Audit and Review Report for

Plant Aging Management Reviews

and Programs

Pilgrim Nuclear Power Station
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Pilgrim Nuclear Power Station Audit and Review Report

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Audit and Review Report for Plant Aging Management Reviews and Programs for Pilgrim Nuclear Power Station

1. Introduction and General Information

1.1 Introduction

By letter dated January 25, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML060300028), Entergy Nuclear Generation Company (Entergy, the applicant) submitted to the U.S. Nuclear Regulatory Commission (NRC) its application for renewal of Facility Operating License Number DPR-35 (ADAMS Accession Number ML011920392) for Pilgrim Nuclear Power Station (PNPS). The applicant requested renewal of its operating license for an additional 20 years beyond the 40-year current license term.

In support of the NRC staff's (the staff's) safety review of the license renewal application (LRA) for PNPS, the License Renewal Branch C (RLRC) led a project team that audited and reviewed selected aging management reviews (AMRs) and associated aging management programs (AMPs) developed by the applicant to support the LRA for PNPS. The project team included both NRC staff and contractor personnel provided by Advanced Technologies and Laboratories International, Inc. (ATL), the RLRC technical contractor. Attachment 2 to this audit and review report lists the project team members as well as other NRC staff and ATL personnel who supported the project team's audit and review.

The project team performed its work in accordance with the requirements of Title 10, Part 54, of the *Code of Federal Regulations* (10 CFR Part 54), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants"; the guidance provided in NUREG-1800, Revision 1, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR); and the guidance provided in NUREG-1801, Revision 1, "Generic Aging Lessons Learned (GALL) Report" (GALL Report).

Details of how the project team implemented these requirements and guidance are found in "Audit and Review Plan for Plant Aging Management Reviews and Programs – Pilgrim Nuclear Power Station," Docket No. 50-293 (ADAMS Accession Number ML061220630) (PNPS audit and review plan).

Overall, for its assigned scope of work, the project team determined that the applicant's aging management activities and programs will adequately manage the effects of aging on systems, structures, and components (SSCs), so that their intended functions will be maintained for PNPS during the period of extended operation (PEO).

This audit and review report documents the results of the project team's audit and review work. The project team performed its work at NRC Headquarters in Rockville, Maryland; at ATL offices in Germantown, Maryland; and at the applicant's offices (PNPS site) in Plymouth, Massachusetts. The project team conducted onsite visits during the weeks of May 22, 2006, and June 19, 2006. The project team conducted a public exit meeting at the PNPS site on July 19, 2006. Attachment 2 to this audit and review report lists the applicant personnel and other individuals contacted by the project team in support of the work documented in this audit and review report. It also lists those attending the public exit meeting.

1.2 Background

In 10 CFR 54.4, the scope of license renewal is defined as those SSCs (1) that are safety-related, (2) whose failure could affect safety-related functions, or (3) that are relied on to demonstrate compliance with NRC regulations for fire protection, environmental qualification (EQ), pressurized thermal shock, anticipated transients without scram, and station blackout (SBO). An applicant for a renewed license must review all SSCs within the scope of license renewal to identify those structures and components (SCs) subject to an AMR. SCs subject to an AMR are those that perform an intended function without moving parts or without a change in configuration or properties and that are not subject to replacement based on qualified life or a specified time period. Pursuant to 10 CFR 54.21(a)(3), an applicant for a renewed license must demonstrate that the effects of aging will be managed in such a way that the intended function or functions of those SCs will be maintained for the PEO.

In addition, 10 CFR 54.21(d) requires that the applicant submit a supplement to the Final Safety Analysis Report (FSAR) that contains a summary description of the programs and activities for managing the effects of aging.

The SRP-LR provides staff guidance for reviewing applications for license renewal. The GALL Report is a technical bases document. It summarizes staff-approved AMPs for the aging of a large number of SCs that are subject to an AMR. It summarizes the aging management evaluations, programs, and activities credited for managing aging for most of the SCs used by commercial nuclear power plants, and it serves as a reference for both the applicant and staff reviewers to quickly identify those AMPs and activities that the staff has determined will provide adequate aging management during the PEO. 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 identifies (1) SSCs, (2) component materials, (3) environments to which the components are exposed, (4) aging effects/mechanisms (AEMs) associated with the materials and environments, (5) AMPs that are credited with managing the aging effects, and (6) recommendations for further applicant evaluations of aging effects and their management for certain component types.

The GALL Report is treated in the same manner as an NRC-approved topical report that is generically applicable. An applicant may reference the GALL Report in its LRA to demonstrate that its programs correspond to those that the staff reviewed and approved in the GALL Report. If the material presented in the LRA is consistent with the GALL Report and is applicable to the applicant's facility, the staff will accept the applicant's reference to the GALL Report. In making this determination, the staff considers whether the applicant has identified specific programs described and evaluated in the GALL Report but does not conduct a review of the substance of the matters described in the GALL Report. Rather, the staff determines that the applicant established that the approvals set forth in the GALL Report apply to its programs.

If an applicant takes credit for a GALL Report program, it is incumbent on the applicant to ensure that its plant program addresses all 10 program elements of the referenced GALL Report program. These elements are described in SRP-LR Appendix A.1, "Aging Management

Review – Generic (Branch Technical Position RLSB-1)." In addition, the conditions at the plant must be bounded by the conditions for which the GALL Report program was evaluated. The applicant must certify in its LRA that it completed the appropriate verifications and that those verifications are documented and retained by the applicant in an auditable form.

2. Audit and Review Scope

The AMRs and associated AMPs that the project team reviewed are identified in the PNPS audit and review plan. The project team examined 37 of the 38 PNPS AMPs and the associated AMRs. The project team reviewed AMPs and AMRs that the applicant claimed were consistent with the GALL Report and AMRs for which further evaluation is recommended by the GALL Report. The project team also reviewed plant-specific AMPs and AMRs that were not consistent with or not included in the GALL Report.

The applicant noted that some of its AMPs, although described as consistent with the GALL Report, contain some deviations from the GALL Report. These deviations are of two types:

- exceptions to the GALL Report – exceptions are specified GALL Report recommendations that the applicant does not intend to implement.

- enhancements – enhancements include those actions/activities necessary to (1) ensure consistency with GALL Report AMP recommendations, or (2) provide additional features to the program or program activities that the applicant will implement before the PEO. Enhancements may expand, but not reduce, the scope of an AMP.

The project team's audit and review activities for the PNPS AMPs and its conclusions regarding these reviews are documented in Section 3.0.3 of this audit and review report.

The project team reviewed all PNPS LRA Table 2s[1] AMR line items in Chapter 3, except those that were assigned to the NRC Office of Nuclear Reactor Regulation (NRR), Division of Engineering (DE) staff. Those the project team reviewed were either consistent with the GALL Report, as identified by Notes A through E in PNPS LRA Table 3.X.2-Y (from Column 9 of the Table 2s discussed in Section 3.0.1 of this audit and review report), or not consistent with or not included in the GALL Report, as identified by Notes F through J in PNPS LRA Table 3.X.2-Y (from Column 9 of the Table 2s discussed in Section 3.0.1 of this audit and review report). The project team also reviewed time-limited aging analysis (TLAA) in Sections 4.3, 4.4, 4.7.2.2, 4.7.2.3, and 4.7.2.5.

The project team determined that the AMR results, reported by the applicant to be consistent with the GALL Report, are consistent with the GALL Report. The project team also determined that the plant-specific AMR results reported by the applicant are technically acceptable and applicable. For AMR results for which the GALL Report recommends further evaluation, the project team reviewed the applicant's evaluation and determined that it adequately addresses the issues for which the GALL Report recommends further evaluation. The project team performed a technical review of the TLAAs to determine that the TLAAs have been projected to

the end of the PEO or that the effects of aging on the intended function(s) will be adequately managed for the PEO.

The AMR results that are within the scope of the project team are identified in Appendix D of the PNPS audit and review plan. These AMR result line-items reviewed by the project team in Chapter 3 of the PNPS LRA Tables 3.X.2-Y were either consistent with the GALL Report or justified by the applicant on the basis of a NRC-approved precedent. The TLAAs that are within the scope of the project team are identified in Appendix E of the PNPS audit and review plan.

In PNPS LRA Table 3.X.2-Y, in addition to the notes, the applicant provided a summary of AMR results for the applicable systems, which included SCs, associated materials, environment, any aging effects requiring management (AERMs), and an AMP for each line item. The notes describe how the information in the tables aligns with the information in the GALL Report. Those that are aligned with the GALL Report are assigned letters and are described below. Those defined by the applicant are assigned numbers and defined in its PNPS LRA.

- Note A indicates that the PNPS AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the PNPS AMP is consistent with the AMP identified in the GALL Report.

- Note B indicates that the PNPS AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the PNPS AMP takes some exceptions to the AMP identified in the GALL Report. The project team concluded that the identified exceptions to the GALL Report AMPs are acceptable.

