising from several different RAI responses about current and future inspection of Class MC supports and the commitment to IWF as the AMP (see Open Item 3.5.2.3.2-1 in SER Section 3.5.2.3.2), as part of the evaluation of the ASME Section XI, Subsection IWF AMP.

The “Discussion” column of LRA Table 3.5-1, Reference No. 3.5.1.20, states that “Dresden and Quad Cities do not use stainless steel lined, carbon steel tanks as evaluated in NUREG-1801, line III.A8.2-a.” The staff notes that NUREG-1801, line III A8.2-a, addresses loss of material due to corrosion for unlined carbon steel tanks, and that NUREG-1801, line III A8.2-b, addresses stainless steel liners in steel tanks. The “Discussion” column of LRA Table 3.5-1, Reference No.3.5.1.28, states that “Dresden and Quad Cities do not use steel tanks lined with stainless as identified in NUREG-1801, line III.A8.2-b.”

Based on the information provided in LRA Table 3.5-1, the staff cannot determine (1) whether any unlined carbon steel tanks are included in the license renewal scope; and (2) if so, where the AMR results are located in the LRA. The applicant was requested in RAI 3.5.8 to identify any unlined carbon steel tanks in the license renewal scope and, if applicable, to describe the AMR and the credited AMPs.

In its response to RAI 3.5-8, the applicant stated the following:

> The statement “Dresden and Quad Cities do not use stainless steel lined, carbon steel tanks as evaluated in NUREG-1801, line III.A8.2-a” in LRA Table 3.5-1, Aging Management Reference 3.5.1.20, was inadvertently placed in this line entry.
>
> Tanks are evaluated with the primary system in which they were installed. Some examples of carbon steel tanks can be found in LRA Table 2.3.2-1, High Pressure Coolant Injection, LRA Table 2.3.2-3, Containment Isolation Components and Primary Containment Piping System, and LRA Table 2.3.3-6, Emergency Diesel Generator and Auxiliaries. None of the LRA Chapter 2 component tables requiring aging management containing tanks are linked to Chapter 3 Aging Management Reference 3.5.1.20.

In its RAI response, the applicant also identified a revision to LRA Table 3.5.1, Reference No. 3.5.1.20, removing the statement in the “Discussion” column. The staff verified that all tanks are evaluated with the primary system in which they are installed, and that there are no AMR references to entry 3.5.1.20 in LRA Table 3.5-1. This review confirmed the applicant’s assertion that, with one exception, the Radwaste Floor Drain Surge Tank is included in the structures scope (LRA Section 2.4.9) and is evaluated as a structure (AMR reference LRA Table 3.5-1). Therefore, RAI 3.5-8 is resolved.

On the basis of its review, pending resolution of Open Item 3.5.2.3.2.2-1, the staff finds that the applicant appropriately evaluated AMR results involving management of aging of structures not covered by the Structures Monitoring Program, as recommended in the GALL report. Since the applicant’s AMR results are otherwise consistent with 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).

<u>Aging Management of Inaccessible Areas</u>. The GALL Report recommends further evaluation of aging management for inaccessible concrete areas, such as foundation and exterior walls below grade exposed to ground water, if specific criteria defined in the GALL Report cannot be satisfied. The staff reviewed the AMP to ensure that the intended functions will be maintained during the period of extended operation. The degradations managed are cracking, spalling, and increases in porosity and permeability due to aggressive chemical attack; and cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel for Group 1–3, 5, and 7–9 structures.

In LRA Section 3.5.1.1.7, the applicant states that no plant-specific aging management is required to manage the following structural aging effects for inaccessible areas:

- increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack of concrete

- cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel of concrete.

To support this conclusion, the applicant states in LRA Section 3.5.1.1.7 that Dresden and Quad Cities ground- water test data obtained during construction, and for the 1980's, 1990's, and 2000's shows that the below-grade environment is not aggressive based on NUREG-1801 criteria (chlorides less than 500 ppm, sulfates less than 1500 ppm, and pH greater than 5.5). Examination of representative samples of below- grade concrete, when excavated for any reason, is included as part of the Structures Monitoring Program. To ensure conditions are maintained throughout the period of extended operations, the Structures Monitoring Program will be enhanced to include monitoring of below-grade water chemistry to demonstrate that the environment remains non-aggressive. Existing plant procedures will be used to periodically sample pH, chlorides, and sulfates.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of aging management of inaccessible areas, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

Conclusions. The staff has reviewed the applicant's evaluation of the issues for which the GALL Report recommends further evaluation of Class I structures. On the basis of its review, pending satisfactory resolution of Open Item 3.5.2.3.2.2-1, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed and that the subject aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.2.3 Component Supports

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

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of component supports, in LRA Table 3.5-1. In row entry 3.5.1.29 of LRA Table 3.5-1, the applicant stated that it will use its Structures Monitoring Program to manage the aging effects identified above in the preceding paragraph.

Since the applicant is managing the aging effect for the component supports covered by row entry 3.5.1.29 of LRA Table 3.5-1, as recommended by the GALL Report, the staff finds that the applicant has adequately addressed this further evaluation criterion. The staff's evaluation of the applicant's Structures Monitoring Program is found in Section 3.0.3.14 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of aging of supports not cover by the Structures Monitoring Program, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with 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).

Cumulative Fatigue Damage due to Cyclic Loading. Fatigue of support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3, only if a CLB fatigue analysis exists. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c).

In LRA Section 3.5.1.1.8, the applicant states that Dresden and Quad Cities piping and component supports were designed to ASME Section VIII and ANSI USAS B31.1. Dresden Unit 3 ASME III Class I replacement piping was analyzed to Subsection NB, 1980 Edition including Summer 1982 Addenda. None of these codes required formal fatigue analysis of supports or design of supports for fatigue effects. Some ASME III Class MC support components were the subject of fatigue analysis in support of the Mark I "New Loads" program. Cumulative fatigue damage of ASME III Class MC support components is required to be evaluated in accordance with 10 CFR 54.21(c)(1). The TLAA evaluation of the ASME III Class MC support components is addressed in LRA Section 4.6. The staff's evaluation of this TLAA is in DSER Section 4.6 of this SER.

Conclusions. The staff has reviewed the applicant's evaluation of the issues for which the GALL Report recommends further evaluation for component supports. On the basis of its review, pending satisfactory resolution of Open Item 3.5.2.3.2.2.-1, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed and that the subject aging effects will be adequately managed for the period of extended operation.

3.5.2.3 Aging Management Programs for Containment, Structures, and Component Supports

In LRA Section 3.5, the applicant credits a total of ten10 AMPs to manage the aging effects associated with structures and structural components. Five of the AMPs are credited with managing aging for components in other system groups (common AMPs); and five AMPs are credited with managing aging only for structures and structural components. The staff's evaluations of the common AMPs are provided in the following sections of this SER:

- Water Chemistry Program (B.1.2)—(Section 3.0.3.2)
- Bolting Integrity (B.1.12)—(Section 3.0.3.5)
- One-Time Inspection (B.1.23)—(Section 3.0.3.10)
- Appendix J, Containment Leak Rate Test Program (B.1.28)—(Section 3.0.3.13)
- Structures Monitoring Program (B.1.30)—(Section 3.0.3.14)

The staff's evaluations of the five (5) AMPs credited with managing aging only for the containment, structures, and component supports are provided in this section of the SER.

3.5.2.3.1 ASME Section XI, Subsection IWE (B.1.26)

Summary of Technical Information in the Application. The Quad Cities program complies with Subsection IWE for steel containments (Class MC) of ASME Section XI, 1992 Edition including 1992 Addenda. The Dresden program utilizes a relief request. The relief request permits utilization of the 1998 Edition of Subsection IWE of ASME Section XI in its entirety instead of the 1992 Edition and Addenda. The applicant states that the ASME Section XI, Subsection IWE aging management program is consistent with the ten elements of aging management program XI.S1, "ASME Section XI, Subsection IWE," specified in NUREG-1801 (GALL), with the following exceptions:

- NUREG-1801 indicates that ASME Section XI, Subsection IWE and the additional requirements specified in 10 CFR 50.55a(b)(2) constitute an existing mandated program applicable to managing aging of a steel containment. The NUREG-1801 evaluation covers both the 1992 Edition with the 1992 Addenda and the 1995 Edition with the 1996 Addenda of ASME Section XI, Subsection IWE, as approved in 10 CFR 50.55a. The Dresden program utilizes a relief request. The Dresden program is based on the 1998 Edition of Subsection IWE of ASME Section XI as provided for in Relief Request MCR-02.

- NUREG-1801 indicates that pressure retaining weld visual examinations and pressure retaining dissimilar metal welds surface examinations are optional. These requirements are not part of the Dresden program because it is based on the 1998 Edition of Subsection IWE of ASME Section XI as provided for in Relief Request MCR-02.

- NUREG-1801 indicates that bolt preload is checked by either a torque or tension test. The Dresden and Quad Cities programs do not provide for checking of bolt preload by either torque or tension test because acceptance is based on Appendix J testing of associated bolted components and general visual examination. This practice is consistent with Dresden Relief Request MCR-02 and Quad Cities Relief Request CR-24.

- NUREG-1801 indicates that the program provides for examination of seals, gaskets and moisture barriers by visual methods prescribed in ASME Section XI, Subsection IWE

- The Dresden program uses Relief Request MCR-02 and the Quad Cities program uses Relief Request CR-21 as the basis for not routinely inspecting seals and gaskets, and the extent of surface examination of moisture barriers. Aging management program 10 CFR Part 50, Appendix J (B.1.28) provides for monitoring of seals and gaskets. Seals and gaskets are inspected only when sealed or gasketed components are disassembled for maintenance. Moisture barriers, which are accessible, are examined for tears, cracks or other damage that would allow intrusion of moisture, using general visual criteria.

As described in LRA Section B.1.26, the ASME Section XI, Subsection IWE aging management program is credited with managing aging of the primary containment for loss of material. The basic program requires visual examination. Limited surface or volumetric examination is conducted when IWE requires augmented examination. It is implemented through station plans and procedures and covers steel containment shells and their integral attachments;

containment hatches and airlocks; seals, gaskets and moisture barriers; and pressure-retaining bolting.

The applicant states that the operating experience of the inservice inspection (ISI) programs at Dresden and Quad Cities, which includes ASME Section XI, Subsection IWE aging management program activities, has not shown any adverse trend of program performance. Periodic self-assessments of the ISI programs have been performed to identify the areas that need improvement to maintain program quality.

Inspections were conducted on Dresden Unit 3 drywell in response to NRC Generic Letter (GL) 87-05, “Request for Additional Information Assessment of Licensee Measures to Mitigate and/or Identify Degradation of Mark I Drywells,” and Information Notice 86-99, “Degradation of Steel Containments,” which addressed the potential for corrosion of boiling water reactor (BWR) Mark I steel drywells in the “sand pocket region.” The results of these inspections and analysis of the results concluded that ultrasonic examinations showed evidence of no apparent corrosion of liner in the "sand pocket region." The conclusions were found to also apply to Dresden Unit 2 and both Quad Cities units, as Dresden Unit 3 conditions were determined to be bounding based on more occasions of moisture in its sand pocket region. Dresden Unit 3 has experienced leakage from the drywell sand pocket drains during refueling outages in 1997 and 2000. As a result, an augmented UT inspection of the Unit 3 drywell sand pocket area is scheduled for the second half of 2002.

The applicant concludes that the ASME Section XI, Subsection IWE aging management program provides reasonable assurance that the loss of material aging effects are adequately managed so that the intended functions of primary containment components are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.26, “ASME Section XI, Subsection IWE”, the applicant described its AMP to manage aging of the steel containment. The LRA stated that this AMP is consistent with GALL AMP XI.S1, with the exceptions described above in Section 3.5.2.3.1 of this report. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the exceptions to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for both Dresden and Quad Cities to determine whether they provide an adequate description of the revised program.

The staff notes that the exceptions described by the applicant are different for Dresden and for Quad Cities; and for each exception, the applicant references a current Relief Request granted by the staff.

The staff position is that current Relief Requests granted by the staff have no bearing on License Renewal commitments, because the basis for the relief request and the period of time during which the relief request is applicable generally will not carry over to the period of extended operation. Consequently, for license renewal the staff expects a commitment to IWE and supplemental requirements consistent with 10 CFR 50.55a. The staff notes that 10 CFR 50.55a was updated in 2002 to include the 1998 edition with the 1999 and 2000 Addenda of Subsection IWE, with the additional requirements of paragraphs (b)(2)(ix) (A), (B), and (F) through (I).

Therefore, the applicant was requested in RAI B.1.26 to (1) describe the extent of its commitment to the IWE requirements specified in the most recent issuance of 10 CFR 50.55a; (2) specifically identify any exceptions taken to these requirements, for the extended period of operation; and (3) submit a detailed technical basis for each exception taken.

In its response to RAI B.1.26 dated October 3, 2002, the applicant stated:

> LRA Appendix B.1.26 describes the current “ASME Section XI, Subsection IWE” aging management program and its exceptions as defined by Relief Requests. This program was developed in response to the August 8, 1996 Federal Register posting of the final rulemaking, mandating a comprehensive containment inservice inspection program. This program is valid for 120-month inspection interval. At the end of this 120-month interval, the program must be updated to comply with 10 CFR 50.55a(g)(4)(ii).
>
> Exelon agrees that the current Relief Requests do not have a bearing on the period of extended operation. Based on the requirements of 10 CFR 50.55a(g)(4)(ii), the program will be based on the latest edition and addenda, which is approved by the NRC 12 months prior to the end of the current 120-month inspection interval.
>
> Based on these requirements, the program will be updated by 2008 (prior to the beginning of the extended period of operation) and then again by 2018 and 2028 (both during the period of extended operation).
>
> Exelon will continue to follow the regulations as established in 10 CFR 50.55a, which include a commitment to IWE and the established supplemental requirements.

The additional information provided by the applicant in its RAI response is consistent with the staff’s position on Relief Requests. The staff accepts the applicant’s commitment for license renewal to IWE and supplemental requirements consistent with 10CFR50.55a. This is part of Commitment #26 in Appendix A of this SER.

Conclusions. On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and 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 during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.2 ASME Section XI, Subsection IWF (B.1.27)

Summary of Technical Information in the Application. The applicant states in LRA Section B.1.27 that, with enhancements, the ASME Section XI, Subsection IWF aging management program is consistent with the ten elements of aging management program XI.S3, "ASME Section XI, Subsection IWF," specified in NUREG-1801.

The ASME Section XI, Subsection IWF aging management program is credited for visual examination of component and piping supports within the scope of license renewal for loss of material and loss of mechanical function aging effects. The program is implemented through station procedures, which provide for visual examination of inservice inspection Class 1, 2, and 3 supports in accordance with the requirements of ASME Section XI, Subsection IWF, 1989 Edition and Code Case N-491-1.

The applicant states that, for license renewal, the program will be enhanced to provide for inspection of Class MC component supports consistent with NUREG-1801, Chapter III, Section B1.3. This enhancement is scheduled for implementation prior to the period of extended operation.

In its discussion on operating experience, the applicant states that the operating experience of the inservice inspection (ISI) programs at Dresden and Quad Cities, which include ASME Section XI, Subsection IWF aging management program activities, has not shown any adverse trend of program performance. Periodic self-assessments of the ISI programs have been performed to identify the areas that need improvement to maintain program quality.

The applicant concludes that the aging management program provides reasonable assurance that the loss of material and loss of mechanical function aging effects are adequately managed so that the intended functions of component and piping supports within the scope of license renewal are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.27, “ASME Section XI, Subsection IWF,” the applicant described its AMP to manage aging in ASME Section XI Class 1, 2, 3 and MC supports. The LRA stated that this AMP is consistent with GALL AMP XI.S3, when enhanced to provide for inspection of Class MC component supports. The staff confirmed the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancement to determine whether the AMP, with the enhancement, is adequate to manage the aging effects for which it is credited. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for Dresden and Quad Cities to determine whether they provide an adequate description of the revised program.

In its description of this AMP, the applicant specifically states “The program is implemented through station procedures, which provide for visual examination of inservice inspection Class 1, 2, and 3 supports in accordance with the requirements of ASME Section XI, Subsection IWF, 1989 Edition and Code Case N-491-1.” Inspection of Class MC supports is identified as an “enhancement” that is “scheduled for implementation prior to the period of extended operation.” This is part of Commitment #27 of Appendix A of this SER.

The staff considers the applicant’s program to be consistent with GALL, except for the element of “Scope”. GALL presents a generic evaluation of IWF, an existing mandated program for inspection of ASME Class 1, 2, 3, and MC supports. The applicant’s existing IWF program is not consistent with GALL in that it does not include the inspection of Class MC supports. The staff’s acceptance of IWF (or any other existing program) for aging management during the license renewal period is substantially based on the assumption that the components covered by the scope of the existing program are being periodically inspected during the current licensing term and any problems affecting performance of intended function(s) have been detected and corrected.

Therefore, the applicant was requested in RAI B.1.27 to describe the plant-specific operating experience for the aging of Class MC supports in terms of: (1) the current inspection method, frequency, scope, and acceptance criteria; and (2) any observed degradation and subsequent corrective actions taken to manage the aging of these components.

In its response to RAI B.1.27 dated October 3, 2003, the applicant stated:

> 10 CFR 50.55a(g)(4) states in part "…components (including supports) which are classified as ASME Code Class 1, Class 2 and Class 3 must meet the requirements, …set forth in Section XI…" It later states, "Components which are classified as Class MC pressure retaining components and their integral attachments, and components which are classified as Class CC pressure retaining components and their integral attachments must meet the requirements, …set forth in Section XI…"
>
> The CFR statement above specifically requires Class 1, 2, and 3 supports to meet the requirements of Section XI. However, other than integral attachments, there is no mention of the Class MC supports. The Dresden and Quad Cities Inservice Inspection programs have complied with the requirements of 10 CFR 50.55a. Therefore, containment supports are not required to be examined in accordance with Subsection IWF.
>
> There are no inspections required by Subsection IWF that will not be performed by the use of Subsection IWE. Per the 1989 Edition and the 1992 Edition, with the1992 Addenda of ASME Section XI, Table IWE-2500-1, Item E1.11, the Class MC integral attachments are subject to a General Visual Examination (as described in IWE-3510.1) prior to each Type A Test. Additionally, per Item E1.12, these integral attachments are subject to a VT-3 each inspection interval. Per the 1995 Edition, with the 1996 Addenda of ASME Section XI, Table IWF-2500-1, supports are subject to a VT-3 each inspection interval.
>
> The containment inservice inspection (CISI) program was developed in response to a recently mandated final rulemaking per an amendment to the Code of Federal Regulations (10 CFR 50.55a). This rulemaking incorporates, by reference, the requirements of the 1992 Edition with the 1992 Addenda of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsections IWE and IWL with specified modifications. The final rulemaking was published on August 8, 1996 and specified an effective date of September 9, 1996 as well as an expedited implementation of these requirements within five years of the effective date (September 9, 2001). In response, the Dresden and Quad Cities CISI program included integral attachments as part of the IWE examination boundary.
>
> As there is no inspection history of containment supports, there is no site operating experience related to this program to provide.

The applicant's response to RAI B.1.27 did not address the staff's concern, but served to reinforce the concern regarding the inspection of Class MC Supports. The applicant's existing IWF program is not consistent with GALL in that it does not include the inspection of Class MC supports. The staff's acceptance of IWF (or any other existing program) for aging management during the license renewal period is substantially based on the assumption that the components covered by the scope of the existing program are being periodically inspected during the current licensing term and any problems affecting performance of intended function(s) have been detected and corrected. In its response to RAI B.1.27, the applicant states that "containment supports are not required to be examined in accordance with Subsection IWF." Furthermore, the response states that "as there is no inspection history of containment supports, there is no site operating experience related to this program to provide." Since there is no existing program to inspect Class MC supports, the staff cannot accept the use of IWF in the license renewal period without further information or actions by the applicant. Furthermore, the staff is confused as to which Class MC supports the applicant is proposing to inspect under IWF in the license renewal period. The response to RAI 2.4-2 lists at least three items that appear to be Class MC supports (items c, d and j), but the LRA Table number and component group referenced for each item leads to the Structures Monitoring program, not IWF. The response to RAI 2.4-2 also lists a number of items that appear to be Class 1 supports (items a, b, and f (regarding anchor bolts)), but the LRA Table number and component group referenced for each item leads to the Structures Monitoring Program, not IWF. Some of the same components discussed in the response to RAI 2.4-10 reference IWF, so there is an inconsistency between the two RAI responses.

The applicant's response to RAI 3.5-14 provides a justification for inspecting downcomer bracing (a Class MC support) using IWE. This raises an additional staff concern as to how many other Class MC supports the applicant intends to inspect using IWE rather than IWF.

Some of the Class MC supports discussed by the applicant in the above RAI responses seem to be inaccessible. Therefore, the staff needs to better understand how the applicant is treating these supports.

In order to resolve the staff's concerns, the staff has requested the applicant to provide the following information:

(a) Identify each type of Class MC support by name and confirm whether the support will be inspected under IWF during the period of extended operation. Provide a technical explanation for those supports that are proposed to be inspected under another program (such as IWE or Structures Monitoring) or for cases where no inspection is planned.

(b) Since Class MC supports are not currently being inspected, provide a commitment to perform a baseline inspection of typical samples of each type of Class MC component support prior to the period of extended operation, to identify and correct any problems affecting performance of intended functions.

(c) Describe how the performance of Class MC component supports in inaccessible areas are currently being managed and how they will be managed during the period of extended operation. Clarify the commitment to the provisions of !0CFR50.55a covering inaccessible areas.

(d) Review the response to RAI 2.4-2 and identify the aging management program applicable to each item (a) through (k). Also verify the consistency of this RAI response with the response to RAI 2.4-10.

This is Open Item 3.5.2.3.2-1.

<u>Conclusions</u>. On the basis of its review and audit of the applicant's program, pending satisfactory resolution of Open Item 3.5.2.3.2-1, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.3 Masonry Wall Program (B.1.29)

<u>Summary of Technical Information in the Application</u>. The applicant states in LRA Section B.1.29 that the masonry wall program is consistent with the ten elements of aging management program XI.S5, "Masonry Wall Program," specified in NUREG-1801.

The masonry wall program, which is part of the structures monitoring program, is based on guidance provided in I. E. Bulletin 80-11, "Masonry Wall Design," and Information Notice 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to I. E. Bulletin 80-11," and is implemented through station procedures. The program provides for inspections of masonry walls within the scope of license renewal for cracking. The program includes all masonry walls that perform intended functions in accordance with 10 CFR 54.4, and is credited for management of aging effects so that the established evaluation basis for each masonry wall within the scope of license renewal remains valid through the period of extended operation.

In its discussion on operating experience, the applicant states that the masonry wall program has provided for detection of cracks, and other minor aging effects in masonry walls. The corrective action process has ensured timely repair in order to prevent continued degradation. Maintenance history revealed minor degradation of masonry block walls. In response to I. E. Bulletin 80-11, "Masonry Wall Design," and Information Notice 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to I. E. Bulletin 80-11," various actions were taken. Actions included program enhancements, follow-up inspections to substantiate masonry wall analyses and classifications, and the development of procedures for tracking and recording changes to the walls. These actions addressed all concerns raised by I. E. Bulletin 80-11 and Information Notice 87-67, namely unanalyzed conditions, improper assumptions, improper classification, and lack of procedural controls. Operating history shows that the program was and continues to be assessed for its effectiveness based on program specific corrective actions that addressed issues such as inspection schedules and program database discrepancies.

The applicant concludes that the masonry wall program provides reasonable assurance that the aging effects of cracking are adequately managed so that the intended functions of masonry walls within the scope of license renewal are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.29, "Masonry Wall Program," the applicant described its AMP to manage aging in masonry walls. The LRA stated that this AMP is consistent with GALL AMP XI.S5. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for Dresden and Quad Cities to determine whether it provides an adequate description of the program.