- Note C indicates that the component for the PNPS AMR line item is different from but consistent with the GALL Report for material, environment, and aging effect. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report. However, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component that was under review. The project team concluded that the PNPS AMR line item of the different component was applicable to the component under review.

- Note D indicates that the component for the PNPS AMR line item is different from but consistent with the GALL Report for material, environment, and aging effect. In addition, the PNPS AMP takes some exceptions to the AMP identified in the GALL Report. The project team reviewed these line items to confirm consistency with the GALL Report. The project team concluded that the PNPS AMR line item of the different component was applicable to the component under review. The project team concluded that the identified exceptions to the GALL Report AMPs are acceptable.

- Note E indicates that the PNPS AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The project team evaluated these line items to determine that the AMP credited by the applicant is applicable.

- Note F indicates that the material is not in the GALL Report for the identified component.

- Note G indicates that the environment is not in the GALL Report for the identified component and material.
- Note H indicates that the aging effect is not in the GALL Report for the identified component, material, and environment combination.
- Note I indicates that the aging effect in the GALL Report for the identified component, material, and environment combination is not applicable.
- Note J indicates that neither the identified component nor the material and environment combination is evaluated in the GALL Report.

Discrepancies or issues discovered by the project team during the audit and review that required a response are documented in this audit and review report. If resolution of an issue was not resolved before issuing this audit and review report, the project team prepared a request for additional information (RAI) to solicit the information needed to disposition the issue. The RAI will be included and dispositioned in the safety evaluation report (SER) related to the PNPS LRA. The list of RAIs associated with this audit and review report is provided in Attachment 4 to this audit and review report.

The project team conducted an audit and review of the information provided in the PNPS LRA and program bases documents, which are available at the applicant's office, and through interviews with PNPS technical staff. The project team determined that the applicable aging effects were identified, the appropriate combination of materials and environments were listed, and acceptable AMPs were specified.

The AMR results of PNPS LRA Sections 3.1 through 3.6 reviewed by the project team are provided in Sections 3.1 through 3.6 of this audit and review report. The results of the project team's review of TLAAs identified in PNPS LRA Section 4.0 are provided in Sections 4.3, 4.4, and 4.7 of this audit and review report.

3. Aging Management Review Audit and Review Results

This section of the audit and review report contains the project team's evaluation of the PNPS AMPs and AMRs. In PNPS LRA Appendix B, the applicant described the AMPs that it relies on to manage or monitor the aging of long-lived, passive components and structures.

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

3.0 PNPS's Use of the Generic Aging Lessons-Learned Report

In preparing its PNPS LRA, Entergy credited the GALL Report. The GALL Report contains the staff's generic evaluation of the existing plant programs, and it documents the technical bases for determining where existing programs are adequate without modification and where existing

programs should be augmented for the PEO. The evaluation results documented in the GALL Report indicate that many of the existing programs are adequate to manage the aging effects for particular structures or components for license renewal without change. The GALL Report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. PNPS references the GALL Report in its LRA to demonstrate that the programs at its facility correspond to those recommended in the GALL Report.

3.0.1 Format of the PNPS License Renewal Application

The PNPS LRA closely follows the standard LRA format presented in Nuclear Energy Institute (NEI) 95-10, Revision 6, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule."

The organization of Section 3 of the PNPS LRA parallels Chapter 3 of the SRP-LR. Section 3 of the PNPS LRA provides the results of the AMRs for SCs that the applicant identified as subject to an AMR. Organization of this section is based on Tables 1 through 6 of Volume 1 of the GALL Report, dated September 2005, and Chapter 3, "Aging Management Review Results," of the SRP-LR, dated September 2005.

This section provides the results of the AMRs for SCs identified in Section 2 of this audit and review report as subject to AMR. Tables 3.0-1, 3.0-2, and 3.0-3 provide descriptions of the mechanical, structural, and electrical service environments, respectively, used in the AMRs to determine AERMs.

The results of the AMRs are presented in two table types. The first table type is Table 3.X.1 (Table 1), where the "3" indicates the table pertaining to the Chapter 3 AMR; the "X" indicates the table number from Volume 1 of the GALL Report (see the definition table below), and the "1" indicates that this is the first table type (Table 1) in Section 3.X. For example, in the "Reactor Vessel, Internals, and Reactor Coolant Systems" subsection, this is Table 3.1.1, and in the "Engineered Safety Features" (ESF) subsection, this is Table 3.2.1.

Definition Table

X	Definition
1	Reactor Vessel, Internals, and Reactor Coolant Systems
2	Engineered Safety Features
3	Auxiliary Systems
4	Steam and Power Conversion System
5	Containment, Structures, Component Supports, and Piping and Component Insulation
6	Electrical Components

The second table type is Table 3.X.2-Y (Table 2) where "3" again indicates the PNPS LRA section number; "X" again indicates the table number from Volume 1 of the GALL Report; the "2" indicates that this is the second table type (Table 2) in Section 3.X; and "Y" indicates the system table number. For example, within the "Reactor Vessel, Internals, and Reactor Coolant Systems" subsection, the AMR results for the isolation condenser system are presented in Table 3.1.2.1.1, and the results for the nuclear boiler instrumentation system are in Table 3.1.2.1.2. In the "Engineered Safety Features Subsection," the containment spray system results are presented in Table 3.2.2.1.1, and the core spray system results are in Table 3.2.2.1.2.

The applicant compared the PNPS AMR results with information set forth in the tables of the GALL Report and provided the results of its comparisons in two table types that correspond to the two table types described above.

3.0.1.1 Overview of Table 1

PNPS LRA Table 1 provides a summary comparison of how the PNPS AMR results align with the corresponding tables of the GALL Report. PNPS LRA Table 1 consists of the following columns: "Item Number," "Component," "Aging Effect/Mechanism," "AMPs," "Further Evaluation Recommended," and "Discussion." These PNPS LRA tables have the same format and are essentially the same as Tables 1 through 6 of the GALL Report, Volume 1, except that the "ID" and "Type" columns of the GALL Report tables were replaced by an "Item Number" column, and the "Related Generic Item" and "Unique Item" columns of the GALL Report tables were replaced by a "Discussion" column. The "Discussion" column includes further clarifying/amplifying information. The following are examples of information that are contained within the "Discussion" column:

(1) information on further evaluation required or reference to the location of that information

(2) the name of a plant-specific program being used

(3) exceptions to the GALL Report assumptions

(4) a discussion of how the line item is consistent with the corresponding line item in the GALL Report

(5) a discussion of how the line item differs from the corresponding line item in the GALL Report, when it may appear to be consistent

3.0.1.2 Overview of Table 2

PNPS LRA Table 3.X.2-Y (Table 2) provides the detailed results of the AMRs for those components identified in PNPS LRA Section 2 as being subject to an AMR. There is a Table 2 for each of the components or systems within a system grouping (e.g., reactor vessel, internals, and Reactor Coolant Systems (RCS); ESF; auxiliary systems, etc.). For example, the SF

system group contains tables specific to the containment spray system, core spray system, and standby gas treatment (SGT) system. Table 2 consists of the following nine columns:

(1) *Component Type* – The first column identifies the component types that are subject to an AMR. The component types are listed in alphabetical order. In the structural tables, component types are subgrouped by material.

(2) *Intended Function* – The second column identifies the license renewal intended functions for the listed component types. Definitions and abbreviations of intended functions are listed in Table 2.0-1 in Section 2 of the PNPS LRA.

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

(4) *Environment* – The fourth column lists the environment to which the component types are exposed. Internal and external service environments are indicated. A description of these environments is provided in Tables 3.0-1, 3.0-2, and 3.0-3 for mechanical, structural, and electrical components, respectively.

(5) *Aging Effect Requiring Management* – The fifth column lists the aging effects identified as requiring management for the material and environment combinations of each component type.

(6) *Aging Management Programs* – The sixth column lists the programs used to manage the AERM.

(7) *GALL Report Volume 2 Item* – The seventh column documents identified consistencies of factors listed in Table 2 of the PNPS LRA with the GALL Report by noting the appropriate GALL Report AMR line item. Each combination of the following factors listed in Table 2 is compared to the GALL Report to identify those consistencies: component type, material, environment, AERM, and AMP. If there is no corresponding AMR line item in the GALL Report for a particular combination of factors, Column 7 is left blank.

(8) *Table 1 Item* – The eighth column is a cross-reference of line items from Table 2 to Table 1. Each combination of the following factors that has an identified GALL Report AMR line item also has a Table 1 line-item reference number: component type, material, environment, AERM, and AMP. Column 8 lists the corresponding line item from Table 1. If there is no corresponding item in the GALL Report Volume 1, Column 8 is left blank.