Conclusions. On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that there is reasonable assurance 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 UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.4 RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants

Summary of Technical Information in the Application. The applicant states in LRA Section B.1.31 that, with enhancements, the RG 1.127 aging management program is consistent with the ten elements of aging management program XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," specified in NUREG-1801.

The RG 1.127, “Inspection of Water-Control Structures Associated with Nuclear Power Plants,” aging management program is part of the structures monitoring program and consists of procedures that provide for condition monitoring of structural steel elements and concrete. With enhancements, the program provides for visual inspections of structural steel and concrete components within the scope of license renewal that are in the Unit 1 and Unit 2 and 3 crib houses at Dresden, and the Unit 1 and 2 crib house and discharge canal weir structure supporting the ultimate heat sink at Quad Cities. The program is credited for aging management of concrete and structural steel elements exposed to raw water and aging management of concrete not exposed to raw water, and is based on Regulatory Guide 1.127, Revision 1.

For license renewal, the following enhancements will be made. Enhancements are scheduled for implementation prior to the period of extended operation.

- The program will provide for monitoring of crib house concrete walls and slabs with an opposing side in contact with river water and the Quad Cities discharge canal weir.

- Procedures will be revised to emphasize inspecting for structural integrity of concrete and steel components and identify specific types of components to be inspected.

In its description on operating experience, the applicant states that the operating history of crib houses at Dresden and Quad Cities indicates that structural components are not experiencing any significant degradation. Minor degradation of concrete has been detected such as cracks with water stains, pitting, and leaching. These types of degradation were evaluated and dispositioned. The effective use of the corrective action process has provided significant quantitative and qualitative data on performance, extent of degradation, and effects of operating and environmental conditions ensuring timely identification and correction of degraded conditions. The program has been assessed for its effectiveness based on program specific corrective actions that addressed issues such as inspection schedules and program database discrepancies.

The applicant concludes that the RG 1.127, “Inspection of Water-Control Structures Associated with Nuclear Power Plants,” aging management program provides reasonable assurance that the aging effects are adequately managed so that the intended functions of concrete and structural steel components in water control structures within the scope of license renewal are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.31, “RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants,” the applicant described its AMP to manage aging of structural steel and concrete components within the scope of license renewal that are in the Unit 1 and Unit 2 and 3 crib houses at Dresden, and the Unit 1 and 2 crib house and discharge canal weir structure supporting the ultimate heat sink at Quad Cities. The LRA stated that this AMP is consistent with GALL AMP XI.S7 with the enhancements described in the previous section. The staff will confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancements to determine whether the AMP, with the enhancements, is adequate to manage the aging effects for which it is credited. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for both Dresden and Quad Cities to determine whether they provide an adequate description of the revised program.

In its description, the applicant states that this program "is part of the structures monitoring program and consists of procedures that provide for condition monitoring of structural steel elements and concrete."

Based on the applicant's description of this aging management program, it is not readily apparent to the staff that it is consistent with the ten elements of GALL XI.S7. The staff cannot determine whether this is an existing program, and cannot identify the specific structures and structural components, environments, and aging effects that are managed by this program. In RAI 2.4-7, the staff has questioned the apparent omission from the scope of license renewal of many structures that appear to be essential elements of the ultimate heat sinks at Dresden and Quad Cities. These structures are typically monitored using the guidance in RG 1.127, and for license renewal should be included in the scope of an aging management program consistent with GALL XI.S7.

To complete its evaluation of this aging management program, the staff requested the applicant to submit the following additional information:

(a) Clarify whether the program described in LRA Appendix B.1.31 is an existing program. If so, explain what structures and structural components, environments, and aging effects are currently inspected under this program at Dresden and Quad Cities. If not, explain how the condition of water-control structures is currently monitored at Dresden and Quad Cities.

(b) Describe the plant-specific operating experience with regard to the inspection of all essential structural elements of the ultimate heat sink, including (as applicable) the intake and discharge canals and on-site ponds.

(c) Under the first "Enhancement", the applicant states that "The program will provide for monitoring of crib house concrete walls and slabs with an opposing side in contact with river water and the Quad Cities discharge canal weir." Clarify whether the sides of the crib house concrete wall and slabs that are exposed to raw water are inspected under this program? If not, explain why not. Also, verify that the underwater surfaces of the Quad Cities discharge canal weir are inspected under this program, or explain why they are not.

(d) Under the second "Enhancement", the applicant states that "Procedures will be revised to emphasize inspecting for structural integrity of concrete and steel components and identify specific types of components to be inspected." Describe the procedures that already exist and provide a more detailed description of the revisions that will be made.

(e) Describe any additional enhancements to this program that may be required as a result of the response to staff RAI 2.4-7, related to the scope of water-control structures that serve an intended function for license renewal.

In its response to RAI B.1.31 dated October 3, 2003, the applicant stated:

(a) The program described in LRA Appendix B.1.31 is an existing program. The structures currently monitored include the Dresden Unit 1 and 2/3 Crib Houses intake and discharge canal, and the Quad Cities Unit 1/2 Crib House. The parameters monitored at these concrete structures include cracking, movements, settlement, deflection, cavitation, in-leakage, abrasion, spalling, scaling, leaching of calcium hydroxide, corrosion of embedded steel, and others. For further details see the clarifications provided in (d) below.

(b) The Dresden intake and discharge canals were determined to be in the scope of license renewal and the Dresden cooling lake was determined to out of scope of license renewal (Reference RAI 2.4-7). A search of the corrective action database indicated that there have been several leaks found in the cooling lake dike by various means including the bi-monthly dike inspection, and operator and security rounds. Corrective actions were taken to resolve the leaking such as installing sheet piling. However there were no conditions of canal wall degradation found. It should be noted that the canal walls are not subject to the same failure mechanisms as the cooling lake dike walls. The canals are trenched in existing ground topography, where the cooling lake dike walls were built above the grade of the surrounding topography.

(c) The program does inspect the crib house concrete walls and slabs exposed to raw water. The existing program does not include the Quad Cities discharge canal weir. However, the discharge canal weir is being added as an enhancement as noted in (d) below.

(d) The current structural monitoring program procedures inspect concrete beams, floor and roof slabs, columns and walls. This program inspects concrete surfaces for the following conditions: leaching and chemical attack; abrasion, erosion, and cavitation; drummy areas (poorly consolidated concrete with past deficiencies); pop-outs and voids; scaling; spalling; signs of corrosion in reinforcing steel or anchorage components; corrosion of exposed embedded metal surfaces and corrosion stains around the embedded metal; and detached embedments or loose bolts. The program inspects steel elements for the following conditions: excessive deflection, cross-section distortion, or member misalignment; significant corrosion; cracks, tears, and laminations; loose or missing bolts on bolted connections.

The enhancements to be made to this procedure as it applies to water control structures include the following:

(a) Enhance the Monitoring and Trending section to include review of previous inspection reports, photos, etc. of elements to be inspected at the next inspection interval/period.
(b) Clarify scope to include inspections of all Crib House interior concrete walls with an opposing side in contact with river water and all Crib House concrete slabs with an opposing side in contact with river water.
(c) Add inspection parameters for joints, and structural isolation gaps.
(d) Add a task to review ground water chemistry data to ensure limits are not exceeded and include task frequency.
(e) Clarify scope for Dresden Unit 1 Crib House.
(f) Clarify scope to include the discharge canal weir at Quad Cities.
(g) Clarify inspection scope is to include condition monitoring of concrete below water line.
(h) Add requirements for qualifications for personnel performing inspections and personnel evaluating results.

(e) The additional component groups added to the scope of License Renewal in response to RAI 2.4-7 are already being inspected through structural monitoring program or had no viable aging mechanisms requiring aging management. The additional existing activity to be credited as license renewal commitments is monitoring the earthen structures (canal) at Dresden.

The additional information provided by the applicant in its response to RAI B.1.31 did not completely address all of the staff's request for information and raised some additional concerns as discussed below. Therefore, the applicant was requested to provide the following additional information to supplement its initial RAI response:

(1) The response to RAI B.1.31(a) states the parameters monitored for the concrete structures (Dresden Unit 1 and 2/3 Crib House and Quad Cities Unit 1 / 2 Crib House) included in the existing B.1.31 program. However, the RAI response also indicates that the Dresden intake and discharge canals are currently monitored under this existing program. Based on the information provided in the response to RAI 2.4-7, the staff understands that these canals are earthen structures. Therefore, the applicant is requested to explain what parameters are monitored for the earthen structures under this existing program.

(2) The response to RAI B.1.31(a) did not explain how the condition of water control structures within the scope of license renewal that are not included in the existing program are currently monitored at Dresden and Quad Cities.. The applicant is requested to provide this information for all structures and components identified in the response to RAI 2.4-7 as being within the scope of license renewal, as well as any other applicable structures and components that may not have been listed by the staff as part of RAI 2.4-7.

(3) The response to RAI B.1.31(b) only described the operating experience with regard to the Dresden intake and discharge canals and the Dresden cooling lake (which is stated as being out of the scope of license renewal). The applicant is requested to describe the operating experience with regard to the inspection of all essential structural elements of the ultimate heat sink for both Dresden and Quad Cities as identified in the response to RAI 2.4-7.

(4) The response to RAI B.1.31(d) does not discuss any existing procedures or planned enhancements related to the inspection of earthen structures. The applicant is requested to describe these procedures since it is clear that earthen structures are being monitored under the B.1.31 program.

(5) The response to RAI B.1.31 does not address the Quad Cities intake flume/canal. The response to RAI 2.4-7 discusses the intake flume/canal boundaries, but does not specify whether the flume/canal is included in the license renewal scope, and does not provide a reference for the aging management review of the topographic basin. The staff requests the applicant to clarify whether the Quad Cities flume/canal, including the topographic basin, is monitored under the B.1.31 program. If it is, describe the monitoring procedures used . If it is not, explain the technical basis for its exclusion.

(6) For the structures and components of the ultimate heat sink that are not currently being inspected under an existing program, the staff requests the applicant to provide a commitment to perform a baseline inspection of typical portions of each structure or component prior to the period of extended operation, to identify and correct any problems affecting performance of intended functions.

(7) The staff notes that in LRA Section A.1.31 for both Dresden and Quad Cities there is no mention of earthen structures in the description of the RG 1.127 program for the UFSAR Supplement. The applicant is requested to revise these supplements to specifically identify earthen structures as being within the scope of this program, and also to include a discussion of any other significant changes in the scope of this program that have occurred

as a result of the applicant's responses to the staff RAIs related to this program.

In its response to the staff's request for additional information dated December 5, 2003, to supplement the initial RAI response, the applicant stated

> (1) The canals are earthen structures that require aging management. Specifically, these structures are vulnerable to the buildup of sedimentation. Existing station procedures monitor the aging effect, "Loss of Form due to Sedimentation", to ensure that the required volume of water is available in the ultimate heat sink to support emergency cooling conditions. This includes the forebay at Dresden and the forebay at Quad Cities. (Note the "Dresden Only" annotation in table 2.3.3-22 for Component Group "Earthen Structures" provided RAI 2.4-7 was incorrect and has been deleted.)
>
> The Quad Cities Earthen Structure consists of a bay excavated from the river front area down and into the existing bedrock up to the in-scope concrete structures. The sidewalls of this structure are engineering designed earthen slopes and are covered with rip-rap, both above and below the water line.
>
> The Dresden Earthen Structure was excavated through the soil. The actual canals are excavated from bedrock. The soil portions above the canals are capped with concrete.
>
> The aging management review of these structures found that "Loss of Form" was the only applicable aging effect, and sedimentation the only applicable aging mechanism contributing to this effect based on the design and configuration of these structures.
>
> (2) The existing Aging Management activities for the in-scope Quad Cities components as discussed in RAI 2.4-7 are:
>
> - Intake Flume - Aging management of the earthen portion of this structure is discussed in the response to (1) above. Concrete portions are addressed in LRA Table 2.4-11, under Component Group, "Concrete Walls", and Aging Management Reference 3.5.22, RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, Program B.1.31.
> - 16' diameter discharge piping - This piping is addressed in LRA Table 2.3.3-22, under Component Group, "Piping and Fittings", and Aging Management Reference 3.3.1.15, Open Cycle Cooling Water Program B.1.13.
> - 96" Ice Melting Line, including Gate - The ice melt line is addressed in LRA Table 2.3.3-22, under Component Group, "Piping and Fittings", and Aging Management Reference 3.3.1.15, Open Cycle Cooling Water Program B.1.13. The gate is addressed in LRA Table 2.3.3-22, under Component Group, "Valves" and Aging Management Reference 3.3.2.278, Open Cycle Cooling Water Program B.1.13 and Aging Management Reference 3.3.2.300, Bolting Integrity Program B.1.12.
> - Discharge Flume/Canal - This structure is addressed in LRA Table 2.4-11, under Component Group, "Concrete Walls", and Aging Management Reference 3.5.1.22, RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, Program B.1.31. However, these aging management activities are an enhancement and are not currently implemented.
> - Weir Gate in discharge canal - This component is addressed in LRA Table 2.4-11, under Component Group, "Concrete Walls", and Aging Management Reference 3.5.1.22, RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, Program B.1.31. However, these aging management activities are an enhancement and are not currently implemented.
>
> The existing Aging Management activities for the in-scope Dresden components as discussed in RAI 2.4-7 are:
>
> - Intake flume/canal - Aging management of the earthen portion of this structure is discussed in the response to (1) above. Concrete portions are addressed in LRA Table 2.4-11, under Component Group, "Concrete Walls", and Aging Management Reference 3.5.1.22, RG 1.127, Inspection of

Water Control Structures Associated with Nuclear Power Plants, Program B.1.31.

- Crib House Stop Logs - These components are addressed in LRA Table 2.3.3-22, Component Group “Stop Logs” and Aging Management Reference 3.3.2.304, with no aging management required (as supplied in RAI 2.4-7 response).

- Crib house dewatering valves and trash rake refuse pit - The valves are addressed in LRA Table 2.3.3-22, under Component group, “Valves”, and Aging Management Reference 3.3.2.278, Open Cycle Cooling Water Program B.1.13 and Aging Management Reference 3.3.2.300, Bolting Integrity Program B.1.12. The refuse pit is addressed in LRA Table 2.4-11 under component groups “Concrete Walls and Concrete Slabs” and Aging Management Reference 3.5.1.22, RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, Program B.1.31.

- Discharge Outfall Structure - This structure is addressed in LRA Table 2.3.3-22, under Component Groups, “Concrete Walls and Concrete Slabs”, and Aging Management Reference 3.5.1.22, RG 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants, Program B.1.31 (as supplied in RAI 2.4-7 response). However, these aging management activities are an enhancement and are not currently implemented.

- 8' Diameter Ice Melt Recirculating Pipe, including ice melt gate - The ice melt pipe is addressed in LRA Table 2.3.3-22, under Component Group, “Piping and Fittings”, and Aging Management Reference 3.3.1.15, Open Cycle Cooling Water Program B.1.13. The gate is addressed in LRA Table 2.3.3-22, under Component Group, “Valves”, and Aging Management Reference 3.3.2.278, Open Cycle Cooling Water Program B.1.13. and Aging Management Reference 3.3.2.300, Bolting Integrity Program B.1.12.

- Discharge flume/canal - The aging management for this earthen structure is discussed in the response to (1) above.

(3) Section B.1.31 of the LRA does list the operating experience for concrete structures. Section B.1.13 of the LRA lists the operating experience for the piping components covered by the Open Cycle Cooling Water Program.

The operating experience for the earthen structures:

Dresden has performed inspections of the intake and discharge canals and has not found any appreciable silting. However, minor silting was found at the intake structure near the bar racks. This silting was removed prior to loss of function of the ultimate heat sink.

Quad Cities, taking suction directly off the Mississippi River, has found significant levels of silting in the earthen structure of the intake flume as well as at the intake structure on several occasions. Timely corrective actions (dredging or cleaning) were completed prior to the loss of function of the ultimate heat sink, indicating an effective monitoring program.

(4) The only enhancement needed is to annotate the existing requirements of the Exelon procedures that monitor the aging effect, “Loss of Form due to Sedimentation”, to ensure that the required volume of water is available in the ultimate heat sink to support emergency cooling conditions as license renewal commitments. This requirement is implemented through a site Predefine Activity for scheduling and tracking purposes at Quad Cities. A similar Predefine Activity will be developed for Dresden.

(5) The Quad Cities intake flume is in the scope of license renewal. Management of this earthen structure is discussed in the response to (1) above.

(6) A baseline inspection will be performed prior to the period of extended operation for the Quad Cities Discharge Flume/Canal and Weir Gate and the Dresden Outfall Structure. Any problems affecting performance of intended functions will be identified and corrected.

Note that there are no current aging management activities performed for the Dresden Stop Logs. As there has been no viable aging mechanism identified, the stop logs will not be included in the baseline inspection.

(7) LRA Section A.1.31 for Dresden and Quad Cities will be updated to specifically indicate the applicable in-scope earthen structures (Dresden intake/discharge flumes and Quad Cities intake/discharge flumes) and the aging management activities associated with these structures.

This is Commitment #31 of Appendix A of this SER. Based on the initial and supplemental information provided by the applicant, the staff finds that the water control structures in the scope of license renewal have been appropriately evaluated in the applicant's AMR, and that AMP B.1.31 - "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" has been appropriately credited and enhanced to manage aging of water control structures for the period of extended operation. RAI B.1.31 is resolved.

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

3.5.2.3.5 Protective Coating Monitoring and Maintenance (B.1.32)

Summary of Technical Information in the Application. The applicant states in LRA Section B.1.32 that, with enhancements, the protective coating monitoring and maintenance program is consistent with the ten elements of aging management program XI.S8, "Protective Coating Monitoring and Maintenance Program," specified in NUREG-1801.

For license renewal, the following enhancements will be made. Enhancements are scheduled for implementation prior to the period of extended operation.

- Procedure revisions will provide for thorough visual inspections of Service Level I coatings near sumps or screens associated with the emergency core cooling system.

- Procedure revisions will provide for pre-inspection reviews of previous reports so that trends can be identified.

- Procedure revisions will provide for analysis of suspected reasons for coating failure.

This is Commitment #32 of Appendix A of the SER. The protective coating monitoring and maintenance program is credited for aging management of Service Level I coatings inside primary containment. Service Level I coatings are used in areas where the coating failure could adversely affect the operation of post-accident fluid systems and thereby impair safe shutdown.

The program provides for visual inspections to identify any condition that adversely affects the ability of the coating film to function as intended. It is implemented through procedures based on the technical and quality requirements of Regulatory Guide 1.54, Revision 0, "Quality Assurance Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants," and ANSI N101 4-1972, "Quality Assurance for Protective Coatings Applied to Nuclear

Facilities," and the guidance provided in EPRI TR-109937, "Guidelines on Nuclear Safety-Related Coating."

In its discussion on operating experience, the applicant states that examinations of the Dresden internal drywell accessible steel surfaces during refueling outages revealed the original coatings were acceptable other than exhibiting minor surface rust, paint flaking and discoloration. No significant degradation has been identified in the corrective action process records. The internal surfaces of the torus for each of the Dresden units were re-coated with an epoxy coating in the late 1980's during refuel outages D2R11 and D3R10. Surveillance of the coated torus internal surfaces during refueling outages has resulted in local coating repairs. A review of past inspections of the torus shells indicates the majority of the problems have been attributed to blistering of coating in small areas, localized pitting, and mechanical damage. Since the application of the epoxy protective coating on the internal surfaces, torus wall thinning has not been an issue. Inspections of drywell steel at Quad Cities have not identified any significant coating or corrosion problems requiring repair of the torus. In 1994 the Quad Cities Unit 1 torus internal surface corrosion was removed and the base metal was re-coated. During the subsequent refueling outage the torus shell immersion area was inspected. Coating deficiencies, such as mechanical damage, burrs and projections were identified and repaired. Minor local repairs to the coating on the inside of the Quad Cities Unit 2 torus were performed in March 1974. Inspections are conducted each outage, with local coating repairs performed as required.

The applicant concludes that the protective coating monitoring and maintenance program provides reasonable assurance that aging effects are adequately managed so that the intended functions of Service Level 1 coatings inside primary containment are maintained during the period of extended operation.

Staff Evaluation. In LRA Section B.1.32, "Protective Coating Monitoring and Maintenance Program," the applicant described its AMP to manage Service Level 1 coatings inside primary containment. The LRA stated that this AMP is consistent with GALL AMP XI.S8 with the enhancements described in the previous section. The staff confirmed the applicant's claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancements to determine whether the AMP, with the enhancements, is adequate to manage the aging effects for which it is credited. In addition, the staff determined whether the applicant properly applied the GALL program to its facility. The staff also reviewed the UFSAR supplements for both Dresden and Quad Cities to determine whether they provide an adequate description of the revised program.

In order to complete its evaluation, the applicant was requested in RAI B.1.32 to submit the following information:

(a) It is the staff's understanding that this program is being credited for prevention/mitigation of loss of material due to corrosion of steel structural components inside containment, including the accessible inside surfaces of the containment drywell and torus. In addition, it is the staff's understanding that this program augments, but does not replace, inspections conducted under IWE, IWF, and structures monitoring program. Please confirm that these understandings are correct, or provide additional explanatory information to clarify the scope and purpose of the Protective Coating Monitoring and Maintenance program.

(b) Does the scope of this program include monitoring and maintenance of anti-corrosion coatings applied to the sand pocket region of the drywell? If not, what program monitors the condition of these coatings?

(c) In the third paragraph under "Operating Experience," the LRA states "Inspections of drywell steel at Quad Cities have not identified any significant coating or corrosion problems requiring repair of the torus." Please clarify what is meant by this statement.

In its response to RAI B.1.32 dated October 3, 2003, the applicant stated:

> (a) The Protective Coating Monitoring and Maintenance program is being credited for License Renewal to prevent/mitigate loss of material due to corrosion of steel structural components inside containment, including the accessible inside surfaces of the containment drywell and torus. In addition, the program does augment, but does not replace, inspections conducted under the ASME Section XI, Subsection IWE program (LRA Section B.1.26), the ASME Section XI, Subsection IWF program (LRA Section B.1.27), and the structures monitoring program (LRA Section B.1.30).
>
> (b) The scope of the program does not include monitoring and maintenance of anti-corrosion coatings applied to the sand pocket region of the drywell. There is no program that monitors the condition of the coatings in the sand pocket region of the drywell. However, UT inspections of the drywell shell of the bounding unit (Dresden Unit 3) in the sand pocket region are performed each refueling outage as part of the ASME Section XI, Subsection IWE program. These UT inspections ensure drywell shell thickness at these locations is maintained above the minimum allowable.
>
> (c) The subject sentence in the third paragraph under "Operating Experience" inadvertently made reference to the torus. The sentence involves drywell steel and should have read as follows:
>
> Inspections of the drywell steel at Quad Cities have not identified any significant coating or corrosion problems requiring repair of the drywell steel.

The additional information provided by the applicant in its RAI response confirms the staff's understanding of the scope and purpose of the Protective Coating Monitoring and Maintenance program. The staff accepts that the scope of the program does not include monitoring and maintenance of anti-corrosion coatings applied to the sand pocket region of the drywell.

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

3.5.2.4 Aging Management Review of Plant-Specific Structures and Structural Components

In this section of the SER, the staff presents its evaluation of the applicant's aging management review of specific structures and structural components. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.4-1 through 2.4-16 to determine whether the applicant properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. The staff also reviewed the "Aging Management Review Aid" submitted by the applicant as a supplement to the LRA. This element of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in LRA Section 3, and that an appropriate AMP was credited for management of the aging effect. The results of the staff's review are provided below.

3.5.2.4.1 Primary Containment

Summary of Technical Information in the Application. The applicant's description of the primary containment (Dresden and Quad Cities) is in LRA Section 2.4.1. The applicant has defined "primary containment" to include not only the steel containment shell, but also all structures and structural components inside containment. The component groups requiring aging management review are identified in LRA Table 2.4-1. For each component group listed, LRA Table 2.4-1 specifies a reference to LRA Section 3 for the AMR results. For the primary containment component groups, the AMR results are provided in LRA Tables 3.5-1 and 3.5-2, with one exception: —walls, ceilings, and floors that serve as fire barriers reference LRA Table 3.3-1 (Reference No. 3.3.1.28). The applicant used the SRP-LR report format in LRA Table 3.5-1 to present its AMR for the containment components that are addressed in the GALL Report. Further evaluation of aging management, as recommended by GALL, is discussed in LRA Section 3.5.1.1. Aging management programs or evaluations that are different from those in GALL are described in LRA Section 3.5.1.2. In LRA Table 3.5-2, the applicant identified the containment component groups that are not addressed in the GALL Report and provided the following information: on (1) material, (2) environment, (3) aging effect(s)/mechanism(s), and (4) AMP(s).aging management program(s).

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the following applicable materials for the primary containment, including the structures inside containment: as carbon steel, stainless steel, reinforced concrete, grout, lubrite base plates, polyurethane expansion foam, and various materials for seals, gaskets, and moisture barriers. The staff also identified the following applicable environments as (1) inside containment, (2) outside containment, (3) and inside containment, and exposed to aggressive environment.

Aging Effects

The LRA identified the following applicable aging effects:

- cracking, loss of material, and change in material properties for concrete components and grout

- cumulative fatigue, cracking, and loss of material for steel elements, penetrations, and hatches

- loss of seal for elastomers

- lock-up for beam seats

- hardening of drywell expansion foam

Aging Management Programs

The LRA credits the following AMPs for managing the identified aging effects:

- ASME Section XI, Subsection IWE
- 10 CFR Part 50, Appendix J
- Protective Coating Monitoring and Maintenance Program
- Structures Monitoring Program
- Fire Protection

A description of these AMPs is provided in LRA Appendix B. The applicant concludes that the effects of aging will be adequately managed by these AMPs, such that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section provides the staff's evaluation of the applicant's AMR for the primary containment and the applicability of the AMPs credited to manage the aging effects. Table 3.5-1 of this SER provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Table 3.5-1, for the components that are addressed in the GALL Report. Section 3.5.2.1 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, which do not require further evaluation. Section 3.5.2.2 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, for which the GALL Report recommends further evaluation.

The staff's evaluations of the aging management evaluations for the primary containment that are different from those described in the GALL Report, or are not addressed in GALL, are discussed below.

Aging Effects

Steel: Table 3.5-2 of the LRA, Reference No. 3.5.2.15, "Thermowells", states that stainless steel thermowells are installed in the torus. Section XI, Subsection IWE, of ASME is credited with managing the stainless steel/dissimilar metal welds for thermowells, inside or outside containment, for loss of material due to general galvanic pitting and crevice corrosion. The applicant was requested to (1) describe the location of all the stainless steel components and identify the specific environments to which they are exposed; (2) identify all aging effects/mechanisms that were evaluated, including those not requiring aging management, and provide the technical basis for each conclusion; and (3) discuss the technical basis for the selection of the AMP used to manage the applicable aging effects. This is part of RAI 3.5-16.

In response to the applicable part of RAI 3.5-16, the applicant stated the following:

> (1) The thermowells are installed in the suppression chamber shell. All are located below the waterline, with the exception of four thermowells at Quad Cities, two on each unit, that are located in the air space above the water line. The suppression chamber air space above the suppression chamber water level is made inert with nitrogen to maintain the oxygen content below 4% by volume during normal operation. The air temperature follows the normal, maximum operating suppression chamber water temperature of 95 F and the relative humidity is between 20 and 90%.
>
> The suppression chamber air space environment encompasses the following NUREG-1801

environment description:

Moist Containment Atmosphere (air/nitrogen), steam, or demineralized water

The suppression chamber water environment encompasses the following NUREG-1801 environment description: 25-288 °C (77 ° – 550 °F) demineralized water.

(2) All aging effects/mechanisms that were evaluated for the suppression chamber thermowells are described below along with the technical basis used to determine whether aging management was required. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools" (EPRI Mechanical Tools), Appendix A, Tables 4-1 and 4-2 and Figures 1 and 2, were utilized to identify potential aging effects/mechanisms for the thermowells and are the bases for the following discussions.

Loss of material/general, pitting, and crevice corrosion: This is applicable to the thermowells installed in either the suppression chamber water or air space environments. While stainless steel itself is not susceptible to general corrosion, it was conservatively assumed to be an applicable aging mechanism for the installation due to the fact that thermowells are welded to carbon steel half-couplings, which are in turn welded to the suppression chamber shell.

Loss of material/galvanic corrosion: The stainless steel thermowells are welded to carbon steel half-couplings or sleeves, which are welded to the exterior of the suppression chamber shell. This dissimilar metal weld is outside the suppression chamber where an electrolytic environment does not exist. However, an electrolytic environment does exist between the half-coupling/sleeves and the thermowell. For this reason, this aging effect/mechanism is considered applicable to the thermowell installations.

Crack initiation and growth/SCC: This is not considered applicable to the thermowells installed in either the suppression chamber water or air space environments. Stress Corrosion Cracking (SCC) has been observed in high purity water at temperatures greater than 200 °F and dissolved oxygen levels greater than 100 ppb. The normal, maximum operating suppression chamber water temperature is 95 F. Suppression chamber water quality is maintained within EPRI recommended levels. Therefore, suppression chamber thermowells are not susceptible to SCC.

(3) The stainless steel thermowells installed in the suppression chamber are included in ASME Section XI, Subsection IWE ISI Program. This aging management program is credited with managing the loss of material due to corrosion for these thermowells. The program provides for the inspection of ASME Class MC pressure retaining components and their integral attachments and is also credited for managing the loss of material aging effects due to corrosion for NUREG-1801 Section II.B components with dissimilar metal welds.

The staff finds the applicant's AMR and selection of the AMP for thermowells installed in the suppression chamber shell to be acceptable, based on consistency with the guidance in the GALL Report for similar material and environment. Based on the information provided, the staff accepts the applicant's conclusion that the thermowells are not susceptible to SCC. This part of RAI 3.5-16 is resolved.

Miscellaneous Materials (expansion foam): In LRA Table 3.5-2, Reference No. 3.5.2.8, "Drywell Expansion Foam," the applicant references a plant-specific TLAA that is described in LRA Section 4.7.4. The polyurethane drywell expansion foam installed on the outside of the containment was originally evaluated for hardening due to radiation exposure assuming a 40-year operating life. As discussed in Section 6.2.1.2.1.1 of the Dresden UFSAR, this foam has caught fire twice in Dresden Unit 3 (January 20, 1986, and June 4, 1988). The staff requested the applicant, in RAI 3.5-10, to submit the following information for all four units:

(a) Describe any other instances of fires or other degradation experiences related to the drywell expansion foam.

(b) Describe the programs and procedures put in place to prevent future fires in the drywell expansion foam. If none, explain why they are not necessary.

(c) Describe any investigations that determined whether there was any significant change in material properties due to the fires, or other operating experiences, that would prevent the foam from performing its intended function. If none, explain the technical basis for concluding that there has been no change in material properties.

(d) Identify all the environments that the expansion foam may be exposed to, including leaking water, and discuss what effect each environment may have on the material properties of the foam.

(e) Concerning the January 26, 1986, fire, Dresden UFSAR Section 6.2.1.2.1.1 states, "The polyurethane in the gap burned for several hours resulting in a postulated upper bounding temperature of 500 degree F for both the steel containment and the primary containment shield wall." It also states, "Structural integrity of both the concrete and containment steel were determined not to be impaired to perform as designed in the event of a design basis accident (DBA)." Concerning the June 4, 1988, fire, it was determined that "this fire was bounded by the analyses conducted for the 1986 fire and no further analyses were conducted." Provide a detailed technical basis demonstrating that the evaluation of the concrete and containment steel for the effects of the fires remains valid for the period of extended operation.

In response to RAI 3.5-10, the applicant stated the following:

> (a) The polyurethane foam is installed on the outside of the steel drywell containment vessel, but inside the surrounding concrete shield, providing an expansion gap between the steel and concrete surfaces. No other instances of degradation of Drywell Expansion Foam other than those discussed in the Dresden UFSAR could be found.
>
> (b) Procedures originally developed to prevent recurrence of these fires include Dresden Maintenance Procedure DMP 4100-1 and Dresden Administrative Procedure DAP 3-2, which have been superceded by, OPAA-201-004, "Fire Prevention For Hot Work". This new procedure still emphasizes the requirement for a Fire Watch during hot work (welding, cutting, grinding and open flame operations) for 30 minutes after completion or suspension of the hot work.
>
> (a) The fires were evaluated as part of the initial event and the results accepted by the NRC in "Safety Evaluation Report By The Office of Nuclear Reactor Regulation of The Expansion Gap Fire on January 20, 1986 at Dresden Station Unit 3" dated August 31, 1987. The foam's intended function(s) is "Expansion/Separation – Provides for thermal expansion and/or seismic separation". Test results from the burning of polyurethane foam samples showed that the residuals are easily crushed by finger pressure and would therefore allow the thermal expansion of the drywell liner for the period of extended operation. Additionally, Section 4.7.4 of the LRA provides the basis for concluding that no change in material properties is expected for the extended term of operation.
>
> > (d) The expansion foam was evaluated as exposed to an "Outside Containment" environment. This environment is defined as: The Reactor Building (outside the drywell, torus, and steam tunnel) normal operating area temperatures range from 65 F to 103 F for Dresden and 65 F to 104 F for Quad Cities with relative humidity ranging between 20% and 90%. As discussed in LRA Section 4.7.4, this environment in addition to the expected radiation exposure will not affect the resilient characteristics of this polyurethane foam. This foam is not typically exposed to leaking fluid.

(e) The original function of the foam was to provide separation between the drywell steel liner and the concrete as the concrete was poured. The remaining function of the foam is to allow thermal expansion of the steel liner. Test results from the burning of polyurethane foam samples showed that the residuals are easily crushed by finger pressure and would therefore allow the thermal expansion of the drywell liner for the period of extended operation. The structural integrity of the containment steel and surrounding concrete was not affected by the drywell fires. Temperatures experienced by the drywell liner fires never approached 850 °F, which is the minimum temperature that steel begins to lose tensile strength. The surrounding concrete was also not affected as concrete spalling does not occur below 1000 °F.

The staff finds the applicant's response acceptable and RAI 3.5-10 is resolved.

Fire Barrier Materials: In the LRA, Table 2.4-1 references LRA Table 3.3-1 for the AMR related to cracking and spalling and loss of material for concrete and reinforcement of fire barrier walls, ceilings, and floors. The AMPs credited for these components are Fire Protection and Structures Monitoring. The discussion column on this item states that it is consistent with the GALL Report, with the following exception:

> The exceptions to structural aging effects due to aggressive chemical attack, reaction with aggregates, freeze-thaw & corrosion of embedded steel are described in LRA Section 3.3.1.2.1. The exceptions to Fire Protection are described in LRA Section B.1.18.

Section 3.3.1.2.1 of the LRA states that no aging management is required to manage the following structural aging effects for concrete in inaccessible areas:

- cracking and spalling due to aggressive chemical attack
- cracking and spalling due to reaction with aggregates
- cracking and spalling due to freeze-thaw
- loss of material due to corrosion of embedded steel

The technical bases provided for these exceptions are the same as those described in LRA Sections 3.5.1.1.6 and 3.5.1.1.7. The staff's evaluation of these exceptions is included in SER Section 3.5.2.2.2. The staff concluded that these exceptions are acceptable.

The exceptions to the GALL Fire Protection AMP are described in LRA Section B.1.18. These exceptions primarily relate to the frequency of inspection of various fire protection component groups. With respect to concrete walls, floors, and ceilings that serve a fire barrier intended function, the inspection frequency is consistent with the Structures Monitoring AMP, which the applicant credits to manage aging of all concrete structural components, including those that serve a fire barrier intended function. Therefore, from the standpoint of structural integrity, the staff finds this acceptable. The staff review of the applicant's Fire Protection AMP is presented in SER Section 3.3.2.3.

The aging effects identified in the LRA for the primary containment are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs with managing the aging effects described above for the primary containment:

- ASME Section XI, Subsection IWE
- 10 CFR Part 50, Appendix J
- Protective Coating Monitoring and Maintenance Program
- Structures Monitoring Program
- Fire Protection

In the LRA, Section 3.5.1.2.9 discusses an exception to the GALL Report for evaluation of the ECCS suction header identified under Reference Nos. 3.5.1.12 and 3.5.1.14 in LRA Table 3.5-1. The applicant states that this item is evaluated with GALL item V.D2.1-a, with the results presented in Reference Nos. 3.2.1.2 and 3.2.1.4 in LRA Table 3.2-1. Table 3.2-1 references Water Chemistry and One-Time Inspection as the AMPs for these items. In accordance with GALL item II.B1.1.1-a, aging of the ECCS suction header should be managed by ASME Section XI, Subsection IWE. The applicant was requested in RAI 3.5-9 to (a) explain why the ECCS suction header was evaluated as part of the ECCS piping and not as part of the containment, and (b) submit a detailed technical basis demonstrating that an equivalent level of safety is achieved with the applicant's approach, when compared to Subsection IWE requirements.

In its response to RAI 3.5-9, the applicant stated the following:

> NUREG-1801 addresses the ECCS Suction Headers in two locations. Item II.B.1.1.1-a addresses the Primary Containment (ASME Class MC components) and manages Loss of Material due to Corrosion. Item V.D2.1.a addresses Piping and Fittings, (generally ASME Class 2 components) and manages Loss of Material due to General, Pitting, and Crevice Corrosion.
>
> The current design bases for the Dresden and Quad Cities ECCS Suction Headers classify these as ASME Class 2 components. This is reflected on boundary diagrams LR-DRE-—29 (drawing coordinates C-3 to C-6), LR-DRE-—360-1 (drawing coordinates C-3 to C-6), LR-QDC-—39-1 (drawing coordinates E-3 and E-7), and LR-QDC-—81-9 (drawing coordinates E-3 and E-7). The ASME Code Class flags are defined on boundary diagrams LR-DRE-—11-2 and LR-QDC-—12-3. Since both NUREG-1801 line items provide an NRC-accepted method to manage the loss of material due to corrosion in carbon steel components, the Dresden and Quad Cities LRA selected the applicable NUREG-1801 line item based on current design bases. For this reason, the ECCS Suction Headers are managed by the Water Chemistry (B.1.2) and One-time Inspection (B.1.23) aging management programs.
>
> Note: The ECCS Suction Header shown on boundary diagram LR-DRE-—29 is shown in black. It should have been shown in green as an in-scope component.

The staff acknowledges the applicant's basis for the exception to GALL Item II.B1.1.1-a. Since the applicant has included the ECCS suction headers under V.D2.1 ECCS Piping and Fittings, and the staff has accepted the applicant's AMR for the ECCS, including the suction headers, RAI 3.5-9 is resolved.

The 10 CFR Part 50 Appendix J and Structures Monitoring Programs are considered common AMPs. The staff's evaluation of the common AMPs is in SER Section 3.0.3. The staff's evaluation of the ASME Section XI, Subsection IWE and the Protective Coating Monitoring and Maintenance Programs is in SER Section 3.5.2.3. The staff's evaluation of the Fire Protection AMP is in SER Section 3.3.2.3. The staff finds that the applicant has credited the appropriate AMPs with managing aging of the primary containment.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the ... will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.2 Other Class I Structures

Summary of Technical Information in the Application. This section addresses the other Class 1 structures. The applicant's description of each structure and the component groups requiring AMR is in the LRA section and table shown in parentheses.

- reactor building (LRA Section 2.4.2 and Table 2.4-2)
- main control room and auxiliary electric equipment room (LRA Section 2.4.3 and Table 2.4-3)
- turbine building (LRA Section 2.4.4 and Table 2.4-4)
- diesel generator building (LRA Section 2.4.5 and Table 2.4-5)
- station blackout building and yard structures (LRA Section 2.4.6 and Table 2.4-6)
- isolation condenser pump house (Dresden only) (LRA Section 2.4.7 and Table 2.4-7)
- makeup demineralizer building (Dresden only) (LRA Section 2.4.8 and Table 2.4-8)
- radwaste floor drain surge tank (LRA Section 2.4.9 and Table 2.4-9)
- miscellaneous foundations (LRA Section 2.4.10 and Table 2.4-10)
- crib house (LRA Section 2.4.11 and Table 2.4-11)
- Unit 1 crib house (Dresden only) (LRA Section 2.4.12 and Table 2.4-12)

For each component group listed, LRA Tables 2.4-2 through 2.4-12 specify a reference to LRA Section 3 for the AMR results. The applicant used the SRP-LR report format in LRA Table 3.5-1 to present its AMR for the Class 1 structures components addressed in the GALL Report. Further evaluation of aging management, as recommended by GALL, is discussed in LRA Section 3.5.1.1. Aging management programs or evaluations that are different from those in GALL are described in LRA Section 3.5.1.2. In LRA Table 3.5-2, the applicant identified the Class 1 structures component groups that are not addressed in the GALL Report and provided the following information on material, environment, aging effect(s)/mechanism(s), and AMP(s).

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the applicable materials for Class 1 structures components as carbon steel; stainless steel; galvanized or coated carbon steel; aluminum; reinforced concrete; grout; concrete block; silicone rubber; polyethylene; and vapor barrier, coal tar pitch, rigid insulation, felt, gravel, or single-ply hypalon pavers for roofing. The staff also identified the applicable environments as outside containment, exposed to aggressive environment, indoor, outdoor, weather exposed, flowing water, exposed to water, ambient inside building, and fluid (water, fuel).

Aging Effects

The LRA identifies the following applicable aging effects:

- loss of material

- change in material properties
- cracking
- separation and water in-leakage
- hardening
- reduction in concrete anchor capacity

Tables 2.4-2 through 2.4-12 of the LRA reference LRA Section 3.5 for the AMR results, except for the following:

- boral and boraflex neutron absorbing sheets in chemically treated oxygenated water (LRA References 3.3.1.9 and 3.3.1.12)

- steel fire doors (LRA References 3.3.2.4 and 3.3.1.18)

- cementitious fire proofing and ceramic fiber fire wrap (LRA References 3.3.2.62 and 3.3.2.63)

- concrete block fire barriers (LRA Reference 3.3.2.129)

- fire barrier and flood barrier penetration seals (LRA Reference 3.3.1.18)

- stainless steel spent fuel storage racks in chemically treated oxygenated water (LRA Reference 3.3.1.11)

- fire barrier walls, ceilings and floors (LRA Reference 3.3.1.28)

- carbon steel piles exposed to soil and ground water (LRA Reference 3.3.2.207)

Aging Management Programs

The LRA credits the following AMPs for managing the identified aging effects:

- Structures Monitoring Program
- Masonry Wall Program
- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants
- Water Chemistry
- Fire Protection
- Boraflex Monitoring

A description of these AMPs is provided in LRA Appendix B. The applicant concludes that the effects of aging will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section provides the staff's evaluation of the applicant's AMR for other Class I structures and the applicability of the AMPs credited with managing the aging effects. Table 3.5-1 of this SER provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Table 3.5-1 for the components that are addressed in the GALL Report. Section 3.5.2.1 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, which do not require further evaluation. Section 3.5.2.2 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, for which the GALL Report recommends further evaluation.

The staff's evaluations of the aging management evaluations for the other Class 1 structures that are different from those described in the GALL Report, or are not addressed in GALL, are discussed below.

Aging Effects

Concrete: In entry 3.5.1.22 in LRA Table 3.5-1, the applicant identifies a number of exceptions to the GALL Report for Group 6 structures (water-control structures). These exceptions are discussed in LRA Sections 3.5.1.2.1 through 3.5.1.2.7.

In LRA Section 3.5.1.2.1, the applicant discusses an exception to aging of concrete due to settlement. The applicant states the following:

> The Dresden and Quad Cities licensing basis does not include a program to monitor concrete for settlement nor is a de-watering system in place. Dresden and Quad Cities structures are founded on rock or naturally compacted soil with no documented changes in groundwater conditions or a history of settlement. Cracks, distortion and increase in component stress level due to settlement are not applicable and no aging management is required.

The staff finds the applicant's explanation to be acceptable because there has been no requirement to monitor settlement as part of the licensing basis for all four units, and there are no de-watering systems in place.

In LRA Sections 3.5.1.2.2 through 3.5.1.2.7, the applicant states that the aging management program RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.1.31), is credited for managing concrete in accessible areas for the following aging effects/mechanisms:

- loss of material and cracking due to freeze-thaw
- increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide of concrete
- expansion and cracking due to reaction with aggregates
- loss of material due to abrasion and cavitation of concrete
- cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel
- increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack

The staff finds that this aspect of the applicant's AMR is consistent with the GALL Report, and therefore is acceptable. For the first three aging effects/mechanisms identified above, the applicant states that no aging management is required for concrete in inaccessible areas. In

LRA Sections 3.5.1.2.2 through 3.5.1.2.4, the applicant provides the following technical bases for this conclusion:

- Dresden and Quad Cities have documented evidence to show that the concrete air content is between 3 percent and 6 percent.

- Plant inspections did not show freeze-thaw degradation.

- Dresden and Quad Cities have documented evidence that the concrete used was constructed in accordance with the recommendations in ACI 201.2R-77 for durability and with no evidence of reactive aggregates.

The staff finds this aspect of the applicant's AMR to be consistent with the GALL Report and therefore acceptable.

Section 3.5.1.2.5 of the LRA states that loss of material due to abrasion and cavitation of concrete in accessible areas is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants. The applicant further states that Dresden and Quad Cities water flow velocity (3.68 ft/sec) is less than the industry abrasion erosion threshold velocity of 4 ft/sec, and also less than the industry cavitation threshold velocity of 25 ft/sec. The applicant concludes that loss of material due to abrasion and cavitation of concrete in inaccessible areas is not applicable and no aging management is required. As discussed under GALL Item III A6.1-h, the staff expects that for Group 6 structures (water-control structures), loss of material due to abrasion and cavitation of reinforced concrete in a flowing water environment will be managed by the RG 1.127 program. This applies to all concrete—exterior above and below grade, foundation, and interior slab. In RAI 3.5-11, the staff requested that the applicant (1) clarify what is meant by "accessible" and "inaccessible" areas for all Group 6 components, (2) identify the reference for the stated industry abrasion erosion and cavitation threshold velocities, and (3) provide the technical basis for the reported Dresden and Quad Cities water flow velocity.

In response to RAI 3.5-11, the applicant stated the following:

> (1) For Group 6 Structures, the term inaccessible applies to those structures and portions of structures that are either buried or submerged under water where the confined area access or high flow rates make diver entrance unsafe without a dual unit outage.
>
> (2) Abrasion and cavitation are limited to concrete exposed to flowing water containing abrasives. Industry sources use an abrasion erosion threshold velocity for concrete of 4.0 feet per second (Ref.: EPRI TR-110025, Concrete Structural Aging References Manual of Nuclear Power Plants) and a cavitation threshold velocity for concrete of 25 fps when abrupt changes occur in closed conduits and 40 fps in continuously flowing water (Refs. EPRI TR-114881, Aging Effects for Structures and Structural Components (Structural Tools), Final Report and EPRI TR-103842, Class-I Structures - License Renewal Industry Report). Cavitation is not applicable for concrete structures continuously exposed to flowing water if the water velocity is less than these values.
>
> (1) The maximum water velocity in the crib houses for Dresden and Quad Cities is based on the velocity of the circulating water pump combined with the diesel generator cooling water pump, due to their close proximity and the reduced flow area in the intake tunnel where these pumps are located. The circulating water pump capacity is 157,000 gpm and the diesel generator cooling water pump capacity ranges from 1100 gpm to 1304 gpm. Flow area in the intake tunnel adjacent to the circulating water pump is conservatively 8 ft x 12 ft or 96 ft^2.