(9) *Notes* – The ninth column contains notes that are used to describe the degree of consistency with the AMR line items in the GALL Report. Notes that use letter designations are standard notes based on the letter from A. Nelson, NEI, to P. T. Kuo, NRC, "U.S. Nuclear Industry's Proposed Standard License Renewal Application Format Package, Request NRC Concurrence," dated January 24, 2003 (ADAMS Accession Number ML030290201). (Note that the staff concurred in the standardized format for

LRAs by letter dated April 7, 2003, from P.T. Kuo, NRC, to A. Nelson, NEI (ADAMS Accession Number ML030990052).) Notes that use numeric designators are specific to PNPS. The letter notes are described in detail in Section 2 of this audit and review report.

3.0.2 Audit and Review Process

The project team performed the audit and review in accordance with the criteria defined in the SRP-LR. Additional details on how the SRP-LR criteria were addressed are provided in the PNPS audit and review plan. This section summarizes this review process.

3.0.2.1 Review of AMPs

For the PNPS AMPs for which the applicant claims consistency with the AMPs in the GALL Report, the project team determined consistency. The project team reviewed the PNPS AMP descriptions and compared Program Elements 1 through 6 and Element 10 for those AMPs to the corresponding program elements for the GALL Report AMPs (Attachment 3 to this audit and review report shows the 10 AMP elements from the SRP-LR). For Elements 7, 8, and 9, the project team reviewed and determined the adequacy of the applicant's 10 CFR 50, Appendix B Program, and Section 3.0.4 of this audit and review report documents the results.

For the PNPS AMPs that have one or more exception and/or enhancement, the project team reviewed each exception and/or enhancement to determine whether the exception and/or enhancement is acceptable and whether the PNPS AMP, as modified by the exception and/or enhancement, would adequately manage the aging effects for which it is credited. In some cases, the project team identified differences that the applicant did not identify between the PNPS AMPs credited by the applicant and the GALL Report AMPs. In these cases, the project team reviewed the difference to determine whether or not it is acceptable and whether or not the AMP, as modified by the difference, would adequately manage the aging effects.

For those PNPS AMPs that are not included in the GALL Report, the project team reviewed the PNPS AMP against the program elements specified in Appendix A.1 of the SRP-LR. The project team determined whether these PNPS AMPs would manage the aging effects for which they are credited.

3.0.2.2 Review of AMR Results

The AMRs in the GALL Report fall into three broad categories:

- those that the GALL Report concludes are adequate to manage aging of the components referenced in the GALL Report;
- those for which the GALL Report concludes that further evaluation is recommended for certain aspects of the aging management process; and

- those that are not consistent with the GALL Report or not addressed in the GALL Report.

The project team determined that the PNPS AMR results, reported by the applicant to be consistent with the GALL Report, are consistent with the GALL Report. The project team also determined that the plant-specific AMR results reported by the applicant are technically acceptable and applicable. For AMR results for which the GALL Report recommends further evaluation, the project team reviewed the applicant's evaluation to determine whether it adequately addresses the issues for which the GALL Report recommends further evaluation.

3.0.2.3 NRC-Approved Precedents

To help facilitate the staff review of its LRA, an applicant may reference NRC-approved precedents to demonstrate that its non-GALL programs correspond to reviews that the NRC has approved for other plants during its review of previous applications for license renewal. When an applicant elected to provide precedent information, the project team determined whether the material presented in the precedent was applicable to the applicant's facility, determined whether the plant program was bound by the conditions for which the precedent was evaluated and approved, and determined that the plant program contained the program elements of the referenced precedent. In general, if the project team determined that these conditions were satisfied, it used the information in the precedent to frame and focus its review of the applicant's program.

It is important to note that precedent information is not a part of the LRA; it is supplementary information voluntarily provided by the applicant as a reviewer's aid. The existence of a precedent, in and of itself, is not a sufficient basis to accept the applicant's program. Rather, the precedent facilitates the review of the substance of the matters described in the applicant's program. As such, in the applicant's documentation of its reviews of programs that are based on precedents, the precedent information is typically implicit in the evaluation rather than explicit. If the project team determined that a precedent identified by the applicant was not applicable to the particular plant program for which it is credited, it may have referred the program to NRR DE for review in the traditional manner (i.e., as described in the SRP-LR) without consideration of the precedent information.

Entergy chose not to use precedent information to support its selection of PNPS's programs.

3.0.2.4 UFSAR Supplement

Consistent with the SRP-LR, for the AMR results and associated AMPs that it reviewed, the project team also reviewed the Updated Final Safety Analysis Report (UFSAR) Supplement that summarizes the applicant's programs and activities for managing the effects of aging for the PEO, as required by 10 CFR 54.21(d).

3.0.2.5 Documentation and Documents Reviewed

In performing its work, the project team relied heavily on the PNPS LRA, the SRP-LR, and the GALL Report. The project team also reviewed the applicant's AMP bases documents (a catalog of the documentation used by the applicant to develop or justify its AMPs) and other onsite documents, including selected implementing documents, to determine that the applicant's activities and programs will adequately manage the effects of aging on SCs.

Any discrepancies or issues discovered during the audit and review that required a formal response on the docket are documented in this audit and review report. If an issue was not docketed or was not resolved before issuing this audit and review report, the project team prepared an RAI describing the issue and the information needed to disposition the issue. The RAI, if needed, is included and dispositioned in the SER related to the PNPS LRA. The list of RAIs associated with the audit and review is provided in Attachment 4 to this audit and review report.

Attachment 5 to this audit and review report characterizes the nature and extent of the project team's review of the applicant's documents and lists the documents it reviewed. During its audit and review, the project team also conducted detailed discussions and interviews with the applicant's license renewal project personnel and other personnel with technical expertise relevant to aging management.

3.0.2.6 Commitments To Be Included in the Safety Evaluation Report

During the audit and review, the project team requested additional information to resolve issues related to the content of the LRA. In responding to these RAIs, the applicant, in some cases, committed to supplement its LRA to correct entries or implement additional activities, as needed, to appropriately manage aging of the various SSCs within the scope of license renewal. A list of these commitments is included in Attachment 6 to this audit and review report.

3.0.2.7 Exit Meeting

The project team held a public exit meeting with the applicant on July 19, 2006, to discuss the results of its audits and reviews of the AMPs and AMR results assigned to the project team. These discussions reflected the project team's work and its results, as documented in this audit and review report.

3.0.3 PNPS Aging Management Programs

The project team's audit and review activities for the PNPS AMPs and its conclusions regarding these programs are documented below. The audit and review was performed in accordance with the guidance contained in the PNPS audit and review plan as summarized in Section 3.0.2 of this audit and review report.

Table 3.0.3-1, “PNPS's Aging Management Programs,” presents the AMPs credited by the applicant and described in Appendix B of the LRA. The table also indicates the GALL Report program that the applicant claimed its AMP was consistent with (if applicable) and the SSCs for managing or monitoring aging. The section of the audit and review report that documents the project team’s evaluation of the program also is provided.

Table 3.0.3-1 PNPS Aging Management Programs

PNPS AMP (LRA Section)	GALL Report Comparison	GALL Report AMP(s)	PNPS LRA Systems or Structures That Credit the AMP	Project Team’s Evaluation Section
Boraflex Monitoring Program (B.1.1)	Consistent	XI.M22, “Boraflex Monitoring”	auxiliary systems	3.0.3.1.1
Buried Piping and Tanks Inspection Program (B.1.2)	Consistent with exception	XI.M34, “Buried Piping and Tanks Inspection”	engineered safety features, auxiliary systems, steam and power conversion system	3.0.3.2.1
BWR Control Rod Drive (CRD) Return Line Nozzle Program (B.1.3)	Consistent with exception	XI.M6, “BWR CRD Return Line Nozzle”	reactor vessel, internals, and reactor coolant system	3.0.3.2.2
BWR Feedwater Nozzle Program (B.1.4)	Consistent with exception	XI.M5, “BWR Feedwater Nozzle”	reactor vessel, internals, and reactor coolant system	3.0.3.2.3
BWR Penetrations Program (B.1.5)	Consistent with exception	XI.M8, “BWR Penetrations”	reactor vessel, internals, and reactor coolant system	3.0.3.2.4
BWR Stress Corrosion Cracking Program (B.1.6)	Consistent with exception and enhancement	XI.M7, “BWR Stress Corrosion Cracking”	reactor vessel, internals, and reactor coolant system	3.0.3.2.5
BWR Vessel ID Attachment Welds Program (B.1.7)	Consistent with exception	XI.M4, “BWR Vessel ID Attachment Welds”	reactor vessel, internals, and reactor coolant system	3.0.3.2.6
BWR Vessel Internals Program (B.1.8)	Consistent with exception and enhancement	XI.M9, “BWR Vessel Internals”	reactor vessel, internals, and reactor coolant system	3.0.3.2.7
Containment Leak Rate Program (B.1.9)	Consistent	XI.S4, “10 CFR 50, Appendix J”	engineered safety features, structures and component supports	3.0.3.1.2
Diesel Fuel Monitoring Program (B.1.10)	Consistent with exception and enhancement	XI.M30, “Fuel Oil Chemistry”	auxiliary systems	3.0.3.2.8