Velocity in fps = (158,304 gal/min) x (1 min/60 sec) x (0.134 ft^3/gal) / (96 ft^2) = 3.68 fps < 4.00 fps.

Since underwater accessible areas will be inspected, any occurrences of abrasion erosion or cavitation will be detected in these areas. However, the staff is unclear about the applicant's justification that abrasion erosion and cavitation do not require aging management for inaccessible areas. Part of the definition of "inaccessible areas", in part (1) of the response, is "where...high flow rates make diver entrance unsafe without a dual unit outage." These would appear to the areas most susceptible to abrasion erosion and possibly cavitation. The applicant was requested to quantify "high flow rates." In addition, it is unlikely that the water velocity is a uniform 3.68 ft/sec across the entire flow area in the intake tunnel, adjacent to the circulating water pump. The applicant was requested to consider a realistic velocity profile in estimating the maximum water velocity. In a letter dated December 5, 2003, the applicant stated that the inaccessible areas are better described as those areas where continuous flow makes diver entrance unsafe without a dual unit outage. The highest velocities experienced in the underwater structures will be in the individual circulating water bays, adjacent to the circulating water pumps. The 3.68 ft/sec flow velocity corresponds to the velocity at the pump suction centerline, which is considered to be a high value. The individual circulating water pump bays are accessible and will be inspected since they can be taken out of service during the applicable unit outage. Since the limiting locations for flow velocities and potential erosion effects are to be inspected, the inaccessibility of the areas of lower flow velocity is not detrimental to aging management. The staff finds the applicant's response acceptable. RAI 3.5-11 is resolved.

For Group 6 structures (water-control structures), LRA Section 3.5.1.2.6 indicates that cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel of concrete is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, only for accessible areas. Similarly, LRA Section 3.5.1.2.7 indicates that increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack of concrete is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, only for accessible areas. Sections 3.5.1.2.6 and 3.5.1.2.7 of the LRA indicate that aging management is not required for these aging effects/mechanisms in inaccessible areas because Dresden and Quad Cities ground-water test data show that the below-grade environment is not aggressive based on NUREG-1801 criteria (chlorides less than 500 ppm, sulfates less than 1500 ppm, and pH greater than 5.5); examination of representative samples of below-grade concrete, when excavated for any reason, is included as part of the Structures Monitoring Program; and to ensure conditions are maintained throughout the period of extended operation, the Structures Monitoring Program (B.1.30) will be enhanced to include monitoring of below-grade water chemistry to demonstrate that the environment remains nonaggressive.

As indicated in GALL Items III A6.1-d and e, for Group 6 structures (water-control structures), these aging effects/mechanisms are managed by the RG 1.127 program for all concrete. In the special case of water-control structures, the applicant's technical bases for excluding inaccessible areas from aging management may be applied only to concrete buried in the ground. In RAI 3.5-12, the staff requested that the applicant (a) define the term "inaccessible areas" as it relates to the subject aging effects/mechanisms in water-control structures and specifically discuss whether below-grade and below-water concrete in water-control structures is being excluded from aging management; and (b) if applicable, submit a detailed technical justification for not managing aging of below-grade/below-water concrete in water-control structures, in light of past industry operating experience indicating there is a significant potential for degradation.

In its response to RAI 3.5-12, the applicant stated the following:

> (a) The term inaccessible applies to those structures and portions of structures that are either buried or submerged under water where the confined area access makes diver entrance unsafe without a dual unit outage. The term accessible applies to those structures and portions of structures that are interior, above-grade exterior, or under water accessible.
>
> (b) Aging Management Reference 3.5.1.22 states that this aging management evaluation is "Consistent with NUREG 1801, with exception". The exceptions to NUREG-1801 are described in LRA sections 3.5.1.2.6 and 3.5.1.2.7. The technical bases for exceptions 3.5.1.2.6 and 3.5.1.2.7 apply to the below-grade and inaccessible under water environments.
>
> This technical justification for Group 6 structures is the same as the evaluation for Groups 1, 2, and 3 structures as discussed under NUREG-1801, Items III A1, 2, 3.1-e and III A1, 2, 3.1-g. Dresden and Quad Cities ground water test data obtained during construction, in the 1980's, 1990's, and 2000's shows that the below-grade environment is not aggressive based on NUREG-1801 criteria with chlorides less than 500 ppm, sulfates less than 1500 ppm, and pH greater than 5.5. The specified aging effects are not significant and no aging management is required of components in inaccessible areas. As recommended in the letter from Christopher I. Grimes to Alan Nelson dated 4/5/02, Subject: "Staff response to industry's proposed revisions of chapters II and III of generic aging lessons learned (GALL) report on aging management of concrete elements" that further evaluation of concrete components in inaccessible areas is not required for which non-aggressive environment can be demonstrated. Therefore, Exelon is in compliance with the Interim Staff Guidance (ISG) on concrete for inaccessible area concrete components. To ensure conditions are maintained throughout the period of extended operations, the Structures Monitoring Program (B.1.30) includes monitoring of below-grade water chemistry to demonstrate that the environment remains non-aggressive.

The applicant has not specifically addressed a key element of this RAI. The ultimate heat sink raw water is considered aggressive by its nature, and all concrete exposed to it needs to be managed for these aging effects/mechanisms. In light of past industry operating experience indicating there is a significant potential for degradation, the applicant was requested to specifically discuss whether below-water concrete in water-control structures is being excluded from aging management, and if applicable, submit a detailed technical justification for not managing aging of below-water concrete in water-control structures. The applicant was also requested to submit its AMR for concrete exposed to the ultimate heat sink raw water, and either identify the credited AMPs or submit a detailed technical justification for not managing the aging of concrete exposed to raw water. In a letter dated December 5, 2003, the applicant stated that all in-scope below-water concrete (submerged) exposed to the ultimate heat sink raw water environment will be managed for aging except the inaccessible common area in the crib house intake outside of the individual bays to the circulating water pumps where continuous flow makes diver entrance unsafe without dual unit outage. Aging management program B.1.31 provides for managing the aging effects of in-scope accessible concrete exposed to the ultimate heat sink raw water environment at Dresden and Quad Cities. The staff finds the applicant's response acceptable and considers RAI 3.5-12 resolved.

Steel: Under Reference No. 3.5.1.28 in LRA Table 3.5-1, the applicant identified an exception to the GALL Report for cracking due to crack initiation and growth due to SCC and loss of material due to crevice corrosion. This exception applies to the stainless steel liners in the

Dresden and Quad Cities radwaste floor drain surge tanks. In LRA Section 3.5.1.2.8, the applicant states the following:

> Stainless steel liners in the Dresden and Quad Cities floor drain surge tanks are not susceptible to cracking due to crack initiation and growth due to SCC or loss of material due to crevice corrosion and do not require aging management.
>
> The floor drain surge tanks are vented and constructed of reinforced concrete with a stainless steel liner. The floor drain surge tank liner is not considered susceptible to SCC, since the tanks are vented (low service pressure), concentrated chlorides in the effluent are not expected, and the temperature of effluents would be ambient (less than threshold temperature of 140 degrees F for SCC). Stainless steel is susceptible to crevice corrosion given a sufficiently narrow crevice in the presence of oxygen. Crevice corrosion most frequently occurs in joints, and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads where contaminants can concentrate. The stainless steel liner has all welded seams and plug welds for anchorage, with all welds ground smooth. Therefore, the occurrence of crevice corrosion in the tank liner is not expected due to its configuration.
>
> In addition, the floor drain surge tank has a drain system installed between the liner and concrete that would intercept leakage from behind the liner plate weld seams and drain the leakage to the attached pump house room. There have been no documented corrective action requests related to aging associated with the stainless steel liner plate drains.

The staff finds the applicant's explanation to be acceptable and agrees that the stainless steel liners in the floor drain surge tanks do not require aging management.

In LRA Table 3.5-2 (Reference Nos. 1, 2, 6, and 16), the applicant identified loss of material/general corrosion as an aging effect/mechanism requiring management for the following galvanized or coated carbon steel components in the station blackout building and yard structures:

- bus duct covers
- bus duct supports
- dead end structures
- transmission towers

The applicant credits the Structures Monitoring Program as the AMP for these component groups. In Appendix B.1.30, Structures Monitoring Program, the applicant states that the program will be enhanced to provide for inspections of structural steel in offsite power structural components. The staff finds the applicant's AMR for these components to be acceptable and agrees that the Structures Monitoring Program is an acceptable program to manage the identified aging effect.

Table 2.4-6 of the LRA references LRA Table 3.3-2, entry 3.3.2.207, for the AMR of carbon steel piles exposed to soil and ground water in the station blackout building (Dresden only). Section 2.4.6 of the LRA provides no description of the steel piles. In SER Section 2.4.6.2, the staff requested the applicant in part (c) of RAI 2.4.5 to describe the steel piles at Dresden and define intended functions and explain why the "Aging Management Ref" for the steel piles is 3.3.2.207, which is in LRA Section 3.3 for Auxiliary Systems. The applicant described the steel piles and revised the AMR reference. Consistent with past staff determinations, the applicant has concluded that no aging management is necessary for the steel piles. The staff accepts this assessment.

Elastomers/Roofing: In LRA Table 3.5-2 (Reference Nos. 3, 4, 7, 11, 12, and 13), the applicant identifies the following aging effects/mechanisms for elastomer materials that require management in various component groups for Class 1 structures:

- hardening cracking/elastomer degradation in silicone rubber used in caulking/sealants, door seals, and secondary containment boot seals

- change in material properties/loss of resiliency, loss of strength, loss of elasticity in silicone rubber caulking/sealants and polyethylene seismic gap filler

- separation and water in-leakage/weathering in vapor barrier, coal tar pitch, rigid insulation, felt, gravel, or single-ply hypalon pavers for roofing

The applicant credits the Structures Monitoring Program as the AMP for these component groups. In Appendix B.1.30, Structures Monitoring Program, the applicant states that the program will be enhanced to provide for inspection parameter specificity for nonstructural joints, roofing, grout pads, and isolation gaps. The staff finds the applicant's AMR for these components to be acceptable and agrees that the Structures Monitoring Program is an acceptable program to manage the identified aging effects.

Aluminum New Fuel Storage Racks: In LRA Table 3.5-2 (Reference No. 3.5.2.10), the applicant states that there are no viable aging effects for the aluminum new fuel racks in the indoor environment of the reactor building, and concludes that no AMP is required. The staff agrees with the applicant that no aging management is required for the aluminum new fuel racks.

Spent Fuel Storage Rack Materials: Table 2.4-2 of the LRA references LRA Table 3.3-1 for the AMR of the spent fuel storage racks and the neutron absorbers in the reactor building:

- reduction of neutron-absorbing capacity and loss of material for boral and boraflex neutron absorbing sheets in chemically treated oxygenated water (boral—LRA Reference 3.3.1.9; boraflex—LRA Reference 3.3.1.12)

- crack initiation and growth of stainless steel spent fuel storage racks in chemically treated oxygenated water (LRA Reference 3.3.1.11)

In LRA Table 3.3-1, Reference 3.3.1.12 identifies the Boraflex Monitoring AMP (LRA B.1.36) for managing reduction of neutron-absorbing capacity in boraflex, used at Quad Cities. The discussion column indicates that this AMP is consistent with the GALL Report. The staff finds this acceptable.

In LRA Table 3.3-1, Reference 3.3.1.11 identifies the Water Chemistry AMP (LRA B.1.2) for managing crack initiation and growth in stainless steel spent fuel storage racks. The discussion column indicates that this AMP is consistent with the GALL Report, with exceptions as noted in LRA B.1.2. The exceptions do not affect water chemistry monitoring of the spent fuel pool.

On the basis that the spent fuel storage racks are made of the same material as the spent fuel pool liner and are in the same environment, the applicant's AMP for the spent fuel pool liner (i.e., Water Chemistry AMP plus fuel pool water level monitoring) will also manage aging of the spent fuel storage racks. Any reduction in the spent fuel pool water level that is attributed to crack initiation and growth in the liner would be an indicator that crack initiation and growth may also be occurring in the spent fuel storage racks. The staff finds this acceptable.

Fire and Flood Barrier Materials: Tables 2.4-2 through 2.4-7, 2.4-11, and 2.4-12 of the LRA reference LRA Tables 3.3-1 and 3.3-2 for the AMR results for the following fire and flood barrier items:

- loss of material/wear for steel fire doors (LRA References 3.3.2.4 and 3.3.1.18)

- reduced fire protection capability for cementitious fire proofing and ceramic fiber fire wrap (LRA References 3.3.2.62 and 3.3.2.63) (based on applicant's response to an RAI related to LRA Section 2.3)

- cracking of concrete block fire barriers (LRA Reference 3.3.2.129)

- increased hardness and shrinkage of sealant for fire barrier and flood barrier penetration seals (LRA Reference 3.3.1.18)

- cracking and spalling and loss of material for concrete and reinforcement of fire barrier walls, ceilings, and floors (LRA Reference 3.3.1.28)

The applicant's exceptions to the GALL Fire Protection AMP are described in LRA Section B.1.18. These exceptions primarily relate to the frequency of inspection of the various fire protection component groups. The staff review of the applicant's Fire Protection AMP is presented in SER Section 3.3.2.3.

The aging effects identified in the LRA for the Class 1 structures are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs with managing the aging effects described above for Class 1 structures:

- Structures Monitoring Program
- Masonry Wall Program
- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants
- Water Chemistry
- Fire Protection
- Boraflex Monitoring

The Structures Monitoring and Water Chemistry Programs are considered common AMPs. The staff's evaluation of the common AMPs is in SER Section 3.0.3. The staff's evaluation of the Masonry Wall Program and RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, is in SER Section 3.5.2.3. The staff's evaluation of Fire Protection and Boraflex Monitoring is in SER Section 3.3.2.3. The staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the Class 1 structures.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the Class 1 structures will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.3 Station Chimney (LRA Section 2.4.13)

Summary of Technical Information in the Application. The applicant's description of the station chimney (Dresden and Quad Cities) is in LRA Section 2.4.13. The component groups requiring AMR are identified in LRA Table 2.4-13. For each component group listed, LRA Table 2.4-13 specifies a reference to LRA Section 3 for the AMR results. The AMR results are provided in LRA Tables 3.5-1 and 3.5-2. The applicant used the SRP-LR report format in LRA Table 3.5-1 to present its AMR for station chimney components addressed in the GALL Report. Further evaluation of aging management, as recommended by GALL, is discussed in LRA Section 3.5.1.1. In LRA Table 3.5-2, the applicant identified the station chimney component groups that are not addressed in GALL and provided information about material, environment, aging effect(s)/mechanism(s), and AMPs.

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the applicable materials for Station Chimney components as carbon steel, reinforced concrete, concrete block, and silicone rubber. Utilizing the Review Aid the staff also identified the applicable environments as exposure to aggressive environment and weather exposed.

Aging Effects

The LRA identifies the following applicable aging effects for the station chimney components:

- loss of material
- change in material properties
- cracking

Table 2.4-13 of the LRA references LRA Section 3.5 for the AMR results for all components.

Aging Management Programs

The LRA credits the following AMPs for managing the identified aging effects:

- Structures Monitoring Program
- Masonry Wall Program

A description of these AMPS is provided in LRA Appendix B. The applicant concludes that the effects of aging will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section provides the staff's evaluation of the applicant's AMR for the station chimney, and of the applicability of the AMPs credited with managing the aging effects. Table 3.5-1 of this SER provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Table 3.5-1 for the components that are addressed in the GALL Report. SER Section 3.5.2.1 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, which do not require further evaluation. Section 3.5.2.2 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, for which the GALL Report recommends further evaluation.

The staff's evaluations of the aging management evaluations for the station chimney that are not addressed in the GALL Report are discussed below.

Aging Effects

Elastomers: In LRA Table 3.5-2 (Reference No. 3.5.2.4), the applicant identified change in material properties/loss of resiliency, loss of strength, loss of elasticity in silicone rubber caulking/sealants as an aging effect/mechanism requiring management in the station chimney. The applicant credits the Structures Monitoring Program as the AMP for this component group. In Appendix B.1.30, Structures Monitoring Program, the applicant states that the program will be enhanced to provide for inspection parameter specificity for nonstructural joints, roofing, grout pads, and isolation gaps. The staff finds the applicant's AMR for this component to be acceptable and agrees that the Structures Monitoring Program is an acceptable program to manage the identified aging effects.

Concrete Block: In LRA Table 3.5-2 (Reference No. 3.5.2.9), the applicant identified cracking/restraint, shrinkage, creep, and aggressive environment in concrete block masonry walls as aging effects/mechanisms requiring management in the station chimney. The applicant credits the Masonry Wall Program as the AMP for this component group. The staff finds the applicant's AMR for this component to be acceptable and agrees that the Masonry Wall Program is an acceptable program to manage the identified aging effects.

The aging effects identified in the LRA for the station chimney are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

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

- Structures Monitoring Program
- Masonry Wall Program

The Structures Monitoring Program is considered a common AMP. The staff's evaluation of the common AMPs is in SER Section 3.0.3. The staff's evaluation of the Masonry Wall Program is in SER Section 3.5.2.3.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the station chimney will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.4 Cranes and Hoists

Summary of Technical Information in the Application. The applicant describes the cranes and hoists (Dresden and Quad Cities) in LRA Section 2.4.14. Table 2.4-14 of the LRA lists the component groups and specifies the location of the AMR results in LRA Section 3. For cranes and hoists, the AMR results are provided in LRA Table 3.3-1, under Auxiliary Systems. The applicant used the SRP-LR report format in LRA Table 3.3-1 to present its AMR for cranes and hoists addressed in the GALL Report. Further evaluation of aging management, as recommended by GALL, is discussed in LRA Sections 3.3.1.1.6 and 4.7.1. The credited AMP, including any enhancements or exceptions to the comparable GALL program, is described in LRA Section B.1.15.

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the applicable materials for cranes and hoists as structural steel A-36, A-7, A-285, and A-759, and the applicable environment as air at 100 percent relative humidity and 49 °C (120 °F).

Aging Effects

The applicant identifies the applicable aging effects for the cranes and hoists in LRA Table 3.3-1 (Reference Nos. 3.3.1.3 and 3.3.1.14) as cumulative fatigue damage and loss of material due to general corrosion and wear. Cumulative fatigue is a TLAA, addressed in LRA Section 4.7.1.

Aging Management Programs

The applicant credits the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handing Systems (B.1.15) AMP for managing loss of material due to general corrosion and wear. A description of this AMP is provided in LRA Appendix B, Section B.1.15. The applicant concludes that loss of material due to general corrosion and wear will be adequately managed by this AMP such that there is reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section presents the staff's evaluation of the applicant's AMR for cranes and hoists, and the applicability of the AMP credited with managing the aging effects.

Aging Effects

Table 3.3-1 (Reference No. 3.3.1.3) of the LRA states that further evaluation of cumulative fatigue damage for cranes and hoists is provided in LRA Section 3.3.1.1.6. Section 3.3.1.1.6 of the LRA states that cumulative fatigue damage of load handling cranes is a TLAA, as defined in 10 CFR 54.3, and is evaluated in accordance with 10 CFR 54.21(c)(1). Section 4.7.1 of the LRA "Reactor Building Crane Load Cycles," documents the applicant's evaluation of this TLAA. On the basis that the number of load cycles expected over a 60-year operating life is significantly less than the initial design rating for full-load cycles, the applicant has concluded that this TLAA remains valid for the period of extended operation. The staff's detailed evaluation of this TLAA is provided in SER Section 4.7.

Table 3.3-1 (Reference No. 3.3.1.14) of the LRA states that loss of material due to general corrosion and wear of cranes, including bridges, trolleys, and rail systems, will be managed by the AMP Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems, described in LRA Section B.1.15.

Based on information provided in LRA Section 2.4.14, the staff could not identify which "LRA Aging Management Ref No." is applicable to each of the crane/rail systems included in the scope of LRA 2.4.14. Also, it was unclear to the staff why cranes and hoists have been split into two groups, covered under different sections of LRA Section 2.0, and why all references to the AMR results point to LRA Section 3.3—Auxiliary Systems. In its response to RAI 2.4-9, the applicant listed all cranes and hoists that are in the license renewal scope and also listed all cranes and hoists that are not in the license renewal scope. The staff found the applicant's response to RAI 2.4-9 to be acceptable, from the standpoint of clarifying the scope.

The applicant also clarified the AMR of cranes and hoists in its response to RAI 2.4-9. Cranes and hoists related to refueling are included under auxiliary systems, while all other cranes and hoists within the scope of license renewal are included under structures. In all cases, the AMP Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems, described in LRA Section B.1.15, is credited with managing loss of material due to general corrosion and wear. The staff reviewed this AMP to ensure that all cranes and hoists are included in its scope. The AMP description in LRA Section B.1.15 addresses only load handling systems related to refueling. In a letter dated December 5, 2003, the applicant stated that the program scope is not restricted to cranes and hoists related to refueling but includes all cranes and hoists within the scope of license renewal. The staff finds the applicant's response adequate.

The aging effects identified in the LRA for the cranes and hoists are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the AMP Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.1.15) with managing loss of material due to general corrosion and wear for cranes and hoists.

The staff's detailed evaluation of this AMP is provided in SER Section 3.3.2.3.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the cranes and hoists will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.5 Component Supports Commodity Group

Summary of Technical Information in the Application. The applicant's description of the component supports commodity group (Dresden and Quad Cities) is in LRA Section 2.4.15. The component groups requiring AMR are identified in LRA Table 2.4-15. For each component group listed, LRA Table 2.4-15 specifies a reference to LRA Section 3 for the AMR results. The applicant used the SRP-LR report format in LRA Table 3.5-1 to present its AMR for the component supports commodity group components addressed in the GALL Report. Further evaluation of aging management, as recommended by the GALL Report, is discussed in LRA Section 3.5.1.1. Aging management programs or evaluations that are different from those in GALL are described in LRA Section 3.5.1.2. In LRA Table 3-5-2, the applicant identified the component supports commodity group components that are not addressed in the GALL Report and provided information on material, environment, aging effect(s)/mechanism(s), and AMP(s).

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the applicable materials for the component supports commodity group as carbon steel, low-alloy steel (yield strength 150 ksi), stainless steel, steel and nonsteel materials (e.g., lubrite plates), and nonmetallic materials (e.g., rubber). Utilizing the Review Aid, the staff identified the applicable environments as inside containment; outside containment; submerged (torus grade water); and 25–288 °C (77–550 °F) demineralized water.

Aging Effects

The LRA identifies the following applicable aging effects:

- loss of material
- cumulative fatigue damage
- cracking
- loss of mechanical function
- reduction or loss of isolation function

In most cases, LRA Table 2.4-15 references LRA Section 3.5 for the AMR results for all components. For some structural support members, LRA Table 2.4-15 references LRA Section 3.2, LRA Table 3.2-2 (Reference Nos. 3.2.2.79, 3.2.2.80, and 3.2.2.81).