PNPS AMP (LRA Section)	GALL Report Comparison	GALL Report AMP(s)	PNPS LRA Systems or Structures That Credit the AMP	Project Team's Evaluation Section
Environmental Qualification (EQ) of Electric Components Program (B.1.11)	Consistent	XI.E1, "EQ of Electric Components"	electrical components	3.0.3.1.3
Fatigue Monitoring Program (B.1.12)	Consistent with exception	X.M1, "Metal Fatigue of Reactor Coolant Pressure"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems; steam and power conversion system; structures and component supports	3.0.3.2.9
Fire Protection Program (B.1.13.1)	Consistent with exception and enhancement	XI.M26, "Fire Protection"	auxiliary systems, structures and component supports	3.0.3.2.10
Fire Water System Program (B.1.13.2)	Consistent with exception and enhancement	XI.M27, "Fire Water System"	auxiliary systems	3.0.3.2.11
Flow-Accelerated Corrosion (FAC) Program (B.1.14)	Consistent	XI.M17, "Flow-Accelerated Corrosion"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems; steam and power conversion system	3.0.3.1.4
Heat Exchanger Monitoring Program (B.1.15)	Plant-specific		engineered safety features, auxiliary systems	3.0.3.3.1
Containment Inservice Inspection Program (B.1.16.1)	Plant-specific		structures and component supports	3.0.3.3.2
Inservice Inspection Program (B.1.16.2)	Plant-specific		reactor vessel, internals, and reactor coolant system; structures and component supports	3.0.3.3.3
Instrument Air Quality Program (B.1.17)	Plant-specific		engineered safety features, auxiliary systems	3.0.3.3.4
Metal-Enclosed Bus Inspection Program (B.1.18)	Consistent with exception	XI.E4, "Metal-Enclosed Bus"	electrical components	3.0.3.2.12

PNPS AMP (LRA Section)	GALL Report Comparison	GALL Report AMP(s)	PNPS LRA Systems or Structures That Credit the AMP	Project Team's Evaluation Section
Non-EQ Inaccessible Medium-Voltage Cable Program (B.1.19)	Consistent	XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements"	electrical components	3.0.3.1.5
Non-EQ Instrumentation Circuits Test Review Program (B.1.20)	Consistent	XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements"	electrical components	3.0.3.1.6
Non-EQ Insulated Cables and Connections Program (B.1.21)	Consistent	XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements"	electrical components	3.0.3.1.7
Oil Analysis Program (B.1.22)	Consistent with exception and enhancement	XI.M39, "Lubricating Oil Analysis"	engineered safety features, auxiliary systems, steam and power conversion system	3.0.3.2.13
One-Time Inspection Program (B.1.23)	Consistent	XI.M32, "One-Time Inspection"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems; steam and power conversion system	3.0.3.1.8
Periodic Surveillance and Preventive Maintenance (B.1.24)	Plant-specific		engineered safety features, auxiliary systems, steam and power conversion system, structures and component supports	3.0.3.3.5
Reactor Head Closure Studs Program (B.1.25)	Consistent with exception	XI.M3, "Reactor Head Closure Studs"	reactor vessel, internals, and reactor coolant system	3.0.3.2.14
Reactor Vessel Surveillance Program (B.1.26)	Consistent with enhancement	XI.M31, "Reactor Vessel Surveillance"	reactor vessel, internals, and reactor coolant system	3.0.3.2.15

PNPS AMP (LRA Section)	GALL Report Comparison	GALL Report AMP(s)	PNPS LRA Systems or Structures That Credit the AMP	Project Team's Evaluation Section
Selective Leaching Program (B.1.27)	Consistent	XI.M33, "Selective Leaching of Materials"	engineered safety features, auxiliary systems, steam and power conversion system	3.0.3.1.9
Service Water Integrity Program (B.1.28)	Consistent with exception	XI.M20, "Open-Cycle Cooling Water System"	auxiliary systems	3.0.3.2.16
Masonry Wall Program (B.1.29.1)	Consistent	XI.S5, "Masonry Wall"	structures and component supports	3.0.3.1.10
Structures Monitoring Program (B.1.29.2)	Consistent with enhancement	XI.S6, "Structures Monitoring"	structures and component supports	3.0.3.2.17
Water Control Structures Monitoring Program (B.1.29.3)	Consistent with enhancement	XI.S7, RG 1.127, "Inspection of Water-Control Structures"	structures and component supports	3.0.3.2.18
System Walkdown Program (B.1.30)	Consistent	XI.M36, "External Surfaces Monitoring"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems; steam and power conversion system	3.0.3.1.11
Thermal Aging and Neutron Irradiation Embrittlement of CASS Program (B.1.31)	Consistent	XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of CASS"	reactor vessel, internals, and reactor coolant system	3.0.3.1.12
Water Chemistry Control – Auxiliary Systems (B.1.32.1)	Plant-specific		auxiliary systems, steam and power conversion system	3.0.3.3.6
Water Chemistry Control – BWR (B.1.32.2)	Consistent	XI.M2, "Water Chemistry"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems; steam and power conversion system; structures and component supports	3.0.3.1.13

PNPS AMP (LRA Section)	GALL Report Comparison	GALL Report AMP(s)	PNPS LRA Systems or Structures That Credit the AMP	Project Team's Evaluation Section
Water Chemistry Control – Closed Cooling Water (B.1.32.3)	Consistent with exception	XI.M21, "Closed-Cycle Cooling Water System"	reactor vessel, internals, and reactor coolant system; engineered safety features; auxiliary systems	3.0.3.2.19
Bolting Integrity Program (B.1.33)	Consistent with enhancement	XI.M18, "Bolting Integrity"	steam and power conversion system	3.0.3.2.20

3.0.3.1 PNPS AMPs That Are Consistent with the GALL Report

3.0.3.1.1 BORAFLEX MONITORING PROGRAM (PNPS AMP B.1.1)

In PNPS LRA Appendix B, Section B.1.1, the applicant stated that PNPS AMP B.1.1, "Boraflex Monitoring Program," is consistent with GALL AMP XI.M22, "Boraflex Monitoring."

3.0.3.1.1.1 Program Description

The applicant stated in the PNPS LRA that this program assures that degradation of the Boraflex panels in the spent fuel racks does not compromise the criticality analysis in support of the design of the spent fuel storage racks. The program relies on periodic inspection of the Boraflex, monitoring of silica levels in the spent fuel pool water, and analysis of criticality to assure that the required 5-percent subcriticality margin is maintained. The program provides assurance that effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis (CLB) for the PEO.

3.0.3.1.1.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.1 is consistent with GALL AMP XI.M22.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.1, including Aging Management Program Evaluation Report (AMPER), LRPD-02, Revision 1, Section 4.1, "Boraflex Monitoring Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M22. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.1 and associated bases documents to determine consistency with GALL AMP XI.M22.

During the audit and review, the project team noted that the applicant's LRPD-02, Section 4.1, did not distinguish the boron-10 areal density gage for evaluating racks (BADGER) test from

the blackness testing. The project team asked the applicant to clarify that the BADGER test used in PNPS is an areal density measurement. In its response, the applicant revised LRPD-02, Sections 4.1.B.2b and 4.1.B.4b, to clarify that the BADGER test is an areal density measurement. Based on this revision, the project team found the response acceptable.

The project team reviewed those portions of the applicant's Boraflex Monitoring Program for which the applicant claims consistency with GALL AMP XI.M22 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Boraflex Monitoring Program provides assurance that the effects of aging will be managed during the PEO. The project team found the applicant's Boraflex Monitoring Program acceptable because it conforms to the recommended GALL AMP XI.M22, "Boraflex Monitoring."

3.0.3.1.1.3 Exceptions to the GALL Report

None.

3.0.3.1.1.4 Enhancements

None.

3.0.3.1.1.5 Operating Experience

The applicant stated in the PNPS LRA that blackness testing was performed on Boraflex panels in the spent fuel storage racks during 1996 and 1998 to provide a baseline for development of the monitoring program and assure that the required 5-percent subcriticality margin is maintained. Results of the 1996 testing showed shrinkage and gapping in the Boraflex, but did not indicate that erosion of the Boraflex was occurring. Analysis of the criticality design of the fuel pool based on the observed gap sizes and locations showed a very minor and negligible effect of the gaps on rack reactivity. Therefore, the pool subcriticality margin was greater than 5 percent. Results of the 1998 testing showed about a 20-percent increase in average gap size, but overall shrinkage (gaps and end shortening) of the material was much less on a percentage change basis. There were no very large gaps, and the report concluded that the Boraflex poison material in the spent fuel storage racks continues to perform its intended function.

During the audit and review, the project team asked the applicant to clarify that its spent fuel pool subcriticality margin of greater than 5 percent is not simply dependent on the blackness test results. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that PNPS LRA Section B.1.1.1, "Operating Experience," is revised to clarify that reactivity calculations performed after direct material surveillance (blackness testing) using bounding assumptions with regard to neutron attenuation capacity of the Boraflex demonstrated that the 5-percent subcriticality margin is maintained. The project team asked the applicant to clarify whether the areal density measurements (BADGER tests) have ever been performed at PNPS. In its response, the applicant stated that the areal density measurements (BADGER tests) are scheduled for the fourth quarter of 2006. The project team also asked the applicant to clarify that PNPS will also rely on BADGER tests to demonstrate the

spent fuel pool subcriticality margin of greater than 5 percent. In its response, the applicant stated that the result of BADGER testing will be used in calculations to demonstrate that the spent fuel pool subcriticality margin is greater than 5 percent. The project team noted that blackness testing gives only an indication of whether a neutron absorber is present or not in a Boraflex panel, whereas the BADGER test provides a quantitative measurement of boron-10 areal density of neutron absorber in the rack. The project team found the applicant's response to be acceptable because using the BADGER device would give a better indication of Boraflex effectiveness to perform its intended function.

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Boraflex Monitoring Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.1.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Boraflex Monitoring Program in PNPS LRA Appendix A, Section A.2.1.1, which states that the Boraflex Monitoring Program assures that degradation of the Boraflex panels in the spent fuel racks does not compromise the criticality analysis in support of the design of the spent fuel storage racks. The program relies on (1) neutron attenuation testing, (2) determination of boron loss through correlation of silica levels in spent fuel pool water samples and periodic areal density measurements, and (3) analysis of criticality to assure that the required 5-percent subcriticality margin is maintained.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.1, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.1.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.2 CONTAINMENT LEAK RATE PROGRAM (PNPS AMP B.1.9)

In PNPS LRA Appendix B, Section B.1.9, the applicant stated that PNPS AMP B.1.9, "Containment Leak Rate Program," is an existing plant program that is consistent with GALL AMP XI.S4, “10 CFR 50, Appendix J.”

3.0.3.1.2.1 Program Description

The applicant stated in the PNPS LRA that containment leak rate tests are required to assure that (a) leakage through primary reactor containment and systems and components penetrating primary containment shall not exceed allowable values specified in technical specifications or associated bases, and (b) periodic surveillance of reactor containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of containment, and systems and components penetrating primary containment.

3.0.3.1.2.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.9 is consistent with GALL AMP XI.S4.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.9, including AMPER, LRPD-02, Revision 1, Section 4.8, “Containment Leak Rate Program”, which provides an assessment of the AMP elements' consistency with GALL AMP XI.S4. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.9 and associated bases documents to determine consistency with GALL AMP XI.S4.

The project team also reviewed PNPS Procedure Nos. 8.7.1.3, Revision 21, “Local Leak Rate Test Program”; 8.7.1.3.1, Revision 2, “Performance-Based Leakage Testing of the Primary Containment”; and 8.7.1.4.2, Revision 13, “Primary Containment Integrated Leakage Rate Test.”

The project team reviewed those portions of the applicant’s Containment Leak Rate Program for which the applicant claims consistency with GALL AMP XI.S4 and found that the PNPS program utilizes Option B and the guidance in NRC Regulatory Guide (RG) 1.163 and NEI 94-01. During the most recent integrated leakage testing of primary containment performed in 1995, as-found and as-left test data met all applicable test acceptance criteria. Quality assurance (QA) audits in 2000 and 2005 revealed no issues or findings that could impact program effectiveness. The current integrated leakage rate test periodic interval is 15 years (no later than May 25, 2010) based on Amendment 213 to the PNPS technical specifications, which allowed a 5-year extension to the 10-year interval. With that, they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant’s Containment Leak Rate Program provided assurance that the containment leak rate will be adequately managed for the PEO. The project team found the applicant’s Containment Leak Rate Program acceptable because it conforms to the recommended GALL AMP XI.S4, “10 CFR 50, Appendix J.”

3.0.3.1.2.3 Exceptions to the GALL Report

None.

3.0.3.1.2.4 Enhancements

None.

3.0.3.1.2.5 Operating Experience

The applicant stated in the PNPS LRA that during the most recent integrated leakage testing of primary containment, as-found and as-left test data met all applicable test acceptance criteria, indicating that the program is effective at managing the effects of loss of material and cracking on primary containment components. QA audits in 2000 and 2005 revealed no issues or findings that could impact program effectiveness.

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Containment Leak Rate Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.2.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Containment Leak Rate Program in PNPS LRA Appendix A, Section A.2.1.9, which states that containment leak rate tests are required to assure that (a) leakage through primary reactor containment and systems and components penetrating primary containment shall not exceed allowable values specified in technical specifications or associated bases, and (b) periodic surveillance of reactor containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of containment, and systems and components penetrating primary containment. Corrective actions are taken if leakage rates exceed acceptance criteria.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.9, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.2.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.3 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC COMPONENTS PROGRAM (PNPS AMP B.1.11)

In PNPS LRA Appendix B, Section B1.11, the applicant stated that PNPS AMP B1.11, "Environmental Qualification (EQ) of Electric Components Program," is an existing plant program that is consistent with GALL AMP X.E1, "Environmental Qualification (EQ) of Electric Components."

3.0.3.1.3.1 Program Description

The applicant stated in the PNPS LRA that the NRC has established nuclear station EQ requirements in 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. Section 50.49 of 10 CFR specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments (i.e., those areas of the plant that could be subject to the harsh environmental effects of a loss of coolant accident (LOCA), high-energy line breaks (HELBs), or post-LOCA radiation) are qualified to perform their safety function in those harsh environments. Section 50.49 of 10 CFR requires that the effects of significant aging mechanisms be addressed as part of EQ.

The PNPS EQ program manages the effects of thermal, radiation, and cyclic aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are refurbished, replaced, or their qualification is extended before reaching the aging limits established in the evaluation. Aging evaluations for EQ components are considered TLAAs for license renewal.

3.0.3.1.3.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B1.11 is consistent with GALL AMP X.E1.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report PNPS AMP B1.11, including LRPD-02, Revision 1, Section 4.10, "Environmental Qualification (EQ) of Electrical Components Program," which provides an assessment of the AMP elements' consistency with GALL AMP X.E1. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B1.11 and associated bases documents to determine consistency with GALL AMP X.E1.

Also, the project team reviewed LRPD-03, "TLAA and Exemption Evaluation," Volume 2.

During the audit and review, the project team noted that the results of electrical equipment in LRA Section 4.4 indicate that the aging effects of the EQ electrical equipment identified as TLAA will be managed during the PEO under 10 CFR 54.21(c)(1)(iii). However, no information

is provided on the attribute of a reanalysis of aging evaluation to extend the qualification life of electrical equipment identified as TLAA. The important attributes of a reanalysis are the analytical methods, the data collection, the reduction methods, the underlying assumptions, the acceptance criteria, and corrective actions. The project team requested the applicant to provide information on these important attributes of reanalysis of an aging evaluation of electrical equipment identified in the TLAA to extend the qualification under 10 CFR 50.49(e). In its response, the applicant stated that it adds the following text to LRA Appendix B.1.11 to include the "EQ Component Reanalysis Attributes" specified in NUREG-1801, Volume 2, Section X.E1:

> EQ Component Reanalysis Attributes:
>
> The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of a component is performed on a routine basis pursuant to 10 CFR 50.49(e) as part of an EQ program. While a component life limiting condition may be due to thermal, radiation, or cyclical aging, the vast majority of component aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed ambient temperature of the component, an unrealistically low activation energy, or in the application of a component (de-energized versus energized). The reanalysis of an aging evaluation is documented according to the station's quality assurance program requirements, which requires the verification of assumption and conclusions. As already noted, important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). These attributes are discussed below.
>
> Analytical Methods: The analytical models used in the reanalysis of an aging evaluation are the same as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose (that is, normal radiation dose for the projected installed life plus accident radiation dose). For license renewal, one acceptable method of establishing the 60-year normal radiation dose is to multiply the 40-year normal radiation dose by 1.5 (that is 60 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For cyclical aging, a similar approach may be used. Other methods may be justified on a case-by-case basis.
>
> Data Collection and Reduction Methods: Reducing excess conservatism in the component service conditions (for example, temperature, radiation, cycles) used in the prior aging evaluation is the chief method used for a reanalysis. Temperature data used in an aging evaluation is to be conservative and based on plant design temperatures or on actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance, other installed monitors, measurement made by plant operators during rounds, and temperature sensors on large motors (while the motor is not running). A representative number of temperature measurement are [is] conservatively evaluated to establish the

> temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as by (a) directly applying the plant temperature data in the evaluation, or (b) using the plant temperature data to demonstrate conservatism when using plant design temperature for an evaluation. Any changes to material activation energy values as part of a reanalysis are to be justified on a plant-specific basis. Similar methods of reducing excess conservatism in the component service conditions used in prior aging evaluation can be used for radiation and cyclical aging.
>
> Underlying Assumption: EQ component aging evaluation[s] contain sufficient conservatism to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.
>
> Acceptance Criteria and Corrective Actions: The reanalysis of an aging evaluation could extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component is to be refurbished, replaced, or re-qualified prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner (that is, sufficient time is available to refurbish, replace, or re-qualify the component is [if] the reanalysis is unsuccessful.