Aging Management Programs

The LRA credits the following AMPs for managing the identified aging effects:

- Structures Monitoring Program
- ASME Section XI, Subsection IWF

- Bolting Integrity
- Water Chemistry
- One-Time Inspection

A description of these AMPs is provided in LRA Appendix B. The applicant concludes that the effects of aging will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section presents the staff's evaluation of the applicant's AMR for the component supports commodity group and the applicability of the AMPs credited with managing the aging effects. Table 3.5-1 of this SER provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Table 3.5-1 for the components that are addressed in the GALL Report. Section 3.5.2.1 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, which do not require further evaluation. Section 3.5.2.2 of this SER provides the staff's evaluation of the aging management evaluations in the GALL Report that are relied on for license renewal, for which the GALL Report recommends further evaluation.

The staff's evaluations of the aging management evaluations for the component supports commodity group that are different from those described in the GALL Report, or are not addressed in GALL, are discussed below.

Aging Effects

Section 3.5.1.2.10 of the LRA discusses an exception to the GALL Report for XI.M18, Bolting Integrity, identified under Reference No. 3.5.1.32 of LRA Table 3.5-1. The applicant states that Dresden and Quad Cities recirculation piping loop component supports inside the containment have ASTM 193 Grade B7 high-strength low-alloy steel bolting, which will be managed by ASME Section XI, Subsection IWF (B.1.27). The applicable GALL item number is III.B.1.1.2-a, which identifies XI.M18, Bolting Integrity, as an acceptable AMP for high-strength low-alloy steel bolts (yield strength greater than 150 ksi) used in NSSS component supports. In RAI 3.5-13, the applicant was requested to provide the following information:

(a) It is stated in LRA Section 3.5.1.2.10 that "the specification for ASTM 193 Grade B7 lists minimum yield strength of 105 ksi, with no upper yield strength installed." Clarify what is meant by the phrase "no upper yield strength installed."

(b) Verify that the actual yield strengths of the Dresden and Quad Cities recirculation piping loop component support bolting do not exceed 150 ksi.

(c) Clarify whether other Class 1, 2, 3 and MC component supports use high-strength low-alloy steel bolts. If so, describe the materials used and the corresponding AMP.

In its response to RAI 3.5-13, the applicant stated the following:

> Exelon has reviewed LRA Section 3.5.1.2.10 and the following additional information is provided:
>
> (a) Table 2, "Mechanical Requirements", found in ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service, specifies a minimum yield strength of 105 ksi. No upper limit is specified in the ASTM standard. The phrase "no upper

yield strength installed" means there is no upper yield strength mentioned in the ASTM standard.

(b) ASTM A193, Standard Specification for A193, Grade B7 material, specifies a maximum Brinell Hardness number of 321 HB for recirculation piping loop component support bolting that is less than 2-½ inch diameter. Based on ASTM A370, Standard Specification, Section 1, volume 01.01, a maximum Brinell Hardness number of 321 HB (interpolated between 319 HB and 327 HB) equates to a tensile strength of 153 ksi (interpolated between 152 ksi and 156 ksi). Therefore, the maximum yield strengths of the recirculation piping loop component support bolting are rounded to an approximate tensile strength of 150 ksi threshold value.

(c) Dresden UFSAR Section 3.9.3.1.1.3.3 and Quad Cities UFSAR Section 3.9.3.1.1.3 state that there are high strength bolts used in a friction type connection at the reactor skirt base. The material used for these high strength bolts is assumed to be ASTM A193, Grade B7 or equivalent. ASME Section XI, Subsection IWF (B.1.27) aging management program inspects the bolting. There are no other documented uses of high strength bolting found on Class 1, 2, 3 and MC Component supports at Dresden and Quad Cities Nuclear Power Stations.

The staff finds that the applicant's response related to ASTM A193, Grade B7 bolting material is sufficient to establish that the upper limit on yield strength is less than 150 ksi; consequently, the additional inspections of XI.M.18 Bolting Integrity are not warranted for A193, Grade B7. However, in part (c) of its response, the applicant has assumed that the bolt material used in "a friction type connection at the reactor skirt base" is ASTM A193, Grade B7 or equivalent. The applicant was requested to confirm that assumption or commit to inspection in accordance with NUREG-1801, Program XI.M.18 Bolting Integrity. In a letter dated December 5, 2003, the applicant stated that it would commit to inspection in accordance with NUREG-1801, Program XI.M.18 Bolting Integrity since it could not confirm that the yield strength of the bolts would be less than 150 ksi. This is part of Commitment #12 in Appendix A of this SER. The staff finds the applicant's response acceptable and considers RAI 3.5-13 resolved.

Section 3.5.1.2.11 of the LRA discusses an exception to the GALL Report for the AMP XI.S3, ASME Section XI, Subsection IWF. This exception is identified under Reference No. 3.5.1.31 of LRA Table 3.5-1. The applicant proposes to manage aging of downcomer bracing by inspections performed under the applicant's AMP ASME Section XI, Subsection IWE (B.1.26). The applicable GALL item number is III.B1.3.1-a, which identifies ASME Section XI, Subsection IWF as an acceptable AMP for support members. The staff requested in RAI 3.5-14 that the applicant (1) describe any inspections and schedules that would be required under Subsection IWF that will not be performed under the applicant's proposed use of Subsection IWE and (2) provide the technical bases for any deviations from the requirements of Subsection IWF.

In its response to RAI 3.5-14, the applicant stated the following:

(1) There are no inspections required by Subsection IWF that will not be performed by the use of Subsection IWE. Per the 1989 Edition and the 1992 Edition, with the1992 Addenda of ASME Section XI, Table IWE-2500-1, Item E1.11, the Class MC integral attachments are subject to a General Visual Examination (as described in IWE-3510.1) prior to each Type A Test. Additionally, per Item E1.12, these integral attachments are subject to a VT-3 each inspection interval. Per the 1995 Edition, with the 1996 Addenda of ASME Section XI, Table IWF-2500-1, supports are subject to a VT-3 each inspection interval.

(2) The bases for making this change is the comprehensive containment inservice inspection (CISI) which was recently mandated by the Nuclear Regulatory Commission final rulemaking per an amendment to the Code of Federal Regulations (10 CFR 50.55a). This rulemaking incorporates, by reference, the requirements of the 1992 Edition with the 1992 Addenda of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsections IWE and IWL with specified modifications. The final rulemaking was published on August 8, 1996 and specified an effective

> date of September 9, 1996 as well as an expedited implementation of these requirements within five years of the effective date (September 9, 2001). In response, the Dresden and Quad Cities CISI program included these supports as part of the IWE examination boundary.

The staff finds the applicant's basis for conducting inspection of downcomer bracing under the IWE AMP (B.1.26) to be reasonable and acceptable. Thus, RAI 3.5-14 is resolved.

In Table 3.5-2 of the LRA, Reference No. 3.5.2.5, "Clevis Pins," identifies three different component groups (torus columns, vent systems, and ESF lines), two materials (carbon steel and stainless steel), and three environments (submerged in torus grade water, inside containment and outside containment). For each of the three different component groups, at both Dresden and Quad Cities, the applicant was requested in RAI 3.5-15 to (1) identify all aging effects/mechanisms that were evaluated for each combination of material and environment, including those not requiring aging management; and (2) submit the technical basis for each aging management conclusion.

In its response to RAI 3.5-15, the applicant stated the following:

> For evaluation of carbon steel and stainless steel materials, "inside or outside containment" is treated as one environment. Thus, as evaluated, there are two materials and two environments associated with each of the three different clevis pin component groups. These are
>
> Carbon Steel - Submerged (torus grade water) inside or outside containment
>
> Stainless Steel - Submerged (torus grade water) inside or outside containment.

The applicant provided further clarification by correcting entry 3.5.2.5 in LRA Table 3.5-2 to show the correct combinations of materials, environments, and aging effects for the clevis pins. In addition, the applicant corrected Table 2.4-15 to show the proper AMR references.

The staff finds that the applicant's response clarifies the AMR and the credited AMPs for the clevis pins. The applicant has identified cracking due to SCC as an applicable aging effect/aging mechanism for stainless steel clevis pins submerged in torus grade water and credits the Water Chemistry Program for aging management. The staff position is that some verification of the effectiveness of the Water Chemistry Program is necessary. In a letter dated December 5, 2003, the applicant stated that it will include inspection for SCC as part of its one-time inspection to validate the effectiveness of the Water Chemistry Program in managing the aging of stainless steel components in the torus. This is part of Commitment #23 of Appendix A of this SER. The staff finds the applicant's response acceptable and considers RAI 3.5-15 resolved.

In Table 3.5-2, Reference No. 3.5.2.14, "Support Members," states that stainless steel pipe support stanchions are used on the recirculation piping 28" lines at Dresden and Quad Cities. The applicant credits ASME Section XI, Subsection IWF (B.1.27) with managing the stainless steel support members, inside or outside containment, for loss of material due to pitting and crevice corrosion. In RAI 3.5-16, the applicant was requested to (1) describe the location of all the stainless steel components and identify the specific environments to which they are exposed; (2) identify all aging effects/mechanisms that were evaluated, including those not requiring aging management, and provide the technical basis for each conclusion; and (3) discuss the technical basis for the selection of the AMP used to manage the applicable aging effects.

In response to the applicable part of RAI 3.5-16, the applicant stated the following:

(1) The stainless steel pipe support stanchions are located on the "A" and "B" Recirculation Pump suction and discharge piping, inside the drywell portion of the containment at both Quad Cities and Dresden. The lines are identified on boundary diagrams LR-QDC-35-2 and LR-QDC-77-2 at Quad Cities, and on LR-DRE-26-2 and LR-DRE-357-2 at Dresden. The line numbers are:

    Quad Cities: 1-0201A-28"-A, 1-0202A-28"-A, 1-0201B-28"-A, 1-0202B-28"-A, 2-0201A-28"-A, 2-0202A-28"-A, 2-0201B-28"-A, 2-0202B-28"-A

    Dresden: 2-0201A-28"-A, 2-0202A-28"-A, 2-0201B-28"-A, 2-0202B-28"-A, 3-0201A-28"-AM, 3-0202A-28"-AM, 3-0201B-28"-AM, 3-0202B-28"-AM

    The specific environment assigned to the stainless steel pipe supports is "Inside Containment." The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135 F during normal operations. The relative humidity in the drywell ranges from 20% - 90%.

(2) All aging effects/mechanisms that were evaluated for the pipe support stanchions are described below along with the technical basis used to determine whether aging management was required.

    <u>Stainless Steel Pipe Support Stanchions</u>
    The aging effects degradation of stainless steel external surfaces in indoor/outdoor atmospheric environments is evaluated in EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools" (EPRI Mechanical Tools) Appendix E, Table 4-1 and Figure 1.

    Loss of material/crevice, pitting corrosion: This is the only aging effect/mechanism identified for stainless steel in EPRI 1003056.

(3) The stainless steel pipe supports on the "A" and "B" Recirculation Pump suction and discharge lines inside the drywell are ISI Class 1 component supports. The ASME Section XI, Subsection IWF ISI Aging Management program is credited with managing the aging effect of loss of material due to corrosion for these stainless steel supports. This program provides for the inspection of ASME Class 1, 2, and 3 supports and is also credited for managing the loss of material due to corrosion for NUREG-1801 Section III.B1 component supports.

Since the applicant's use of the IWF AMP to manage loss of material for the stainless steel pipe support stanchions, used on the recirculation piping 28" lines at Dresden and Quad Cities, is consistent with the GALL Report, the staff considers RAI 3.5-16 resolved.

In the LRA Table 3.2-2 (Reference Nos. 3.2.2.79, 3.2.2.80, and 3.2.2.81) states that Water Chemistry (B.1.2) and One-Time Inspection (B.1.23) will be used to manage loss of material/pitting and crevice corrosion in carbon and stainless steel support members submerged in 25–288 °C (77–550 °F) demineralized water. The Water Chemistry Program will also be used to manage cracking/stress-corrosion cracking in stainless steel support members submerged in the same environment. In RAI 3.5-17, the staff requested the applicant to submit the following information:

(a) Identify the specific supports covered by References 3.2.2.79, 3.2.2.80 and 3.2.2.81 and the plant-specific operating experience.

(b) Explain why ASME Section XI, Subsection IWF is not credited for aging management of these supports.

(c) Explain the number, type, and location of the supports that will be included in the one-time inspection.

(d) Explain why the supports covered by Reference 3.2.2.80 are not included in the one-time inspection.

In its response to RAI 3.5-17, the applicant stated the following:

> Exelon has reviewed LRA Table 3.2-2, Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81, and following information is provided.
>
> (a) LRA Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81 discuss support members submerged in a torus water environment. The submerged supports in the Low Pressure Coolant Injection System (LPCI) at Dresden Station and the Residual Heat Removal System (RHR) at Quad Cities Station are addressed by these aging management references. All supports were evaluated for aging as a commodity group. No specific support numbers are cited by Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81. Generic supports are grouped by system, material type, and environment combination. A review of plant operating history did not reveal any loss of intended function for systems for which Suppression Pool/Torus Chemistry control exists.
>
> The following are some plant specific operating experiences of Suppression Pool/Torus water chemistry. These examples demonstrate the effectiveness of the Suppression Pool/Torus water chemistry Aging Management Program (AMP).
>
> - Dresden: Chemistry samples taken on the LPCI (shell) side of the 3A LPCI Heat Exchanger on ½1/00 and again on ½6/00 show that water conductivity, chloride concentration, and sulfate concentration are considerably higher than normal torus water chemistry conditions. The shell side chemistry concentrations are indicative of a service water in-leakage.
> - Dresden: Chemistry took the monthly Unit 2 torus water sample from the shell side of the 2B LPCI Heat Exchanger (8/17/00) and found out-of-specification concentrations of chlorides and sulfates as well as out-of-specification conductivity. On 8/19/00, the existence of a leak in the 2B LPCI Heat Exchanger was confirmed.
> - Quad Cities: Nuclear Oversight identified that the Station had been running with Unit 2 torus water at an elevated specific conductivity since October 1995. Readings had fluctuated above and below the 'goal' value (less than or equal to 3 mS/cm) but less than the limit (5 mS/cm).
> - Quad Cities: Unit 2 torus. On 7/2/96, a sample was found to be over the administrative limit for conductivity of 5.0 mmho. The conductivity was 5.6 mmho as compared to 4.6 mmho from the last sample (6/26/96). The results of an investigation indicated there was work in progress in the Unit 2 torus to replace an instrument air line hanger. The torus hatch was removed on 6/29/96 in preparation for the work to commence and this may have caused the water chemistry administrative limit to [be exceeded].
>
> (b) 10 CFR 50.55a does not require inspecting ASME Section XI, Subsection IWF supports that are associated with ASME Section XI, Subsection IWE. Supports in a submerged (torus water) environment are associated with ASME Section XI, Subsection IWE (components that are part of the reactor coolant pressure boundary) and do not require inspection in accordance with ASME Section XI, Subsection IWF.
>
> (c) A one-time inspection will be performed to verify the effectiveness of the torus water chemistry. One time inspection of HPCI torus suction check valves is credited for the one-time inspection of all submerged supports. The HPCI torus suction check valves and the supports have a similar environment and material condition. The HPCI torus suction check valves are carbon steel typically exposed to stagnant flow conditions but with occasional flow. The one-time inspection utilizes the Preventive Maintenance (PM) program to inspect check valves. The acceptance criteria for the HPCI check valves inspections are based on ASME Section XI, Examination

Category B-—2 (Valve Body). Control of chemistry in accordance with EPRI guidelines (TR-103515) does not preclude loss of material due to general, crevice, or pitting corrosion at locations of stagnant flow conditions. This one-time inspection includes measures to verify the effectiveness of the Suppression Pool/Torus Chemistry and confirm the absence of loss of material in stagnant flow areas as required by NUREG 1801. Examinations are to be conducted in an area where typically stagnant flow is present but occasionally there is flow, which will cause replenishment of the oxygen supply. Therefore, the one-time inspection of the Dresden and Quad Cities HPCI torus suction check valves is credited for verifying the effectiveness of the Suppression Pool/Torus Chemistry and confirming the absence of loss of material in stagnant flow areas.

(d) EPRI TR-1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3" states that cracking due to Stress Corrosion Cracking (SCC) is not likely in a high purity environment below 200°F. The support members that are exposed to torus water do not reach temperatures above 200°F and, therefore, cracking due to SCC is less likely to occur in these support members. Control of torus water chemistry in accordance with EPRI guidelines (TR-103515) will provide high purity water and, therefore, provides assurance that the potential for SCC is minimized. Because of this, a one-time inspection of components in torus water environment for cracking due to SCC is not required to verify the effectiveness of the Suppression Pool/Torus water chemistry for Aging Management Reference 3.2.2.80.

The staff has identified the need for additional information and has also identified a discrepancy between the responses to RAI 3.5-15 and RAI 3.5-17.

First, the applicant's response to RAI 3.5-15 stated the following:

> The line item for Support Members in Table 2.4-15 incorrectly referenced 3.2.2.79, 3.2.2.80, and 3.2.2.81. These references should have been designated as aging management references for Support References. Aging Management References 3.5.1.29, 3.5.1.31, and 3.5.2.14 are correct. New Aging Management References should have included 3.5.2.17, 3.5.2.18, and 3.5.2.19, as shown below in Table 3.5-2.

In the RAI 3.5-17 response, part (a), there is no indication of the correction described in the RAI 3.5-15 response. The applicant was requested to clarify this.

Second, part (b) of the response to RAI 3.5-17 is not acceptable. The supports in question are not Class MC supports. The systems involved are most likely Class 2. In addition, the reference to "(components that are part of the reactor coolant pressure boundary)" appears to be misplaced. The applicant was requested to resubmit its justification for not crediting IWF.

Third, using only carbon steel HPCI torus suction check valves as the basis for the one-time inspection does not address the potential aging effects for stainless steel support members. The applicant was requested to describe how the one-time inspection will address aging effects for stainless steel support members.

Fourth, as previously stated in the evaluation of the response t o RAI 3.5-15, the staff position is that some verification of the effectiveness of the Water Chemistry Program is necessary.

In a letter dated December 5, 2003, the applicant responded to the above questions. With respect to the first question, the applicant corrected the previous references. With respect to the second question, the applicant credited IWF for aging management References 3.5.1.31 and 3.5.2.14, which are applicable to structural members with a component intended function of "structural support" and for References 3.5.1.31, 3.5.2.5 and 3.5.2.23, which are applicable to clevis pins. With respect to the third question, the applicant believes that Torus Water

Chemistry controls will be (1) sufficient to prevent the aging effects of loss of material due to general, crevice, and pitting corrosion in the carbon steel HPCI torus suction check valves and (2) will also be sufficient to prevent aging effects in stainless steel support members and components. Nevertheless, the applicant will provide a one-time inspection of selected stainless steel clevis pins in the submerged environment to confirm the effectiveness of Torus Water Chemistry controls in preventing the aging effect/mechanism of SCC. Where the selected stainless steel clevis pins interface with uncoated carbon steel support members, the interfacing support members will also be inspected for the aging effect/mechanism of loss of material/galvanic corrosion. This is part of Commitment #23 of Appendix A of this SER. With respect to the fourth question, the applicant stated that it had responded in the preceding question that it would provide a one-time inspection of selected stainless steel clevis pins in the submerged environment to confirm the effectiveness of Torus Water Chemistry controls. This is also part of Commitment #23 of Appendix A of this SER. The staff finds the applicant’s response acceptable and, therefore, considers RAI 3.5-17 resolved.

The aging effects identified in the LRA for the components support commodity group are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the following AMPs with managing the aging effects described above for the components support commodity group:

- Structures Monitoring Program
- ASME Section XI, Subsection IWF
- Bolting Integrity
- Water Chemistry
- One-Time Inspection

The Structures Monitoring Program, Bolting Integrity, Water Chemistry, and One-Time Inspection are considered common AMPs. The staff’s evaluation of the common AMPs is in SER Section 3.0.3. The staff’s evaluation of ASME Section XI, Subsection IWF Program is in SER Section 3.5.2.3.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components support commodity group will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.6 Insulation Commodity Group

Summary of Technical Information in the Application. The applicant's description of the insulation commodity group (Dresden and Quad Cities) is in LRA Section 2.4.16. The component groups requiring AMR are identified in LRA Table 2.4-16. For each component group listed, LRA Table 2.4-16 specifies a reference to LRA Section 3 for the AMR results. The applicant states that all of the component groups are not addressed in the GALL Report and provides the AMR results in LRA Tables 3.2-2, 3.3-2 and 3.4-2. These tables identify the insulation commodity group components that are not addressed in the GALL Report and provide information on material, environment, aging effect(s)/mechanism(s), and AMPs.

Utilizing the Dresden and Quad Cities Aging Management Review Aid (February 2003), the staff identified the applicable materials for insulation commodity group components as asbestos, fiberglass, NUKON quilted fiberglass, stainless steel mirror insulation, closed-cell foam, calcium silicate, stainless steel, aluminum, and aluminum jacketing. Utilizing the Review Aid, the staff also identified the applicable environments as air, moisture, humidity less than 100 °C (212 °F), and outdoor ambient conditions.

Aging Effects

The LRA identifies the following applicable aging effects for the insulation commodity group components:

- insulation degradation/loss of insulating characteristics
- insulation degradation/loss of jacket leak-tight integrity

LRA Table 2.4-16 references LRA Sections 3.2, 3.3, and 3.4 for the AMR results for all components.

Aging Management Programs

The LRA credits the Structures Monitoring Program for managing the identified aging effects. A description of this AMP is provided in LRA Appendix B. The applicant concludes that the effects of aging will be adequately managed by this AMP such that there is reasonable assurance that the intended functions will be maintained during the period of extended operation.

Staff Evaluation. This section presents the staff's evaluation of the applicant's AMR for the insulation commodity group and the applicability of the AMPs credited with managing the aging effects. The staff's evaluations of the aging management evaluations for the insulation commodity group that are not addressed in the GALL Report are discussed below.

Aging Effects

In the LRA Table 3.2-2 (Reference Nos. 3.2.2.44 and 3.2.2.45) and Table 3.4-2 (Reference No. 3.4.2.23) state that the Structures Monitoring Program is credited with managing two aging effects/mechanisms—(1) insulation degradation/loss of insulating characteristics for asbestos and fiberglass insulation, and (2) insulation degradation/loss of jacket leak-tight integrity for aluminum insulation jacketing. In LRA Appendix B.1.30, Structures Monitoring Program, the applicant states that the program will be enhanced as follows:

> Program procedures will reference specific insulation inspection criteria for existing cold weather preparation and inspection procedures for outdoor insulation, and establish new inspections for various indoor area piping and equipment insulation.

The staff finds the applicant's AMR for these components to be acceptable and agrees that the Structures Monitoring Program is an acceptable program to manage the identified aging effects.

In the LRA Table 3.2-2 (Reference Nos. 3.2.2.46, 3.2.2.47 and 3.2.2.48), Table 3.3-2 (Reference Nos. 3.3.2.122 and 3.3.2.123) and Table 3.4-2 (Reference No. 3.4.2.22) provide the following technical justifications for concluding that there are no aging effects requiring management for six specific insulation groups:

(1) Plant indoor environment is not conducive to promoting aging degradation of NUKON quilted fiberglass insulation.

(2) Stainless steel mirror insulation materials are not subject to any viable aging mechanism in the absence of aggressive chemical species.

(3) Stainless steel insulation jacketing materials are not subject to any viable aging mechanism in the absence of aggressive chemical species.

(4) Closed-cell foam insulation is susceptible to degradation when exposed to UV light. The plant indoor environment is not conducive to promoting aging degradation of closed-cell foam insulation.

(5) Aluminum is reactive but develops an oxide film that protects it from further corrosion. No viable aging effects exist in the indoor environment for aluminum insulation jacketing.

(6) The plant outdoor environment is not conducive to promoting aging degradation of jacketed calcium silicate insulation.

The staff finds these justifications to be reasonable and acceptable.

The aging effects identified in the LRA for the isolation commodity group are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant has credited the Structures Monitoring Program with managing the aging effects described above for the insulation commodity group components. The Structures Monitoring Program is considered a common AMP. The staff's evaluation of the common AMPs is in SER Section 3.0.3.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the insulation commodity group will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6 Electrical and Instrumentation and Controls

This section addresses the aging management of electrical and instrumentation and controls (I&C) components. The components have been divided into commodity groups as described in the following LRA sections:

- Cables and Connections (2.5.1.1)
- Bus Duct (2.5.1.2)
- High Voltage transmission Conductors and insulators (2.5.1.3)

As discussed in Section 3.0.1 of this SER, the components of the electrical and instrumentation and controls system group are included in two LRA Tables. LRA Table 3.6-1 consists of electrical and I&C components that are evaluated in the GALL report. LRA Table 3.6-2 consists of electrical and I&C components that are not evaluated in the GALL report.

3.6.1 Summary of Technical Information in the Application

In LRA Section 3.6, the applicant described its AMRs for the electrical and I&C commodity groups at Dresden and Quad Cities.

The results of the AMR for the electrical and I&C components or component groups are presented in LRA Section 2.5. AMR was performed to assure that the component groups, materials, environments and aging effects referenced in NUREG-1801 are applicable to Dresden and Quad Cities and that the aging management program described in NUREG-1801 is applicable to Boiling Water Reactors (BWR) or to both Boiling Water Reactors and Pressurized Water Reactors (BWR/PWR).

Not all electrical and I&C component types at Dresden and Quad Cities are listed in NUREG-1801, Volume 2. However, the aging management reviews presented in NUREG-1801, Volume 2 were applied to additional component types if the following criteria were satisfied:

- constructed of the similar material as components in the NUREG-1801 line item

- assigned the same component intended function as components in the NUREG-1801 line item

- located in the same environment as components in the NUREG-1801 line item

- have exhibited the same aging effects identified in the NUREG-1801 line item

Component types meeting these criteria have been included in the presentation of AMR results in Table 3.6-1, “Aging management evaluated in NUREG-1801 that are relied on for license renewal for electrical and instrumentation and control components.”

The third column of the table shows the component types included in each evaluation line. “NUREG-1801 Components” are those that correspond exactly with component types in NUREG-1801, Volume 2. “Evaluated with NUREG 1801 Components” shows the component types that meet the criteria above and therefore share the same evaluation.

The applicant stated that Table 3.6-2, “Aging management review results for the electrical and instrumentation and control components that are not addressed in NUREG-1801," presents the AMR results for the remainder of the electrical and I&C components. These entries result from AMR where the component type, material, environment or aging effect/mechanism differs from NUREG-1801, Volume 2 line item entries. Table 3.6-2 includes a line reference number, component group, material, environment, aging effect/mechanism, aging management program and discussion.

3.6.2 Staff Evaluation

In Section 3.6 of the LRA, the applicant describes its AMR for electrical and I&C component groups at Dresden and Quad Cities. The staff reviewed LRA Section 3.6 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for electrical and I&C system components that are determined to be within the scope of license renewal and subject to an AMR.

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

Table 3.6-1 below provides a summary of the staff’s evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.6 that are addressed in the GALL report.

Table 3.6-1: Staff Evaluation Table for Dresden and Quad Cities Electrical Components Evaluated in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental qualification of electrical components	B.1.35	See Section 4.4
Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by thermal/thermoxidative degradation of organics; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	B.1.33	Consistent with GALL. (See Section 3.6.2.3.1 below and audit report)
Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (IR)	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/thermoxidative degradation of organics; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements	B.1.37	Consistent with GALL with exception (See Section 3.6.2.3.2 below and audit report)
Inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Formation of water trees, localized damage leading to electrical failure (breakdown of insulation); water trees caused by moisture intrusion	Aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements	B.1.38	Consistent with GALL (See Section 3.6.2.3.3 below)

The staff's review of the electrical and I&C system groups for the Dresden and Quad Cities LRA is contained within four sections of this SER. Section 3.6.2.1 is the staff review of components in the electrical and I&C systems that are consistent with GALL, as stated in the LRA, and do not require further evaluation. Section 3.6.2.2 is the staff review of components in the electrical and I&C systems that are consistent with GALL, as stated in the LRA, and GALL recommends further evaluation. Section 3.6.2.3 is the staff evaluation of aging management programs for electrical and I&C components. Section 3.6.2.4 contains an evaluation of aging management programs for plant specific components.

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plants. The staff also identified several areas where additional information or clarification was needed.

On the basis of its review, the staff has verified the applicant's claim of consistency with 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).

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

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

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

3.6.2.3 Aging Management Programs for Electrical and I&C Components

In SER Section 3.6.2.1, the staff determined that the applicant's AMRs and associated AMPs will adequately manage component aging in electrical and I&C systems. The staff then reviewed specific electrical and I&C system components to ensure that they were properly evaluated in the applicant's AMR.

To perform its review, the staff reviewed the components listed in LRA Table 2.5-1 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the UFSAR supplements for the AMPs credited with managing aging in electrical and I&C system components to determine whether the program descriptions adequately describe the programs.

The applicant credits the following three AMPs to manage the aging effects associated with electrical and I&C components:

- aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements

- aging management program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements

- aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements

The staff's evaluation of these AMPs is provided below.

3.6.2.3.1 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification requirements

Summary of Technical Information in the Application. The AMP for electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements manages cables and connections within the scope of license renewal that are subject to an adverse environment. It also identifies and manages cables and connections subject to an adverse localized environment. The aging management program for electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements is a new program.

An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for a subject cable or connection. An adverse variation in environment is significant if it could appreciably increase the rate of aging of a component or have an immediate adverse effect on operability.

Cables and connections subject to an adverse environment are managed by inspection of a sample of these components. Selected cables and connections from accessible areas, which represent, with reasonable assurance, the cables and connections in adverse environments are inspected. They are inspected for signs of accelerated age-related degradation. Additional inspections, repair or replacement are initiated as appropriate.

Samples of cables and connections found to be located in adverse localized areas will be inspected prior to the period of extended operation, with an inspection frequency of at least once every 10 years. The scope of this program includes inspections of power, control and instrumentation cables and connections located in adverse localized areas, including the cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance.

NUREG-1801 Consistency

The aging management program for electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements is a new program. The program is scheduled for implementation prior to the period of extended operation. Program activities are consistent with the ten elements of aging program XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," specified in NUREG-1801.

Operating Experience

This program is new. Therefore, no programmatic operating experience is available. However, existing activities provide for inspection of butyl rubber insulated, environmentally qualified cables in heater bays to assess aging of cable insulation. These cables are in a localized adverse environment. No adverse trends indicative of premature aging of cables have been identified. Cable failures, when identified, are subject to the station corrective action program. Operating experience does not indicate the presence of localized adverse environment or premature aging of cable insulation.

Conclusions

The aging management program for electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements provides reasonable assurance that aging effects are adequately managed so that the intended functions of these types of cables and connections are maintained during the period of extended operation.

Staff Evaluation. In Table 3.6-1, the applicant identifies embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR), electrical failure caused by thermal/thermoxidative degradation of organics, radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics, radiation-induced oxidation, moisture intrusion are the aging effects of cables and connections due to heat or radiation. The staff concurs with the aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL report.

The applicant stated that the scope of this program includes inspections of power, control and instrumentation cables and connections located in adverse localized areas, including the cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance. The staff finds that the aging management activity (LRA Table 3.6-1, Ref. No. 3.6.1.3) submitted by the applicant does not utilize the calibration approach for non-EQ electrical cables used in circuits with sensitive, low level signals. Instead, these cables are simply combined with all other non-EQ cables under the visual inspection activity. The staff believes, however, that visual inspection alone would not necessarily detect reduced insulation resistance (IR) levels in cable insulation before the intended function is lost. Exposure of electrical cables to localized environments caused by heat, radiation, or moisture can result in reduced IR. Reduced IR causes an increase in leakage of electrical currents between conductors and from individual conductors to ground. A reduction in IR is a concern for circuits with sensitive, low-level signals such as radiation monitoring and nuclear instrumentation since it may contribute to inaccuracies in the instrument loop.

The staff raised a question regarding the applicant's assumption that aging of these cables will initially occur on the outer jacket resulting in sufficient damage that visual inspection will be effective in detecting the degradation before IR losses lead to a loss of its intended function, particularly if the cables are also subject to moisture. The staff requested the applicant to provide a technical justification which will demonstrate that visual inspection will be effective in detecting damage before current leakage can affect instrument loop accuracy, or propose an alternate aging management activity (RAI 3.6-9). In its response dated October 3, 2003, the applicant stated that it will develop a program that is consistent with the NRC staff's Interim Staff Guidance (ISG) -15 issued on August 12, 2003, to address the staff's concern identified in

RAI 3.6-9. ISG-15 included a revision of GALL AMP XI.E2, “Electrical cables not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits.” The applicant committed that it will develop a program that is consistent with NUREG 1801 AMP XI.E2 to manage the aging of these cables. This program will be implemented prior to entering the period of extended operation. This is Commitment #37 in Appendix A of this SER. The staff finds that its concern is resolved since the applicant has committed to implement an AMP for cables used in instrument circuits that are sensitive to reduction in conductor insulation resistance consistent with ISG-15.

The applicant stated that the aging effects of fuse blocks will be managed by an AMP for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements. On March 4, 2003, the staff issued ISG-5 concerning identification and treatment of electrical fuse holders for license renewal. The ISG-5 specified that the aging management review for fuse blocks (metallic clamps) need to include the following aging stressors: fatigue, mechanical stress, vibration, chemical contamination and corrosion. While the staff agrees that the proposed AMP (B.1.33) will manage aging of insulation material for fuse holders, the AMP may not be effective in addressing the above mentioned aging stressors associated with fuse blocks (metallic clamps). The staff requested the applicant to provide a description of an aging management program, in accordance with the requirements of 10 CFR 54.21(a)(3), used to detect aging effects associated with aging stressors as discussed in the ISG-5, or provide justification why such a program is not needed (RAI 3.6-1).

In its response dated October 3, 2003, the applicant stated that it will continue to include fuse holders in an aging management program consistent with NUREG 1801 XI.E1. Additionally, it will follow the guidance contained in ISG-5 dated March 4, 2003, and identify those fuse holders that are not part of a larger assembly but support safety-related and non-safety related functions in which the failure of a fuse precludes a safety function from being accomplished. Any fuses satisfying this criterion will be evaluated against the stressors listed in ISG-5 and an aging management program will be developed if the aging evaluation determines that one is necessary. The applicant stated that these fuses will be identified, the evaluation against the stressors completed, and the actions identified in the aging management program completed, if necessary, prior to entering the period of extended operation.

At the request of the staff, the applicant provided supplemental information on November 20, 2003. The applicant stated that a total of 708 fuse holders at Dresden and 724 fuse holders at Quad Cities require evaluation against the stressors identified in ISG-5. The 708 fuse holders at Dresden are located in 17 different SCRAM Solenoid Fuse Panels which are located in the reactor building (elevation 517 feet). The 724 fuse holders at Quad Cities are located in 25 different panels which are located in the reactor building (elevation 595 feet) and the turbine building (elevation 639 feet). The aging evaluation results for each stressor are described below.

Moisture

As stated in DOE Cable Aging Management Guideline (SAND 0944), Section 3.7.2.1.3, 3% of all low-voltage metal connector failures were identified as being caused by moisture intrusion. In each case, the source of moisture was precipitation. Based on the total number of reported connector failures in the DOE Cable AMG, moisture intrusion accounted for only 10 failures in all of the operating plants in the United States. The fuse holders at Dresden and Quad Cities

Stations that require an AMR are protected from external sources of moisture by two barriers. For the first barrier, the panels in which the subject fuse holders are installed are located in rooms inside the reactor and turbine buildings, which do not see high relative humidity conditions. Based on plant walk downs, these panels are not located in areas which experience adverse localized temperature or humidity. These areas are protected from weather variations and are not subject to any significant temperature variations. As a second barrier, the fuse holders are located in closed enclosures. With regard to internal moisture (i.e., formation of condensation), a walk down revealed no signs of moisture/humidity in the area or any signs of moisture within the enclosures.

Chemical Contamination

The fuse holders are protected, as described above, by their location and enclosure. There are no sources of chemicals in the area or vicinity of the fuses, which was confirmed by the plant walk down inspections.

Oxidation and Corrosion

Fuse clips are made of copper or copper alloy plated with a corrosion resistant coating material to protect the base metal from oxidation and provide for low electrical resistance. The fuses experience no appreciable change in operating environment and are not located near heavy industrial or oceanic environments. Furthermore, the fuse holders evaluated are not near any humid areas. Based upon recent inspections of the Bussmann fuse blocks performed in September 2003, the surface condition of the fuse clips show no signs of corrosion and still retain their metal surface. Additionally, there was no evidence or trace of moisture. For these reasons, oxidation and corrosion are not applicable stressors.

Mechanical Stresses, Electrical Transients, Thermal Cycling, Fatigue

Mechanical stress due to forces associated with electrical faults and transients are mitigated by the fast action of circuit protective devices at high currents. However, mechanical stress due to electrical faults is not considered a credible aging mechanism since such faults are infrequent and random in nature.

The Quad Cities fuse holders associated with alternate feeds to switchgear (used during fire protection safe shutdown) are normally de-energized and do not experience frequent cycling. As such, they do not experience enough heat to damage the fuse blocks and connections.

The Dresden and Quad Cities fuse holder SCRAM solenoids stay energized during normal operation and also do not experience frequent cycling. The loading seen by these fuses are well below 60%. A 60% loading is identified as a critical value in NUREG-1760 for fuses as generating enough heat to damage the fuse blocks and connections. The SCRAM solenoids draw about 15 watts and the fuses are rated for 3 amps. Therefore, these fuses are lightly loaded. Inspection of a few samples did not reveal any age related degradation and the fuse clips did not exhibit any signs of degradation.

Vibration is induced in fuse holders by the operation of external equipment, such as compressors, fans, and pumps. Since there are no direct sources of vibration for the fuse holder panels, and the panels are mounted separately on their own support structure on concrete walls, vibration is not an applicable aging mechanism.

By design and their location, the fuse holders are not subject to aging effects associated with thermal cycling. The SCRAM solenoid fuses are very lightly loaded and will experience very insignificant temperature rise.

Wear/fatigue aging mechanism is caused due to repeated insertion and removal of fuses. The fuses evaluated are not subject to frequent manipulations. When these circuits need to be de-energized, power is removed at the safety related power supplies. When manipulated, an inspection is performed that would identify any abnormal indication such as loose or corroded fuse clips.

Fatigue may also be caused by frequent cycling of fuses when subject to significant loading, which would cause the clips to expand and contract and to experience fatigue failure. However, the subject fuses do not experience operational cycling during normal service due to the fact that they are lightly loaded, and therefore this is not a concern.

The applicant concluded that based on the aging evaluations of the stressors identified in ISG-5, evaluations presented in NUREG-1760, and the operating service conditions of the fuses in scope of this evaluation, no stressors are identified for these fuse blocks/clips that would require aging management.

On the basis of its review, the staff finds that the applicant adequately addressed the stressors identified in ISG-5 and agrees that no AMP is required.

GALL XI.E1 program requires visual inspection of cables and connections jacket anomalies, such as embrittlement, discoloration, cracking, or surface contamination. The description of B.1.33 and A.1.33 included inspection for signs of accelerated age related degradation. The staff requested the applicant to describe what would qualify as signs of accelerated age related degradation and explain how the requirements of GALL XI.E1 are met (RAI B.1.33-2). In its response dated October 3, 2003, the applicant clarified that age related degradation includes embrittlement, discoloration, cracking, and surface contamination. The applicant further stated that the terms embrittlement, discoloration, cracking, and surface contamination are used in the plant specific procedures that comprise the aging program described in B.1.33 to identify accelerated age related degradation. The staff finds that its concern is resolved.

The applicant stated that cables and connections subject to adverse environment are managed by inspection of sample of these components. The staff requested the applicant to provide the technical basis for selecting sample location/size consistent with GALL Program XI.E1 attribute number 3 on Parameters Monitored/Inspected; (1) Indicate whether the sample will include different type of cable insulations used in the plant; (2) Provide details about the samples of connections and fuse holders (RAI B.1.33-3). In its response dated October 3, 2003, the applicant stated that all accessible cables exposed to the localized adverse environments will be inspected. This is part of Commitment #33 of Appendix A of this SER. No effort will be made to segregate cables based on insulation material. All accessible fuse holders and terminal blocks insulating material located within localized adverse environments will be inspected. All accessible connections in the localized adverse environments will be inspected. The staff finds that its concern is resolved.

The LRA indicated that selected cables and connections from accessible areas, which represent, with reasonable assurance, the cables and connections in adverse environments are inspected. However, GALL XI.E1 specifies that selected cables and connections from accessible areas are inspected and [should] represent, with reasonable assurance, “all” cables and connections in adverse environments. The staff requested the applicant to clarify this difference (RAI B.1.33-4). In its response dated October 3, 2003, the applicant stated that for the cable aging management referenced in LRA Section B.1.33, there is no difference between NUREG-1801 requirements and the AMP commitments. Cable aging management referenced in B.1.33 AMP applies to all accessible non-EQ in-scope cables and connections in adverse environments. Based on its review, the staff finds that its concern is resolved.

The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

Conclusions. On the basis of its review and audit of the applicant’s program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, 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 concludes that no AMP for fuse holder is required. The staff also reviewed the UFSAR Supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.6.2.3.2 Electrical Cables used in Instrumentation Circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor Insulation Resistance

Summary of Technical Information in the Application. The applicant stated that sensitive instrumentation circuit cable insulations were reviewed for their resilience against temperature, radiation and moisture environments. All cable insulation materials were assessed to have 60-year temperature and radiation thresholds greater than the bounding plant environments for which cables and connections are installed. The specified aging effects are not expected and therefore, no aging management is required. However, the cables of sensitive instrumentation circuits not subject to 10 CFR 50.49 requirements will be managed for aging due to adverse localized environments, as they are included in cables that are managed for aging per Item 3.6.1.2 of LRA Table 3.6-1 and aging management program for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.1.33).

Staff Evaluation. GALL Report contains an AMP specifically for cables with sensitive, low-level signals. However, Dresden and Quad Cities apply the Non-EQ Insulated Cables and Connections Aging Management Program to this area. The applicant claimed that the inspection required by this program would be effective in identifying visual indications of insulation deterioration caused by environmental conditions (e.g., embrittlement, cracking, melting, discoloration, and swelling). This approach is considered by the applicant to be consistent with GALL Report with one exception.

The aging management activity described in LRA Table 3.6-1, Ref. No. 3.6.1.3, does not utilize the calibration approach for non-EQ electrical cables used in circuits with sensitive, low level signals. Instead, these cables are simply combined with all other non-EQ cables under the visual inspection activity. The staff believes, however, that visual inspection alone would not necessarily detect reduced insulation resistance (IR) levels in cable insulation before the intended function is lost. Exposure of electrical cables to localized environments caused by heat, radiation, or moisture can result in reduced IR. Reduced IR causes an increase in leakage currents between conductors and from individual conductors to ground. A reduction in IR is a concern for circuits with sensitive, low-level signals such as radiation monitoring and nuclear instrumentation since it may contribute to inaccuracies in the instrument loop.

The staff raised a question regarding the applicant's assumption that aging of these cables will initially occur on the outer jacket resulting in sufficient damage that visual inspection will be effective in detecting the degradation before IR losses lead to a loss of its intended function, particularly if the cables are also subject to moisture. The staff requested the applicant to provide a technical justification which will demonstrate that visual inspection will be effective in detecting damage before current leakage can affect instrument loop accuracy, or propose an alternate aging management activity (RAI 3.6-9). In its response dated October 3, 2003, the applicant stated that it will develop a program that is consistent with the NRC staff's Interim Staff Guidance (ISG) -15 issued on August 12, 2003, to address the staff's concern identified in RAI 3.6-9. ISG-15 included a revision of GALL AMP XI.E2, "Electrical cables not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits." The applicant committed that it will develop a program that is consistent with NUREG 1801 AMP XI.E2 to manage the aging of these cables. This program will be implemented prior to entering the period of extended operation. This is Commitment #37 in Appendix A of this SER. The staff finds that its concern is resolved since the applicant has committed to implement an AMP for cables used in instrument circuits that are sensitive to reduction in conductor insulation resistance consistent with ISG-15.

Aging Effects

In Table 3.6-1, the applicant identifies embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR), electrical failure caused by thermal/thermoxidative degradation of organics, radiation-induced oxidation, moisture intrusion as aging effects of cables and connections due to heat or radiation. The staff concurs with the aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL report.

Aging Management Program

The applicant committed to develop a program that will be consistent with NUREG 1801 AMP XI.E2 to manage the aging of electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance. This is Commitment #37 in Appendix A of this SER. The cables included within the scope of this program are the cables used in the following Nuclear Instrumentation Systems (NIS) and radiation monitoring systems: Source Range Monitors (SRM), Intermediate Range Monitors (IRM), Local Power Range Monitors (LPRM), Drywell High Range Radiation Monitors, Main Steam Line (MSL) Radiation Monitors, and Steam Jet Ejector (SJAE) Radiation Monitors.

By a letter dated December 22, 2003, the applicant provided the details of the program (ten attributes). The evaluation of the applicant's AMP focused on program attributes. To determine whether the applicant's AMP is adequate to manage the effect of aging so that the intended function will be consistent with CLB for the period of extended operation, the staff evaluated the following seven attributes: (1) scope of program, (2) preventive action, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the staff's safety evaluation.

[Scope of Program] This program applies to the cables used in sensitive instrumentation circuits with low level signals of the NIS which includes SRM, IRM, LPRM and Radiation Monitoring Systems which includes Drywell High Range Radiation Monitors, Main Steam Line Radiation Monitors, and Steam Jet Air Ejector Radiation Monitors. For the LPRM, SRM, and IRM systems, the cables within the scope of this AMP are the cables between the detectors and main control room panel. For the radiation detectors within the scope of this program, the cables within the scope of this AMP are the cables between the detectors and the associated meters. The staff considers the scope of the program to be acceptable.

[Preventive Actions] This is a surveillance program and no actions are taken as part of this program to prevent or mitigate aging degradation. This is acceptable since the staff finds no need for such actions.

[Parameters Monitored/Inspected] Nuclear Instrumentation Systems:
(1) LPRM- Calibration surveillance testing being credited for the LPRM system. The full core LPRM calibration is performed per technical specification surveillance requirements. Per the implementing procedure, the LPRM's are verified to be within calibration. The acceptability of the LPRM cable/detectors/connectors is verified through this calibration. This calibration adjusts for loss in sensitivity of the circuit. The staff finds that this action to be acceptable because the review of calibrations and surveillances will provide reasonable assurance that age related degradation of the cables will be detected prior to loss of cable intended function.

(2) SRM- For the SRM system, the cables between the preamplifier and detectors are subject to Current/Voltage (I/V) testing. The I/V test data is used to calculate the cable insulation resistance. The I/V testing results will be indicative of reduced insulation resistance. These tests verify the insulation resistance of the cables inside the drywell, along with the operability of the detectors and connectors. A surveillance test of the SRM monitors is performed to verify the functionality of the SRM (indicate counts per cycle within a certain range or have proper signal to noise ratio) during core alterations (refueling). This surveillance test verifies the integrity of the SRM cable system. Cable and surveillance testing as recommended by ISG-15 is being credited for the SRM system.