The project team found the change acceptable. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Appendix B.1.11 as described above.

GALL AMP X.E1 under “Preventive Actions” states that 10 CFR 50.49 does not require actions that prevent aging effects. EQ programs that could be viewed as preventive actions include (a) establishing the component service condition tolerance and aging limits (for example, qualified life or condition limit), and (b) where applicable, requiring specific installation, inspection, monitoring, or periodic maintenance actions to maintain component aging effects within the bounds of the qualification basis. PNPS LRPD-02 Section 4.10 under the same heading did not provide EQ program actions that could be viewed as preventive actions. The project team requested the applicant to provide a description of preventive actions for the PNPS EQ program. In its response, the applicant stated that 10 CFR 50.49 does not require actions that prevent aging effects. However, LRPD-02 will be revised to read as follows:

(Section 4.10.b.2.b, “Preventive Actions” – add to the end of first sentence)

> The program actions that could be viewed as preventive actions are the identification of qualified life and specific maintenance/installation requirements.

The project team verified that LRPD-02, Revision 2, Section 4.10.b.2.b was revised as described above. The project team found the applicant’s response acceptable because the

applicant described the actions in the PNPS EQ program that could be viewed as preventive actions.

The project team reviewed those portions of the applicant's EQ of Electric Components Program for which the applicant claims consistency with GALL AMP X.E1 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's EQ of Electric Components Program provided assurance that the effects of thermal, radiation, and cyclical aging for electrical equipment that is important to safety and located in harsh environments will be managed. The project team found the applicant's EQ of Electric Components Program acceptable because it conforms to the recommended GALL AMP X.E1, "Environmental Qualification (EQ) of Electric Components."

3.0.3.1.3.3 Exceptions to the GALL Report

None.

3.0.3.1.3.4 Enhancements

None.

3.0.3.1.3.5 Operating Experience

The applicant stated in the PNPS LRA that the overall effectiveness of the EQ of Electric Components Program is demonstrated by the excellent operating experience for SSCs in the program. The program has been subject to periodic internal and external assessments that have resulted in program improvement.

The team reviewed the EQ program self-assessment (January 28, 2002 to February 1, 2002). The assessment identified EQ files that had not been updated at the time of the assessment. The EQ files needed to be updated due to the implementation of a plant design change 01-03, Cycle 14 reload design. The impact of the reload design on the EQ program was evaluated in EQ document file Reference 420D and 420E before Refueling Outage (RFO) #13. All EQ components were identified to remain qualified for the Cycle 14 reload design. As a result of the EQ Program Assessment Program, LO-PNPLO-2002-0011 CA-09 was initiated to track and enforce workdown of remaining EQ document files per established workdown curves. This action was closed on October 7, 2002.

The project team also interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review and discussions with the applicant's technical staff, the project team concluded that the applicant's EQ of Electric Components Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.3.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the EQ of Electric Components Program in PNPS LRA Appendix A, Section A.2.1.11, which states that the program manages the effects of thermal, radiation, and cyclic aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are refurbished, replaced, or their qualification extended before reaching the aging limits established in the evaluations. Aging evaluations for EQ components are considered time-limited aging analyses (TLAAs) for license renewal.

The project team reviewed the UFSAR Supplement PNPS AMP B1.11 and determined that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.3.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.4 FAC PROGRAM (PNPS AMP B.1.14)

In PNPS LRA Appendix B, Section B1.14, the applicant stated that PNPS AMP B1.14, "Flow-Accelerated Corrosion Program," is an existing plant program that is consistent with GALL AMP XI.M17, "Flow-Accelerated Corrosion."

3.0.3.1.4.1 Program Description

The applicant stated in the PNPS LRA that this program applies to safety-related and nonsafety-related (NSR) carbon steel components in systems containing high-energy fluids carrying two-phase or single-phase high-energy fluid, with greater than or equal to 2 percent of plant operating time. The program, based on Electric Power Research Institute (EPRI) Report NSAC-202L-R2 recommendations for an effective flow-accelerated corrosion (FAC) program, predicts, detects, and monitors FAC in plant piping and other pressure-retaining components. This program includes (a) an evaluation to determine critical locations, (b) initial operational inspections to determine the extent of thinning at these locations, and (c) followup inspections to confirm predictions or to repair or replace components, as necessary.

3.0.3.1.4.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B1.14 is consistent with GALL AMP XI.M17.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B1.14, including AMPER, LRPD-02, Revision 1, Section 4.13,"Flow-Accelerated Corrosion Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M17. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B1.14 and associated bases documents to determine consistency with GALL AMP XI.M17.

During the audit and review, the project team asked the applicant about the piping systems that are excluded from the FAC program scoping as a result of low operating time (i.e., less than 2 percent of plant operating time). Also, the project team inquired about the inspections that were performed to ensure that there was no wear on those lines. The low operating time exclusion was not specifically mentioned in the GALL Report. The applicant responded as follows:

> Portions of the main steam system (plant heating; reactor vessel vent lines); portions of the feedwater system (recirculation lines to the condenser – feedwater cleanup line to the condenser); feedwater heater startup vent lines; portions of RCIC; and portions of HPCI have been excluded. Inspections have been performed on some of these lines typically in response to operational issues such as valve leakage or orifice degradation occurring such that there is flow in the line during normal operation.
>
> In RFO14 and RFO15, the feedwater recycle line (FAC pt# 366) was inspected to verify that a leaking valve had not caused damage. The piping wall thickness was found to not have appreciably changed during the two inspections which provided evidence that significant wear of the piping had not and was not occurring. In RFO15, the RCIC minimum flow bypass line (FAC pt# 376) was inspected due to suspected valve leak by, and the downstream piping was found to show no significant wear based on wall thickness.

The project team determined that this response is acceptable because adequate inspections have been performed, which is consistent with the guidance provided in Section 4.2.2, "Exclusion of System From Evaluation" of EPRI Report NSAC-202L-R2. The GALL AMP XI.M17 program is also based on the recommendations provided in the same EPRI Report.

The project team reviewed those portions of the applicant's FAC Program for which the applicant claims consistency with GALL AMP XI.M17 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's FAC Program provided assurance that the program will adequately manage plant aging for the PEO. The project team found the applicant's FAC Program acceptable because it conforms to the recommended GALL AMP XI.M17, "Flow-Accelerated Corrosion."

3.0.3.1.4.3 <u>Exceptions to the GALL Report</u>

None.

3.0.3.1.4.4 <u>Enhancements</u>

None.

3.0.3.1.4.5 Operating Experience

The applicant stated in the PNPS LRA that 65 FAC ultrasonic thickness (UT) examinations were performed online (between RFO 13 and RFO 14) and during RFO 14 (April 2003). The examinations included components in the condensate, extraction steam, feedwater, heater vents and drains, main steam (MS), reactor core isolation cooling (RCIC), and reactor water cleanup (RWCU) systems. Five of the examinations detected decreased wall thickness. Two of the components were accepted after reevaluation, and the other three components were replaced. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material in carbon steel components.

Ninety-seven FAC UT examinations were performed online (between RFO 14 and RFO 15) and during RFO 15 (April 2005). The examinations included components in the condensate, extraction steam, feedwater, heater vents and drains, MS, RCIC, and RWCU systems. Three of the examinations detected decreased wall thickness. Two of the components were accepted after reevaluation, and the other component was repaired. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material in carbon steel components.

During RFO 15 (April 2005), five piping upgrades to FAC resistant material (American Society for Testing and Materials (ASTM) A335 GR P11) were performed. The FAC program document was developed with input from each of the Entergy Nuclear Northeast (ENN) FAC engineers as a standardized ENN procedure. Therefore, it includes improvements based on industry and other ENN plant operating experience. For example, skid mounted piping is now included in the enhanced system susceptibility evaluation. During RFO 15, several FAC points were added to inspections, or reinspected, in response to industry operating experience and the event that occurred at Kansai Electric Power in Mihama, Japan where FAC caused a steam line to leak, killing a number of workers and injuring other.