(3) IRM - For the IRM system, the cables inside the drywell are subject to Current/Voltage (I/V) testing. The I/V test data is used to calculate the cable insulation resistance. The I/V testing results will be indicative of reduced insulation resistance. These tests verify the insulation resistance of the cables inside the drywell, along with the operability of the detectors and connectors. A surveillance response test will be performed for the IRM monitors from the preamplifier to the control room chassis by injecting simulated inputs into the preamplifier. This surveillance test will verify the integrity of the IRM cables between the preamplifier and control room chassis. Cable and surveillance testing as recommended by ISG-15 is being credited for the IRM system.

The staff finds that above testing is acceptable because those testing will determine cable insulation resistance (potential degradation).

Radiation Monitoring System

Drywell High Range Radiation Monitoring: In accordance with NUREG 1801, calibration surveillance testing is being credited for the Drywell High Range Radiation Monitors. The calibration required by technical specification surveillances will verify that the cables maintain adequate insulation resistance integrity to perform their intended function. In this calibration, a calibrated source is used to expose the detector to gamma radiation field, and verify that acceptable readings are measured on the corresponding meter. As recommended by ISG-15, the applicant is committing to a once every 10 year review of the calibration results for cable aging degradation. The first review will be performed prior to entering the period of extended operation. This is Commitment #37 in Appendix A of this SER.

Main Steam Line Radiation Monitoring: In accordance with NUREG 1801, calibration surveillance testing is being credited for the entire MSLRM system. The calibration utilizes a source capable of producing photon energy in the range expected during normal and abnormal conditions. This check is performed with the entire system, including detectors, cables, and control room chassis, intact. This demonstrates that no detector or connecting cable degradation has occurred that could inhibit the system from performing its intended function. As recommended by ISG-15, the applicant is committing to a once every 10 year review of the calibration results for cable aging degradation. The first review will be performed prior to entering the period of extended operation.

Steam Jet Air Ejector Radiation Monitoring: In accordance with NUREG 1801, calibration surveillance testing is credited for the entire SJAERM system. The calibration utilizes a source capable of producing photon energy in the range expected during normal and abnormal conditions. This check is performed with the entire system, including detectors, cables, and control room chassis, intact. This demonstrates that no detector or connecting cable degradation has occurred that could inhibit the system from performing its intended function. As recommended by ISG-15, the applicant is committing to a once every 10 year review of the calibration results for cable aging degradation. The first review will be performed prior to entering the period of extended operation.

The staff finds that this action to be acceptable because the review of calibrations and surveillances will provide reasonable assurance that age related degradation of the cables will be detected prior to loss of cable intended function.

[Detection of Aging Effects:] The LPRM, Drywell High Range Radiation Monitors, Main Steam Line Radiation Monitors, and the Steam Jet Air Ejector Radiation Monitors are calibrated per the frequency specified in the technical specification. The normal calibration frequency specified in the technical specification provides reasonable assurance that severe aging degradation will be detected prior to loss of the cable intended function. A review of calibration results will be completed before the period of extended operation and every 10 years thereafter. This review may detect severe aging degradation prior to the loss of cable intended function. The staff finds that 10 year testing frequency is consistent with ISG-15.

The SRM and IRM cable systems inside the drywell are tested for insulation resistances. This test is a direct indication of condition of the insulation and will detect severe aging degradation prior to the loss of cable intended function. These cable systems are being tested every 24 months. The staff finds that 24 months testing frequency is acceptable.

The SRM surveillance test is performed every 24 months and will provides reasonable assurance that severe aging degradation will be detected prior to loss of the cable intended function. A review of the surveillance results will be completed before the end of the current term and every 10 years thereafter. This review may detect severe aging degradation prior to the loss of cable intended function.

The IRM surveillance test will be performed before the period of extended operation and every 24 months thereafter. The surveillance test will provides reasonable assurance that severe aging degradation will be detected prior to loss of the cable intended function. A review of the surveillance results will be completed before the period of extended operation and every 10 years thereafter. This review may detect severe aging degradation prior to the loss of cable intended function.

The staff finds that 10 year frequency of the review of surveillance test for SRM and IRM is acceptable because it is consistent with ISG -15.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement of NUREG 1801, calibration results will be trended once every 10 year, as recommended by ISG-15. The staff finds this to be acceptable.

[Acceptance Criteria] The LPRM, Drywell High Range Radiation Monitors, Main Steam Line Radiation Monitors, and the Steam Jet Air Ejector Radiation Monitors calibration results are to be within the acceptance criteria, as set out in the technical specifications surveillance calibration procedures. The staff finds this to be acceptable because surveillance or calibration activity ensures that cable intended function used in instrumentation circuits are maintained under all CLB design conditions during the period of extended operation.

The SRM and IRM cable systems test results and surveillance results are to be within the acceptance criteria, as set out in the testing and surveillance procedures. The staff finds this to be acceptable because testing and surveillance activity ensures that cable intended function used in instrumentation circuits are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] This is a new aging management program and therefore there is no programmatic operating experience. However, plant experience shows that when an equipment cannot be brought into calibration or when cable system tests indicate unacceptable results, further reviews will identify if the problem is attributable to the instrument, connector or cabling. The staff finds that the applicant has adequately addressed operating experience.

The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

<u>Conclusions</u>. On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the

exceptions to the GALL program and 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 during the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program as required by 10 CFR 54.21(d).

3.6.2.3.3 Inaccessible Medium Voltage Cable Not Subject to 10 CFR 50.49 EQ requirements

Summary of Technical Information in the Application. The applicant stated that five medium-voltage power cables at Dresden are exposed to significant moisture and significant voltage (subject to system voltage more than 25% of the time). Prior to the extended period of operation, these five medium-voltage power cables will be replaced with cables that are resistant to insulation degradation due to water treeing, and therefore, no aging management is required. The applicant stated that only Dresden has medium-voltage cables in the scope of license renewal that are routed in underground ducts.

Staff Evaluation. The applicant states that no AMP is required for inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements.

The applicant determined that insulation degradation due to water treeing is not applicable to Quad Cities and, therefore, no AMP is required.

In Section 3.6.1.2.2, LRA indicates that five medium-voltage power cables at Dresden are exposed to significant moisture and significant voltage. The staff requested the applicant to identify these cables. The staff wanted to clarify whether the cable connecting the Station Blackout (SBO) diesel generator is included in this group. The staff requested the applicant to provide a discussion regarding the use of the SBO diesel generator including possible use of the SBO diesel generator to generate power during peak demands. Also, the staff requested the applicant to provide information regarding the replacement cables. (The staff has accepted submarine cables and lead sheathed cables for components not requiring a GALL XI.E3 program.) In addition, the staff requested the applicant to explain why this issue doesn’t apply to Quad Cities. Additionally, the staff requested the applicant to provide a description of an aging management program (with ten attributes) to remove water from the cable manholes or provide a justification why such a program is not needed (RAI 3.6-3). In its response dated October 3, 2003, the applicant stated that the medium voltage cables that are exposed to significant moisture and significant voltage at Dresden Station are scheduled to be replaced prior to the extended period of operation. This is part of Commitment #38 of Appendix A of this SER. These are the power feed cables to the five (5) Dresden Station Service Water Pump motors. The motors are non-safety-related, but perform a function that demonstrates compliance with the NRC's regulation for Fire Protection (10 CFR 50.48). The service water pumps run continuously and are located in the crib house.

The Quad Cities Service water pumps are not credited in the station's fire protection program or required for other license renewal intended functions; therefore, their power feeds do not perform any license renewal intended functions.

The medium voltage cables connecting the SBO Diesel Generator (SBO DG) are not part of this group. The SBO DG bus feeder cables to the ESF buses are routed underground at

Dresden and are routed overhead at Quad Cities. The SBO DG output cables are exempt from the NUREG 1801 XI. E3 program based on their duty cycles (not energized normally or less than 25% of the time). The power feeds from the SBO DG bus to the ESF buses are energized only during an SBO event or surveillances.

The SBO system is a non-safety-related, independent source of additional on-site emergency ac power. The SBO DG is designed to be started remotely or locally in the emergency mode under conditions of total or partial loss of offsite power. The SBO DGs are not used to generate power during peak demands.

Section 3.6.1.2.2 of LRA states that prior to the extended period of operation the five medium-voltage power cables will be replaced with cables that are resistant to insulation degradation due to water treeing and therefore do not require aging management per NUREG 1801 XI. E3 program. The plant modification process will be used to identify suitable replacement cables that are resistant to insulation degradation due to water treeing.

A program to remove water from the cable manholes is not required. At Dresden, the only medium voltage cables that perform an intended function in support of 10 CFR 54.4 and are energized more than 25% of the time will be replaced with cables that are resistant to insulation degradation due to water treeing. At Quad Cities there are no medium voltage cables installed in underground duct banks that perform intended functions that demonstrate compliance with 10 CFR 54.4.

The staff finds that the applicant did not identify the type of the replacement cables at Dresden. On November 20, 2003, the applicant stated that it has reevaluated its position with regards to the replacement of the five medium-voltage cables at Dresden. A review of the industry experience contained within EPRI TR 103834-P1-2, Effects of Moisture on the Life of Power Plant Cables and SAND96-0344, Aging Management Guideline for Commercial Nuclear Power Plants has determined that butyl rubber insulated medium-voltage cable has not experienced failure due to water treeing. Based on the lack of adverse industry experience and 30 plus years of continuous operating experience, the applicant believes that these cable will perform their intended functions for the period of extended operation. As such, the applicant does not intend on replacing the cables as stated in Section 3.6.1.2.2 of the Dresden and Quad Cities License Renewal Application. Rather, the applicant will manage these cables in accordance with NUREG-1801 XI.E3 aging management program. The applicant provided a new LRA section B.1.38 and A.1.38 that describes this new aging management program for Inaccessible Medium-Voltage Cables not Subject to 10 CFR 50.49 Environmental Qualification Requirements. This is part of Commitment #38 of Appendix A in this SER.

The applicant has reviewed all of the in-scope inaccessible medium-voltage cables that are installed in underground duct runs and as stated in the response to RAI 3.6.3 there are only five inaccessible in-scope medium voltage cables at Dresden that are exposed to significant moisture and that are energized more than twenty-five percent of the time. The diesel generator cooling water supply pump motors are 480 V ac, not 4160 V ac. For this reason, they are not considered medium-voltage cables. Additionally, the electrical loads referenced in Table 8.3-2 of the Quad Cities UFSAR represent the major diesel generator loading for both automatic and manual operation on loss of offsite power (LOOP). The loads listed in Table 8.3-2 are not required to achieve safe shutdown of a reactor in the event of a LOOP. LRA Section 2.3.3.16, Service Water system shows that for Quad Cities, the Service Water system is only in-scope, as specified in 10 CFR 54.4(a)(2), to preclude adverse effects on safety-related SSC's and for structural support. The Quad Cities Service Water system does not perform any intended function within the scope of License Renewal as specified in 10 CFR 54.4(a) (1) or (3). Therefore, the medium-voltage cable feeds to the Quad Cities service water pumps are not within the scope of License Renewal. On the basis of its review, the staff finds its concern for Quad Cities is resolved. However, the applicant needs to provide the details of the AMP for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements for Dresden.

Aging Effects

The applicant identifies formation of water trees, localized damage leading to electrical failure (breakdown of insulation); and water trees caused by moisture intrusion as the aging effects for inaccessible medium-voltage cables not subject to 10 CFR 50.49 requirements. The staff concurs with aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL report.

Aging Management Program

Dresden will implement an AMP for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements. The scope of the program is limited to five butyl rubber insulated inaccessible medium-voltage cables routed in underground duct banks that are at times exposed to significant moisture and are energized more than twenty-five percent of the time.

On November 20, 2003, the applicant provided the details of the program (ten attributes). The evaluation of the applicant's AMP focused on program attributes. To determine whether the applicant's AMP is adequate to manage the effect of aging so that the intended function will be consistent with CLB for the period of extended operation, the staff evaluated the following seven attributes: (1) scope of program, (2) preventive action, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the staff's safety evaluation.

[Scope of Program] This program applies to five inaccessible medium-voltage cables that feed the Dresden service water pumps. These cables are routed in underground duct banks that are at times exposed to significant moisture and are energized more than twenty-five percent of the time. At Dresden, adverse conditions are expected to be prevalent inside the duct bank that runs to the crib house. This duct bank is a continuous run without manholes. The ducts are sloped toward the crib house and during wet seasons, water collected in the ducts drains into the crib house. The staff considers the scope of the program acceptable.

[Preventive Actions] At Dresden, the duct bank is a continuous run without manholes. The ducts are sloped toward the crib house and during wet seasons water collected in the ducts drains into the crib house. The ducts will be inspected annually to verify that the crib house end of the ducts are not plugged with debris and that water can drain from the ducts. This is acceptable since the staff finds that these cables will be tested once every 10 years.

[Parameters Monitored or Inspected] Testing will be performed to provide an indication of the condition of the conductor insulation. The specific type of test will be determined prior to the initial test and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state -of-the-art at the time the test is performed. The staff finds this acceptable because it provides means for monitoring the applicable aging effects on the cable insulation.

[Detection of Aging Effects] The five Dresden inaccessible medium-voltage cables exposed to significant moisture and significant voltage will be tested at least once every 10 years. The first tests for license renewal will be completed prior to the period of extended operation. The staff finds a 10-year testing frequency is an adequate period to preclude failure of these cables since aging degradation is a slow process and the ducts will be inspected annually to verify that the crib house end of the ducts are not plugged with debris and that water can drain from the ducts.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Test results that are trendable may be trended to provide additional information on the rate of degradation. The staff finds this to be acceptable.

[Acceptance Criteria] The acceptance criteria for each test will be defined by the specific type of test performed on the five butyl rubber insulated inaccessible medium-voltage cables. The staff finds this to be acceptable because the acceptance criteria is dependable on the test selected.

[Operating Experience] This is a new program and no plant experience exists to verify the effectiveness of this program. However, the five cables are butyl rubber insulated 4 kV cables which are less susceptible to water treeing than the XLPE or HMWPE insulation materials. A review of plant and industry experience determined that there has been no failure due to water treeing of butyl rubber cable installed in underground ducts. The staff finds that the applicant has adequately addressed operating experience.

The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program. On the basis of its review, the staff finds that the AMPs credited in the LRA for the inaccessible medium-voltage circuits will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusion</u>. The staff concludes that the applicant has adequately identified the aging effects and the AMP will be credited for managing the aging effects of cables used in inaccessible medium-voltage circuits at Dresden and that these cables will perform their intended function in accordance with the CLB during the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also concludes that no AMP is required for Quad Cities. The staff also reviewed the UFSAR supplement for this aging management program and finds that it provides an adequate summary description of the program as required by 10 CFR 54.21(d).

3.6.2.4 Aging Management of Plant-Specific Components

The applicant credits one AMP to manage the aging effects associated with electrical and I&C components. The following sections provide the results of the staff's evaluation of the adequacy of aging management for plant specific electrical and instrumentation and control components.

3.6.2.4.1 Bus Duct

Summary of Technical Information in the Application. The applicant stated that bus ducts utilize a pre-assembled raceway (enclosure) design with conductors supported by electrical insulators. The bus ducts within the scope of license renewal are the bus ducts used for safety-related systems and those associated with 4160 V power feeds between the reserve auxiliary transformer (RAT) and switchgear. The function of the bus ducts is to electrically connect power supplies and load centers to deliver voltage and current. The function of the bus duct insulators is to support and insulate the bus bar conductors. Bus ducts were not evaluated in the GALL Report. The applicant identified embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure as the aging effects for the insulators in the bus ducts. The applicant further stated that those aging effects will be managed by a aging management program B.2.2, “Periodic Inspection of Non-Segregated Electrical Bus Ducts.”

This program inspects the non-segregated bus ducts that connect the reserve auxiliary transformers to the 4160V ESF buses. They are normally energized, and therefore, the bus duct insulation material will experience temperature rise due to energization, which may cause age-related degradation during the extended period of operation. These bus ducts are in scope of license renewal but are not subject to 10 CFR 50.49 environmental qualification. These non-EQ, non-segregated bus ducts will therefore be inspected periodically during the period of extended operation. This inspection program considers the technical information and guidance provided in IEEE Standard P1205, “IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations,” SAND 96-0344, “Aging Management Guidelines for Commercial Nuclear Power Plants – Electrical Cable and Terminations,” and EPRI-109619, “Guideline for the Management of Adverse Localized Equipment Environments.”

The non-segregated bus duct internal components and materials are visually inspected under station inspection procedures for signs of aging degradation that indicate possible loss of insulating function. Repair or rework is initiated as required to maintain the operating functions of the bus ducts.

The inspection program for the non-EQ, non-segregated electrical bus ducts that connect the reserve auxiliary transformers to the 4160V ESF buses will provide reasonable assurance that the intended function of the non-EQ, non-segregated bus ducts will be maintained consistent with the CLB for the period of extended operation.

This is a new program and will be implemented prior to the period of extended operation. The applicant provided ten elements of the program in Appendix B, Section B.2.2.

Staff Evaluation. In the LRA Section 2.5.2, the applicant determined whether bus ducts meet the screening criteria of 10 CFR 54.21(a)(1)(i) and evaluated these components against 10 CFR 54.21(a)(1)(ii).

The applicant stated that the bus ducts utilize pre-assembled raceway (enclosure) design with internal conductors installed on electrically insulated supports. Bus ducts are constructed of various metals, polyester glass, PVC, and silicon caulk. Bus ducts at Dresden and Quad Cities includes the bus ducts used for safety-related systems and those associated with the 4160 V power feeds between the reserve auxiliary transformers and switchgear. Bus ducts electrically connect specified sections of an electrical circuit to deliver voltage or current to various equipment and components throughout the plant.

Aging Effects

The applicant identified embrittlement, cracking, melting, discoloration, swelling or loss of dielectric strength leading to reduced insulation resistance, electrical failure as the aging effects/mechanism for the bus ducts.

The aging effects identified in the LRA for the bus ducts are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible the aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

Dresden and Quad Cities have elected to implement an AMP to identify and manage potential aging degradation. This is a non-GALL program and will provide reasonable assurance that the bus ducts will continue to perform their intended function consistent with the CLB through the period of extended operation. LRA Table 3.6-2 indicates that polyester glass insulator associated with electrical bus ducts will be periodically inspected per AMP B.2.2. It is not clear whether all the components (i.e., bus bar, enclosure, insulators, etc.) are covered under this AMP. Industry operating experience, as documented in Information Notices (IN 2000-14, IN 1998-36, and IN 1989-64) and Licensee Event Reports (LERs: 26698002, 41095010, and 27596017), indicate several problems (i.e., loosening of splice plate bolts, degradation of Noryl insulation, insulation failure along with the presence of moisture or debris provided undesired phase to phase or phase to ground electrical tracking paths which resulted in catastrophic failure of the bus) associated with bus ducts. Additionally, most connections to non-segregated bus ducts are made by bolted connections.

The non-segregated bus ducts may be exposed to appreciable ohmic or ambient heating during operation and may experience loosening related to the repeated cycling of connected loads or of the ambient temperature environment (Refer to SAND 96-0344, page 4-38). The staff understands that the proposed AMP B.2.2 program will manage the aging degradation of insulation material. The staff requested the applicant to provide a discussion on how the other problems identified by the above INs and LERs and SAND 96-0344 will be managed by the AMP B.2.2 (RAI 3.6-4). In response to the Staff's RAI 3.6-4, the applicant on October 3, 2003, stated that the procedures that implement AMP B.2.2 visually inspect non-segregated bus duct internal components and materials. These include: insulation material, bus duct support pieces, gaskets, insulating boots, taped connections, and bus bar sleeves. This part of Commitment #40 of Appendix A of this SER. Failure of connection tapes and bus bar sleeves would not prevent the bus duct from performing it's intended function. However, these components are included with the scope of AMP B.2.2. The visual inspections check for evidence of water and dirt accumulation, presence of foreign material, and cracking / chipping of insulation. The description of AMP B.2.2 should have included this detail in the AMP description and in the evaluation Parameters Monitored/Inspected, and Detection of Aging Effects.

LRA Section B.2.2, Evaluation and Technical Basis Element (3) - "Parameters Monitored/ Inspected," should have read as follows: "Accessible normally energized non-segregated bus duct internal components are visually inspected for insulator and bus bar insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, or surface contamination. Internal components such as insulation material, bus duct support pieces, gaskets, insulating boots, taped connections, and bus bar sleeves are inspected. The visual inspections also check for evidence of water and dirt accumulation and presence of foreign material."

The applicant stated that the failures identified in the referenced Information Notices and LERs caused by introduction of contaminants and moisture into the bus duct housing are addressed in AMP B.2.2. However, several of the IN's and LERs address inadequate design or inadequate maintenance as causal factors. These are not valid aging effects and are not addressed by AMP B.2.2.

The information notices or LERs identified do not suggest any age related failures. On the contrary, the failures noticed for installed lives are much shorter than a 40-year plant life.

LER 26698002 states that failure was caused by the presence of condensation. AMP B.2.2 inspects for evidence of water and dirt accumulation.

LER 41095010 event suggests the reason to be the use of wrong penetration sleeve material. This failure mode is not a valid aging effect and is not addressed by AMP B.2.2.

LER 27596017 identifies PVC off gassing as the casual factor. AMP B.2.2 visually inspects insulation for degradation.

IN 89-64 suggests that failure was caused by water and debris. AMP B.2.2 inspects for evidence of water and dirt accumulation.

IN 98-36 identifies failure due to poor maintenance. This failure mode is not a valid aging effect and is not addressed by AMP B.2.2.

IN 2000-14 identifies failures of two bus ducts, which started when a PVC insulator over a splice joint overheated in turn causing heat induced failure on fiberglass insulation. AMP B.2.2 visually inspects insulation for degradation.

The non-segregated bus ducts at Dresden and Quad Cities subject to AMP B.2.2 do not experience bolt loosening caused by the repeated cycling of connected loads from appreciable ohmic or ambient heating during operation. The non-segregated phase bus ducts subject to AMP B.2.2 are the bus ducts that connect the Reserve Auxiliary Transformer to the 4 KV busses. They are normally energized and do not experience appreciable cyclical temperature swings as discussed in SAND 96-0344. Therefore, the issue of heating and cooling that would cause the bolting connections to loosen does not apply. Additionally, operating experience at both sites has indicated no such failures.

In summary, AMP B.2.2 provides reasonable assurance that the applicable aging effects are adequately managed. On the basis of its review, the staff finds that the visual inspection of bus ducts, bus bars, and internal supports will provide an indication of aging effects.

The staff noted however that the proposed program will not verify the bolted connections for proper torque. In its supplemental information dated December 12, 2003, the applicant stated that bronze and stainless steel bolting material are used for the bus bar bolted connections on the normally energized non-segregated bus duct. Bronze and stainless steel bolts are ideal for use with copper bus because both materials have nearly the same coefficients of thermal expansion as the copper bus bar. This prevents thermal stress from causing plastic deformation of the bolts, which is the primary cause of loose connections. EPRI TR104213 (Joint Maintenance and Application Guide) Tables 7-4 and 7-6 show no thermal stress for bronze or stainless steel bolts used with copper bus.

EPRI TR104213 Section 8.2 states the bolts should be inspected for evidence of overheating, signs of burning or discoloration, and indications of loose bolts. The bolts should not be retorqued unless the joint requires service or the bolts are clearly loose.

Applicant's response to RAI 3.6-4 states that accessible normally energized non-segregated bus duct internal components are visually inspected for insulator and bus bar insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, or surface contamination. Internal components such as insulation material, bus duct support pieces, gaskets, insulating boots, taped connections, and bus bar sleeves are inspected. This inspection will verify that there is no discoloration, cracking, chipping or surface contamination of the bus bar insulation material at the bolted connections. The absence of discoloration, cracking, chipping or surface contamination provides positive indication that the bolted connections are not loose and therefore, the intended function of the bus duct will be maintained during the period of extended operation.