A self-assessment in January 2005 revealed no issues or findings that could impact effectiveness of the program to manage FAC in carbon steel components in systems containing high-energy fluids greater than or equal to 2 percent of plant operating time.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

The project team also reviewed the operating experience provided in the basis document and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's FAC Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.4.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the FAC Program in PNPS LRA Appendix A, Section A.2.1.15, which states that the FAC Program applies to safety-related and NSR carbon steel components in systems containing high-energy fluids carrying two-phase or single-phase high-energy fluid, with greater than or equal to 2 percent of plant operating time.

The program, based on EPRI recommendations for an effective FAC program, predicts, detects, and monitors FAC in plant piping and other pressure-retaining components. This program includes (a) an evaluation to determine critical locations, (b) initial operational inspections to determine the extent of thinning at these locations, and (c) followup inspections to confirm predictions. The program specifies repair or replacement of components as necessary.

The project team reviewed the UFSAR Supplement PNPS AMP B1.14, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.4.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.5 NON-EQ INACCESSIBLE MEDIUM-VOLTAGE CABLE PROGRAM (PNPS AMP B.1.19)

In PNPS LRA Appendix B, Section B.1.19, the applicant stated that PNPS AMP B.1.19, "Non-EQ Inaccessible Medium-Voltage Cable Program," is a new plant program that will be consistent with GALL AMP XI.E3, “Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements.”

3.0.3.1.5.1 Program Description

The applicant stated in the PNPS LRA that periodic actions will be taken in the program to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit and draining water as needed. In-scope medium-voltage cables exposed to significant moisture and voltage will be tested at least once

every 10 years to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined before the initial test.

The program will be initiated before the PEO.

3.0.3.1.5.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.19 is consistent with GALL AMP XI.E3.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.19, including LRPD-02, Revision 1, Section 3.4, “Non-EQ Inaccessible Medium-Voltage Cable Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.E3. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.19 and associated bases documents to determine consistency with GALL AMP XI.E3.

Also, the project team reviewed AMRE-01, Revision 2, “Electrical Screening and Aging Management Reviews.”

During the audit and review, the project team noted that under the “detection of aging effects” program element, GALL AMP XI.E3 recommends that the inspection for water collection be performed based on actual plant experience with water accumulation in the manholes. However, the inspection frequency should be at least once every 2 years. The PNPS Non-EQ Inaccessible Medium-Voltage Cable Program, under the same program element, states that inspection for water collection in cable manholes and conduit occur at least once every 2 years. The team asked the applicant to explain how operating experience is considered in manhole inspection frequency. In its response, the applicant stated that LRPD-02 will be revised to include the following:

> The inspection will be based on actual plant experience with water accumulation in the manholes and the frequency of inspection will be adjusted based on the results of the evaluation, but the frequency will be at least once every 2 years.

The team found the applicant’s response acceptable because the criteria for inspection for water collection in the manholes will be based on actual plant experience with water accumulation. These criteria are consistent with the GALL Report. The project team verified that LRPD-02, Revision 2, was revised to reflect the change as described above.

GALL AMP XI.E3, under the “scope of program” program element, defines significant moisture as periodic exposure to moisture that lasts less than a few days (e.g., cable in standing water). Significant voltage exposure is defined as being subject to system voltage for more than 25 percent of the time. PNPS LRPD-02, Revision 1, under the same program element, states that this program will include inaccessible (i.e., in conduit or direct buried) medium-voltage cables within the scope of license renewal that are exposed to significant moisture simultaneously with applied voltage. It does not define what is the significant voltage and moisture. In addition,

AMRE-01, Revision 2, Section 3.4.1.5, "Non-EQ Inaccessible Medium-Voltage Cable Screening," states that the cables that are susceptible to water treeing are those exposed to significant moisture (submerged for years). The team requested the applicant to revise the AMP B.1.19 basis document to be consistent with the GALL Report's scope or to explain how inaccessible medium-voltage exposed significant moisture more than a few days and less than a few years is not susceptible to water tree. In its response, the applicant stated that it would revise the LRPD as follows:

> This program applies to inaccessible (e.g., in conduit or direct buried) medium-voltage cables within the scope of license renewal that are exposed to significant moisture simultaneously with significant voltage. Significant moisture is defined as periodic exposure to moisture that last more than a few days (e.g., cable in standing water). Periodic exposure to moisture that lasts less than a few days (i.e., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than 25 percent of the time.

The team found the applicant's response acceptable because the scope of the program is consistent with the GALL Report. The project team verified that LRPD-02, Revision 2, was revised as described above.

Under the "program description" program element, the GALL Report states that periodic actions such as inspecting for water collection in cable manholes and draining water are needed to prevent cable from being exposed to significant moisture. The above actions are not sufficient to ensure water is not trapped elsewhere in raceways. In addition to the periodic actions described above, in-scope medium-voltage cables are tested to provide an indication of the condition of the conductor insulation. PNPS LRPD, under the same program element, states that periodic actions will be taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit and draining water as needed. In-scope medium-voltage cable exposed to significant moisture and voltage will be tested to provide an indication of the conductor insulation. The team requested the applicant to confirm that the intent of the AMP is to inspect for water in manholes and to test all in-scope medium-voltage cables. In its response, the applicant confirmed that the intent of the PNPS is to inspect for water in manholes and to test all of the in-scope medium-voltage cables.

The team also asked the applicant if the plant currently inspects water in the manholes and if there are any existing procedures for inspecting manholes. If it does, the project team requested the applicant to provide a copy of these procedures. In its response, the applicant stated that although it has no formal procedure, PNPS has an existing repetitive task and job plan for inspecting manholes. The applicant committed to develop a formal procedure to inspect manholes for in-scope medium voltage cable. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. Commitment No. 15 on the list identifies this item. Also, the applicant will revise LRPD-02, Section 3.4.B.10, "Operating Experience," to discuss the process for considering plant operating experience that will be used during implementation of the Non-EQ Medium-Voltage Cable Program. The project team found the applicant's response acceptable because the applicant currently inspects manholes for water collection and committed to develop a formal

procedure to prevent cables from being exposed to significant moisture. The project team verified that LRPD-02 was revised as stated above.

GALL AMP XI.E3 defines medium-voltage as ranging from 2 kilovolts (kV) to 35 kV. AMRE-01, Revision 2, "Aging Management Review Report Electrical," lists medium-voltage cables from 2 kV to 23 kV. The project team requested the applicant to provide the definition of medium-voltage cable in the LRA to be consistent with the GALL Report or provide a justification of why water tree (the effects of significant moisture to energized medium-voltage cables) is not applicable to inaccessible medium-voltage cable greater than 23 kV. In its response, the applicant stated that LRA Appendix B.1.19 will be revised to define medium-voltage cables as follows:

> In-scope medium-voltage includes cable with operating voltage from 2 kV to 35 kV.

The team found the applicant's response acceptable because the definition of medium voltage is consistent with the GALL Report. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Section B.1.19 program description as described above.

Under the "parameters monitored/inspected" program element, the GALL Report states that the specific type of test performed will be determined before 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 test, or polarization index, as described in EPRI TR-103834-P1, or other testing that is state-of-the-art at the time the test is performed. The PNPS LRPD under the same program element only stated that the specific type of test performed will be determined before the initial test. The project team requested the applicant to revise the LRPD to be consistent with the GALL Report or explain how it ensured that the test to be performed would be in accordance with the industry guideline. In its response, the applicant stated that LRPD-02, Section 3.4.B. 3.b, will be revised to read that the specific type of test to be performed will be determined before the initial test and is to be a proven test for detecting deterioration of the insulation system due to wetting 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 project team found the applicant's response acceptable because the test to be performed will be in accordance with the industry guideline. The project team verified that LRPD-02, Revision 2, was revised as described above.

The electrical screening and AMRs (AMRE-01) provide a list of in-scope inaccessible medium-voltage cables. However, they do not include the service water cables. The project team requested the applicant to explain why these cables are not in-scope of the non-EQ inaccessible medium-voltage cable AMP. In its response, the applicant stated that since medium-voltage cables are defined as 2 kV to 35 kV, the service water cables are not in-scope because they run on a system voltage of 480 volts (V). The project team found the applicant's response acceptable because the system voltage of 480 V is not considered medium-voltage and, therefore, the service water cables are not within the scope of the non-EQ inaccessible medium-voltage AMP.

The project team reviewed those portions of the applicant's Non-EQ Inaccessible Medium-Voltage Cable Program for which the applicant claims consistency with GALL AMP XI.E3 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Non-EQ Inaccessible Medium-Voltage Cable Program at PNPS will be comparable to the program described in the GALL Report, Section XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." In this program, periodic actions will be taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit and draining water as needed. In addition, in-scope medium-voltage cables exposed to significant moisture and voltage will be tested at least once every 10 years to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined before the initial test and will be in accordance with industry guidelines.

The program will be initiated before the PEO. The Non-EQ Inaccessible Medium-Voltage Cable Program provides assurance that the aging effects of inaccessible medium-voltage cables due to significant moisture and voltage will be managed and that the in-scope components will continue to perform their intended functions for the PEO. The project team found the applicant's Non-EQ Inaccessible Medium-Voltage Cable Program acceptable because it conforms to the recommended GALL AMP XI.E3, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements."