Applicant stated in LRA Section B.2.2 that it has not experienced any bus bar insulation failures that would indicate that bolted connections have a creditable aging mechanism. Additionally, there is no industry experience that indicates loosening of properly designed and installed bus bar bolted connections is an industry problem for bus duct that is not overloaded. The reference to SAND 96-0344 page 4-38 used in RAI 3.6-4 does not apply to bus bar bolting. A review of the empirical data presented in SAND 96-0344 Section 3 shows only nine failures of medium voltage cable splices. None of the failures were due to thermal cycling; most were due to mechanical stress and failure of the insulation material.

In summary, there is no plant or industry operating experience that shows that there is a credible aging mechanism pertaining to the bus bar bolts; therefore, no aging management other than visual inspection is required. On the basis of its review, the staff's concern is satisfactorily resolved.

The evaluation of the applicant's AMP focused on program elements. To determine whether the applicant's aging management program is adequate to manage the effect of aging so that the intended function will continue to be performed consistent with CLB for the period of extended operation, the staff evaluated the following seven elements:(1) scope of program, (2) preventive action, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the staff's safety evaluation.

[Program Scope] This inspection program applies to the normally-energized non-segregated bus ducts within the scope of license renewal, not subject to the environmental qualification requirements of 10 CFR 50.49, which can be affected by elevated temperatures prior to the end of the extended period of operation. The staff was concerned about excluding bus ducts that are not normally energized from the scope of the program (RAI B.2.2-1). In response to RAI B.2.2-1, the applicant by a letter dated October 3, 2003, stated that there are non-segregated bus ducts within the scope of license renewal that are not normally energized. These are bus ducts connecting the diesel generator to the ESF busses and connecting safety related buses. They are included in Section 2.5.1 of the license renewal application. These are not normally energized and are energized only for technical specification surveillance or emergency activities. They are only energized for very short durations during normal plant operation and are located inside (Reactor/Turbine/Diesel Generator/HPCI) buildings where the environment is free from moisture, wind, and extreme ambient temperature differences. Therefore, thermal aging is not a concern for the bus duct insulators or sleeves. There are no other aging mechanisms applicable for these bus ducts. Periodic surveillance testing performed per technical specification verifies functionality of the bus ducts. Dresden and Quad Cities operating experience including experience from the non-segregated bus duct (Reserve Auxiliary Transformer to 4 KV Busses) inspections currently performed at Dresden and Quad Cities also confirm that no aging mechanisms apply for these bus ducts that would affect their intended function. On the basis of its review, the staff finds that thermal cycling for bolted connections is a concern for these bus ducts. The staff notes that EPRI TR104213 recommends inspection of bolted joints for evidence of overheating, signs of burning or discoloration, and indication of loose bolts (Section 8.2) regardless of bolt material.

LER 26698002 states that component failure was caused by the presence of condensation. For the bus ducts not normally energized, condensation could occur since the area is “not” air conditioned. Additionally, dust, debris and moisture can be introduced inside the bus duct during maintenance work around the vicinity with relaxed housekeeping practices.

By a letter dated December 22, 2003, the applicant stated that the non-energized non-segregated bus duct bus bars are tubular aluminum with bolted joint connectors that are torqued to 65 ft. lbs. Each joint connector is filled around the bolts/nuts with Duxseal and then taped to provide a smooth surface. The available drawings do not indicate the bolting material. The applicant believes based on discussion with the vendor that the bolts are zinc plated high strength steel or stainless steel. The vendor manual states that under normal operating conditions, no internal maintenance is required on the bus ducts. Additionally, EPRI TR104213 Section 8.2 states the bolts should be inspected for evidence of overheating, signs of burning or discoloration, and indications of loose bolts. The bolts should not be retorqued unless the joint requires service or the bolts are clearly loose.

The applicant stated that there are no credible aging effects concerning bus duct bolted connections that require management. However, the applicant will include these bus ducts in the B.2.2 (Periodic Inspection of Non-EQ, Non-Segregated Electrical Bus Ducts) inspection program to inspect 10% of the bus bar insulation splice material at the bolted connections for surface anomalies, such as embrittlement, discoloration, cracking, chipping, or surface contamination. This part of Commitment #40 of Appendix A of this SER. The absence of insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, and discoloration provides positive indication that the bolted connections are not loose and therefore, the intended function of the bus duct will be maintained during the period of extended operation. This inspection will verify that there are no insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, and discoloration of the bus bar insulation splice material at the bolted connections. The inspection will also include a verification for the presence of dirt and moisture in the bus duct. This is part of Commitment #40 of Appendix A of this SER. The visual inspection will include as much of the insulation as can be seen in both directions beyond the location of the bolted material. The initial baseline inspections will be completed prior to the beginning of the period of extended operation. Follow-up inspections will be performed on a frequency not to exceed once every ten years. If degradation is found that could adversely effect the intended function of the bus bar, inspections will be expanded appropriately to determine the extent of condition. On the basis of its review, the staff finds that its concern is resolved.

[Preventive Actions] This is an inspection program only. This program does not prevent or mitigate aging degradation. This is acceptable since the staff finds no need for such actions.

[Parameters Monitored/Inspected] Accessible normally-energized nonsegregated bus duct internal components are visually inspected for insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, or surface contamination. As a result of the staff's RAI 3.6-4, on October 3, 2003, the applicant provided a revision of this element as follows: "Accessible normally energized non-segregated bus duct internal components are visually inspected for insulator and bus bar insulation material surface anomalies, such as embrittlement, discoloration, cracking, chipping, or surface contamination. Internal components such as insulation material, bus duct support pieces, gaskets, insulating boots, taped connections, and bus bar sleeves are inspected. The visual inspections also check for evidence of water and dirt accumulation and presence of foreign material." This is part of Commitment #40 of Appendix A of this SER. The staff finds this to be acceptable since this inspection will verify that there is no discoloration, cracking, chipping or surface contamination of the bus bar insulation material at the bolted connections. The absence of discoloration, cracking, chipping or surface contamination provides positive indication that the bolted connections are not loose and therefore, the intended function of the bus duct will be maintained during the period of extended operation.

[Detection of Aging Effects] Normally-energized non-segregated bus ducts that connect the reserve auxiliary transformers to the 4160V ESF buses are inspected at least once every 10 years for material surface anomalies which are precursors to any onset of insulation failure due to temperature or radiation degradation. Experience has shown that aging degradation is a slow process. This frequency is therefore adequate to preclude age-related failures of the conductor insulation. As a result of RAI B.2.2-2, the applicant stated that the program will be implemented prior to the period of extended operation. The staff finds that the 10-year inspection frequency is an adequate period to preclude failure of bus ducts because industry experience has shown that the aging degradation is a slow process.

[Monitoring and Trending] Trending is not included in this activity because the parameters inspected are difficult to quantify. The 10-year inspection frequency will however provide at least 2 data points within 20 years, which will permit some characterization of the rate of degradation. The staff finds this to be acceptable because the two data points will provide some characterization of the rate of degradation.

[Acceptance Criteria] The accessible normally-energized non-segregated bus ducts are to be free from unacceptable visual indications. Unacceptable visual indications are duct insulation material surface anomalies which suggest that bus duct insulation degradation exists, which if left unmanaged, could lead to a loss of the intended function, as determined by an engineering evaluation. The staff finds that the acceptance criteria to be acceptable because an unacceptable visual indication will indicate bus duct insulation degradation and loose bolts.

[Operating Experience] No age-related bus duct insulation failures that would indicate aging to be a concern at Dresden or Quad Cities have been identified. However, industry experience indicates that high temperatures may cause degradation of electrical insulation materials. Some visual surface indications of high-temperature degradation in bus duct electrical insulation, such as color changes or surface cracking, have been observed in the industry. The staff finds that the applicant has adequately addressed operating experience.

The staff also reviewed the UFSAR supplement to determine whether it provides an adequate description of the program.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the bus duct will effectively manage or monitor the aging effects identified in the LRA.

Conclusions. On the basis of its review of the applicant's program, 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). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.6.2.4.2 High Voltage Electrical Switchyard Bus

Summary of Technical Information in the Application. Switchyard bus electrically connect specified sections of an electrical circuit to deliver voltage or current to various equipment and components throughout the plant. The switchyard bus is used in swtchyards to connect two or more elements of an electrical power circuit such as active disconnect switches and passive transmission conductors. The material used for the switchyard bus is aluminum and iron. The staff notes that this component is missing from LRA Table 3.6-2.

Staff Evaluation. In the LRA Table 3.6-2, the staff did not find aging management review results for switchyard bus. The staff finds that change in material properties leading to increased resistance and heating due to oxidation, and cracking due to vibration are known to be potential aging effects/mechanism for the high voltage electrical switchyard bus. The staff requested the applicant to provide a description of aging management program, in accordance with the requirements of 10 CFR 54.21(a)(3), used to detect/manage above mentioned aging effects or provide a justification why such a program is not needed (RAI 3.6-7). In its response dated October 3, 2003, the applicant stated that the switchyard bus consists of aluminum tube, copper bar, aluminum conductors, and the necessary connections. Conductor connections are generally of the compression bolted category. The switchyard bus is located in an outside environment subject to ambient temperatures that normally range from -6 °F to 93 °F (referenced in section 9.4 of the Dresden & Quad Cities UFSAR). Copper and aluminum materials do not experience any appreciable aging effects in this environment. Additionally, connections are adequately designed and treated with corrosion inhibitors such as "No-oxide." For this reason, the switchyard bus is not susceptible to corrosion due to oxidation.

There are no credible sources of vibration in the switchyard bus at Dresden and Quad Cities stations that could result in fatigue or cracking. As such, this aging mechanism does not apply.

The staff finds that the applicant adequately addressed why these aging effects are not applicable aging effects at Dresden and Quad Cities. The staff agrees that there is reasonable assurance that the switchyard bus will perform its intended function for the period of extended operation.

Conclusions. On the basis of the staff's review of the information presented in the RAI 3.6-7 response, the staff concludes that switchyard bus has no aging effects that require management.

3.6.2.4.3 High Voltage Transmission Conductors

Summary of Technical Information in the Application. The high voltage transmission conductors within the scope of license renewal rule are those associated with the power feed from the switchyard to RATs. The function of the high voltage transmission conductors is to supply power to the plant systems through the RATs. Materials used for the high-voltage transmission conductors are aluminum conductor steel reinforced (ACSR).

Aging Effects

The applicant identified loss of material/corrosion as the aging effects/mechanism for the transmission conductors.

Aging Management Program

The applicant stated that the plant outdoor environment is not subject to heavy industry air pollution or saline environment. Aluminum is reactive, but develops an aluminum oxide film that protects it from further corrosion. Therefore, no aging management program is proposed.

Staff Evaluation. In LRA Table 3.6-2, Ref. No. 3.6.2.1, aging effect/mechanism for high voltage transmission conductors is identified as loss of material/corrosion. However, no aging management program for high voltage transmission conductors and connections is provided. The LRA states that "the plant outdoor environment is not subject to heavy industry air pollution or saline environment. Aluminum is reactive but develops an aluminum oxide film that protects it from further corrosion." The staff finds that loss of conductor strength and vibration is a known potential aging effects/mechanism for transmission line conductors. The most prevalent mechanism contributing to loss of conductor strength of an aluminum conductor steel reinforced (ACSR) transmission conductor is corrosion which includes corrosion of steel core and aluminum strand pitting. For ACSR conductors, degradation begins as a loss of zinc from the galvanized steel core wires. Corrosion rate depend largely on air quality which includes suspended particles chemistry, SO_2 concentration in air, precipitation, fog chemistry, and meteorological conditions. Transmission conductor vibration (caused by wind loading) or sway could cause loss of material (wear) and fatigue.

The staff requested the applicant to provide a description of aging management program, in accordance with the requirements of 10 CFR 54.21(a)(3), used to detect/manage the aging effects discussed above or provide justification why such a program is not needed (RAI 3.6-8).

In response to RAI 3.6-8, the applicant by letter dated October 3, 2003, stated that EPRI 1003057, License Renewal Electrical Handbook, discusses the aging of high voltage transmission conductors and concludes that the potential aging mechanism of corrosion does not produce any significant effects that would be of a concern for their intended function. Regarding high voltage transmission conductor strength, tests performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength of an 80-year-old ACSR conductor due to corrosion. Using the example of a 4/0 ACSR conductor, EPRI 1003057 shows the ultimate strength and the National Electrical Safety Code (NESC) heavy load tension requirements of 4/0 ACSR are 8350 lbs. and 2761 lbs. respectively. The margin between the NESC Heavy Load and the ultimate strength is 5589 lb.; i.e., there is a 67% of ultimate strength margin. The Ontario Hydroelectric study showed a 30% loss of composite conductor strength in an 80-year-old conductor. In the case of the 4/0 ACSR transmission conductors, a 30% loss of ultimate strength would mean that there would still be a 37% ultimate strength margin between what is required by the NESC and the actual conductor strength.

There is a set percentage of composite conductor strength established at which a transmission conductor is replaced. The NESC requires that tension on installed conductors be limited to a maximum of 60% of the ultimate conductor strength. The NESC also sets the maximum tension a conductor must be designed to withstand under various load requirements, which includes consideration of ice, wind and temperature. The applicant's design and installation practice limits the tension in the conductors such that it will not exceed a maximum of 50% of its rated tensile strength. Therefore, for a typical transmission conductor, there is ample design margin to offset the loss of strength due to corrosion and maintain the transmission conductor intended function through the extended period of operation. With respect to corrosion of steel core caused by loss of zinc coating or aluminum strand pitting corrosion, this is a very slow acting aging effect that is even slower for rural areas with generally less suspended particles and SO_2 concentrations in the air than urban or industrial areas. The transmission conductors at Dresden and Quad Cities do not see air particulates or contaminants as seen in urban or heavy industrial areas. Therefore, corrosion is not a credible aging mechanism for the intended function of Dresden and Quad Cities transmission conductors.

EPRI 1003057 also discusses the aging of high voltage transmission conductors and concludes that the potential aging mechanism of vibration does not produce any significant effects that would be of a concern for their intended function. Regarding wind loading induced vibration, wind loading is considered in the design and installation. Aging effect of loss of material and fatigue that could be caused by transmission conductor vibration or sway are not applicable in that they would not cause a loss of intended function for the extended period of operation. Experience has shown that the transmission conductors do not normally swing significantly. When they do swing 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 to sway is considered in the design and installation. Therefore, wind loading induced vibration and fatigue are not credible aging mechanisms, and will not cause a loss of intended function of the conductors at Dresden and Quad Cities.

The applicant concluded that the aging mechanism identified in the RAI are not significant for Dresden and Quad Cities transmission conductors in that they would not cause a loss of intended function for the period of extended operation.

The staff finds that the applicant adequately addressed why these aging effects (loss of conductor strength and vibration) are not applicable at Dresden and Quad Cities transmission conductors. The staff concludes that there is reasonable assurance that the transmission conductors will perform its intended function for the period of extended operation.

Conclusions. On the basis of the staff's review of the information presented in the RAI 3.6-8 response, the staff concludes that transmission conductors have no aging effects that require management.

3.6.2.4.4 High Voltage Insulators

Summary of Technical Information in the Application. High-voltage insulators within the scope of license renewal rule are those associated with the power feeds from the switchyard to reserve auxiliary transformers. The function of high voltage insulators is to support and insulate the high voltage transmission conductors. Materials used for the high-voltage insulators are porcelain.

Aging Effects

The applicant identified no aging effects/mechanism for the switchyard bus.

Aging Management Program

The applicant stated that the plant outdoor environment is not subject to heavy industrial air pollution or saline environment. Plant indoor and outdoor environments are not conductive to promoting aging degradation of porcelain components. Therefore, no aging management program is proposed.

Staff Evaluation. In the LRA Table 3.6-2, the aging effect/mechanism for porcelain insulator is indicated as "none." The LRA states that "the plant outdoor environment is not subject to heavy industrial air pollution or saline environment. Plant indoor and outdoor environment are not conducive to promoting aging degradation of porcelain components." The staff finds that surface contamination, cracking, and loss of material due to wear are the aging effect/mechanism. Various airborne materials such as dust, salt, and industrial effluents can contaminate insulator surfaces. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover.

Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge shoot or near the sea cost where salt spray is prevalent. Porcelain is essentially a hardened, opaque glass. As with any glass, porcelain will crack or break when subjected to enough force. Cracks have also known to occur with insulators when the cement that binds the part together expands enough to crack the porcelain. This phenomenon is known as cement growth. Mechanical wear is an aging effects for 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 swing is frequent enough, it could cause wear in the metal contact points of the insulator string and between an insulator and supporting hardware. The staff requested the applicant to provide a discussion why these aging effects/mechanism are not of concern for Dresden and Quad Cities (RAI 3.6-6). In response to RAI 3.6-6, the applicant by letter dated October 3, 2003, stated that the concerns identified in the RAI were evaluated and discussed as follows:

Surface Contamination

Regarding the potential for contamination of insulators, the buildup of surface contamination is gradual. In most areas, this contamination is washed away by rain or snow; the glazed insulator surface aids this contamination removal. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near a seacoast where salt spray is prevalent. Dresden and Quad Cities are located in areas where airborne particle concentrations are comparatively low, since they are not located in heavy industrialized areas. Any insignificant contamination would be washed away by the rainfall or snow, which is seasonal in nature, and cumulative build up is not expected. There is no salt spray that can affect the insulators as Dresden and Quad Cities are not located near a seacoast. Therefore, surface contamination is not a credible event for the insulators at Dresden and Quad Cities.

Cracking/ Cracking of Cement Due to Cement Growth

Regarding HV porcelain insulator cracking, porcelain is essentially a hardened, opaque glass. As with any glass, if subjected to enough force it will crack or break. The most common cause for cracking or breaking of an insulator is being struck by an object (e.g., a rock or bullet). Cracking and breaking caused by physical damage is not an aging effect and is not subject to an AMR. Cracks have been known to occur with insulators when the cement that binds the parts together expands enough to crack the porcelain. This phenomenon, known as cement growth, occurs mainly because of improper manufacturing processes or materials, which make the cement more susceptible to moisture penetration, and the specific design and application of the insulator. Therefore, cracking due to cement growth is not an applicable aging effect for the HV switchyard insulators in the service conditions they are exposed to at Dresden and Quad Cities. Along with improper manufacturing, cracking would also be caused by severe temperature extremes or variation. The temperature extreme will be seasonal in nature and does not produce a cumulative effect for 60 years. Any temperature related failures would be manifested in a few years. The insulators are properly selected and specified for the expected conditions. This is a design consideration. In summary, the concern of cracking is either event driven or a design issue and is not an aging concern.

Loss of Material Due to Wear/ Mechanical Wear Due to Wind Blowing the Transmission Conductors

Regarding mechanical wear, this applies to 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 swinging is frequent enough, it could cause wear in the metal contact points of the insulator string and between an insulator and the supporting hardware. Although this mechanism is possible, experience has shown that the transmission conductors do not normally swing significantly. When they do swing 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 sway is considered in the design and installation. Therefore, the loss of material due to wear is not considered a credible aging effect and will not cause a loss of intended function of the insulators at Dresden and Quad Cities. Therefore, loss of material due to wear is not an applicable aging effect for insulators.

The staff finds that the applicant adequately addressed why these aging effects (surface contamination, cracking, and loss of material due to wear) are not applicable at Dresden and Quad Cities. The staff agrees that there is reasonable assurance that the high-voltage insulators will perform its intended function for the period of extended operation.

Conclusions. On the basis of the staff's review of the information presented by the applicant, the staff concludes that high-voltage insulators have no aging effects that require management.

3.6.2.4.5 Non-EQ Electrical Penetration Assemblies

Summary of Technical Information in the Application. The applicant did not provide an AMR of the electrical penetration assemblies.

Staff Evaluation. The staff requested the applicant to clarify whether there are any electrical penetrations that are not covered under EQ program (RAI 3.6-2). In response to the staff's RAI 3.6-2, the applicant on October 3, 2003, stated that at Dresden Station, all electrical penetrations are covered under the Environmental Qualification (EQ) program. At Quad Cities Station, all but three electrical related penetrations (1-X102B, 2-X100A, and 2-X105A) are part of the station EQ program. These three penetrations serve circuits (such as drywell booster fans and main steam line vibration monitoring instrumentation) that do not perform any electrical intended function.

As stated in Section 2.5.1.4 of the License Renewal Application, the intended function (electrical continuity) is managed by the EQ program. The mechanical and structural related intended functions of all electrical penetrations, including the three Quad Cities penetrations not included within the station EQ program, are addressed in Table 2.4-1 under Component Group "Containment Penetrations (Electrical)" and the associated aging management is discussed in Table 3.5-1, Aging Management Reference 3.5.1.3 of the application. The staff requested the applicant to provide details about these circuits (i.e., energized during shutdown only and power supply is disconnected during plant operation, etc.). The staff also requested the applicant to discuss why the aging of the insulation do not have any effect on the penetration damage curve so that penetration seal integrity is maintained as part of containment pressure boundary.

In its supplemental information dated December 5, 2003, the applicant stated that the drywell booster fans are continuously energized during plant operations. The circuit for these fans is protected by redundant 100 amp in-scope circuit breakers. The cables from the MCC to the penetrations and from the penetrations to the fans are in-scope and managed by aging management program B.1.33, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The conax penetration feed-through-modules are #2 AWG solid copper conductors insulated with polyimide film. The circuits are designed such that the 100 amp breakers are coordinated to clear all fault currents before the short circuit capacity of the #2 AWG feed-through-modules is exceeded thus preventing damage to the penetration seal integrity. There are no credible aging effects that reduce the short circuit capability of solid copper conductors. Short circuit capacity is based on the circular mills of the copper conductor.

The vibration Instrumentation circuits are low voltage, milliamp circuits protected by fuses. Fault currents are in the milliamp range and not severe enough to cause damage to the # 18 AWG feed-through-modules. The cables for these instrumentation circuits are in-scope and managed by aging management program B.1.33, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements."

The design of the Conax penetration module is a stainless steel tube that is sealed at both ends with polysulfone. Solid copper polymide film insulated conductors passes though the stainless steel tube and are molded into the polysulfone seal at both ends to provide a leak proof seal. A visual inspection of the exposed polymide film insulation will not provide any indication of the leak tightness of the penetration because the insulation cannot be visually inspected once it passes into the polysulfone seal. The aging management programs that are used to manage the aging of the pressure boundary function are Containment 151 (B.1.26) and Containment leak rate test (B.1.28).

Identical Conax EQ penetrations are installed at the Dresden station. The Dresden Conax EQ penetrations are qualified for 60 years of normal and one-year accident/post accident conditions in accordance with IEEE 323-1983 requirements and NUREG-0588, Category I. The Quad Cities Conax penetrations are bounded by the environmental qualification reports approved for Dresden.

The applicant concluded that license renewal intended function of the Quad Cities Non-EQ penetrations will be maintained during the period of extended operation by using AMPs Containment ISI (B.1.26) and Containment Leak Rate Test (B.1.28).

On the basis of its review, the staff finds that three non-Class 1E penetrations at Quad Cities will not require an AMR.

Conclusion. On the basis of its review, the staff concludes that no AMR is required for Dresden since all penetrations are covered under EQ program. The staff also concludes that no AMR is required for Quad Cities Non-EQ penetrations and that the component intended function for Quad Cities will be maintained consistent with CLB for the extended operation as required by 10 CFR 54.21(a)(3).

3.7 Conclusion for Aging Management

On the basis of its review of AMR results and AMPS, with the exception of open and confirmatory items identified in the chapter of the SER, the staff concludes that actions have been identified and have been or will be taken to manage the effects of aging during the period of extended operation on the functionality of SCs subject to an AMR such that there is reasonable assurance with the CLB, as required by 10 CFR 54.21(a)(3).

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