3.0.3.1.5.3 Exceptions to the GALL Report

None.

3.0.3.1.5.4 Enhancements

None.

3.0.3.1.5.5 Operating Experience

In the LRA, the applicant stated that the Non-EQ Inaccessible Medium-Voltage Cable Program at PNPS is a new program for which there is no operating experience. GALL AMP XI.E3 indicates that operating experience has shown that degradation of cables and connections within the scope of XI.E3 may exist. Cross-linked polyethylene or high molecular weight polyethylene insulation materials are most susceptible to water tree formation. The formation and growth of water trees vary directly with operating voltage. Water tree is much less prevalent in 4 kV cables than those operated at 13 or 33 kV. Also, minimizing exposure to moisture minimizes the potential for the development of water treeing. The project team requested the applicant to provide industrial and plant operating experience for this program. In its response, the applicant stated that LRA Section B.1.19 will be revised to state that the non-EQ Inaccessible Medium-Voltage Cable Program at PNPS is a new program. Industry and plant-specific operating experience will be considered in the development of this program. Industry operating experience that forms the basis for the program is described in the operating experience element of the GALL Report program description. PNPS plant-specific operating experience is consistent with the operating experience in the GALL Report program description.

The PNPS program is based on the program description in the GALL Report, which in turn is based on industry operating experience. As such, the operating experience used for implementation of the Non-EQ Inaccessible Medium-Voltage Cable Program will provide assurance that effects of aging will be managed such that applicable components will continue perform their intended functions consistent with the CLB for the PEO. The team found the applicant's response acceptable because the applicant has reviewed the plant-specific operating experience against the industry experience identified in the GALL Report. As additional operating experience is obtained, lessons learned can be used to adjust the program elements. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Section B.1.19 operating experience as described above.

Operating experience at PNPS is controlled by procedure EN-OP-100, "Operating Experience Program." The program includes the following components: Operating experience – Information received from various industry sources that describes events, issues, and equipment failures that may represent opportunities to apply lessons learned to avoid negative consequences or to re-create positive experience as applicable. Internal operating experience – operating experience that originates as a condition report (CR) or request from plant personnel which warrants consideration for possible Entergy-wide distribution. Internal operating experience can originate from any Entergy plant or headquarters. Impact evaluation – analysis of an operating experience event or problem that requires additional information and research to determine impact or potential impact, as it relates to plant condition and/or configuration. Impact evaluations are typically documented with a CR. CR action items and corrective actions are used to confirm program effectiveness and to modify the program as needed.

The project team also reviewed basis document LRPD-05 and confirmed that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team found that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the above operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Non-EQ Inaccessible Medium-Voltage Cable Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.5.6 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the Non-EQ Inaccessible Medium-Voltage Cable Program in PNPS LRA Appendix A, Section A.2.1.21, which states that in-scope medium-voltage cables not designed for but exposed to significant moisture and voltage are tested at least once every 10 years to provide an indication of the condition of the conductor insulation. The specific test performed is a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, polarization index, or other testing that is state-of-the-art at the time the test is performed. Significant moisture is

defined as periodic exposures that last more than a few days. Significant voltage exposure is defined as being subjected to system voltage for more than 25 percent of the time.

Inspections for water collection in cable manholes and conduit occur at least once every 2 years. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. In Commitment No. 15, the applicant committed to implement the Non-EQ Inaccessible Medium-Voltage Cable Program as described in LRA Section B.1.19, including developing a formal procedure to inspect manholes for in-scope medium voltage cable by June 8, 2012.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.19 and determined that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.5.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.6 NON-EQ INSTRUMENTATION CIRCUITS TEST REVIEW PROGRAM (PNPS AMP B.1.20)

In PNPS LRA Appendix B, Section B.1.20, the applicant stated that PNPS AMP B.1.20,"Non-EQ Instrumentation Circuits Test Review Program," is a new plant program that is consistent with GALL AMP XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits."

3.0.3.1.6.1 Program Description

The applicant stated in the PNPS LRA that this program will provide assurance that the intended functions of instrument cables exposed to adverse localized equipment environments caused by heat, radiation, and moisture can be maintained consistent with the CLB through the PEO. An adverse localized environment is significantly more severe than the specified service environment for the cable. This program will consider the technical information and guidance provided in NUREG/CR-5643, Institute of Electrical and Electronic Engineers (IEEE) STD P1205, SAND96-0344, and EPRI TR-109619.

The program will be initiated before the PEO.

3.0.3.1.6 2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.20 is consistent with GALL AMP XI.E2.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.20, including LRPD-02, Section 3.5, “Non-EQ Instrumentation Circuits Test Review Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.E2. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.20 and associated bases documents to determine consistency with GALL AMP XI.E2.

Also, the project team reviewed AMRE-01, Revision 2, “Electrical Screening and Aging Management Reviews,” and LRPD-05, Revision 0, “Operating Experience Review Results.”

During the audit and review, the project team noted that GALL AMP XI.E2 recommends that the test frequency shall be determined by the applicant based on engineering evaluation, but the test frequency shall be at least once every 10 years. PNPS LRPD-02 Section 3.5, under the same attribute, states that for neutron flux monitoring system cables that are disconnected during instrument calibration, testing is performed at least once every 10 years. The project team requested the applicant to explain how engineering evaluation is considered in the test frequency. In its response, the applicant stated that to clarify that the PNPS AMP is consistent with GALL recommendation, LRPD-02 will be revised as follows:

> The first test of neutron monitoring system cables that are disconnected during instrument calibrations shall be completed before the period of extended operation and subsequent tests will occur at least every 10 years. In accordance with the corrective action program, an engineering evaluation will be performed when test acceptance criteria are not met and corrective actions, including modified inspection frequency, will be implemented to ensure that the intended functions of the cables can be maintained consistent with the current license basis (CLB) for the period of extended operation.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Section B.1.20 program description is revised to include the following clarification:

> The first test of neutron monitoring system cables that are disconnected during instrument calibrations shall be completed before the period of extended operation and subsequent tests will occur at least once every 10 years. In accordance with the corrective action program, an engineering evaluation will be performed when test acceptance criteria are not met and corrective actions, including modified inspection frequency, will be implemented to ensure that the intended functions of the cables can be maintained consistent with the current licensing basis for the period of extended operation.

The project team found the applicant's response acceptable because testing frequency will be at least once every 10 years and modified testing frequency based on an engineering evaluation will be implemented when acceptance criteria is not met to ensure intended functions of the cables can be maintained consistent with the CLB. This action is consistent with GALL AMP XI.E2 in regard to testing frequency. The project team verified that the applicant revised the LRPD-02, Revision 2, to incorporate this change.

The scope of GALL AMP XI.E2 applies to cable system (cables and connections). The project team requested the applicant to confirm that the test includes both cables and connections. In its response, the applicant confirmed that the Non-EQ Instrumentation Circuits Test Review Program includes both cables and connections that are within the scope of license renewal.

GALL AMP XI.E2, under the "scope of program" program element, states that this program applies to cable systems used in circuits with sensitive, high-voltage, low-level signal such as radiation monitoring and nuclear instrumentations that are subject to an AMR. PNPS LRPD-02, Section 3.5 under the same program element states that this program will include non-EQ electrical cables used in circuits with sensitive, high-voltage, low-level signal, that is, neutron flux monitoring instrumentation. The program did not include high-range radiation monitor cables. The project team requested the applicant to explain why high-range radiation monitor cables are not within the scope of the Non-EQ Instrumentation Circuits Test Review Program. In its response, the applicant stated that the high-range radiation monitoring system monitors radiation levels inside containment (drywell and torus areas) during and following a design basis event. The monitors (RE 1001-606A/B and RE 1001-607A/B) are safety-related. The cables from the detectors to the cabinets in the control room are EQ and, therefore, are replaced based on qualified life, so these cables are not subject to an AMR. The project team found the applicant's response acceptable because the high-range radiation monitoring cables are EQ and are not in-scope of the Non-EQ Instrumentation Circuits Test Review Program.

GALL AMP XI.E2, under the "parameters monitored/inspected" program element, states that the parameters monitored are determined from the specific calibration, surveillance, or testing performed and are based on the specific instrumentation under surveillance or being calibrated as documented in plant procedures. LRPD-02 Section 3.5, under the same program element, states that the results from calibration or surveillance of components within the scope of license renewal will be reviewed. The parameters reviewed will be based on the specific instrumentation circuit under surveillance or being calibrated, as documented in the plant calibration or surveillance procedures. The project team requested the applicant to explain why the review of calibration results belongs to the "parameters monitored/inspected" program element and why parameter for cable testing was not mentioned. The project team also requested the applicant to confirm that cable testing will be performed on in-scope cables disconnected during instrument calibration. In its response, the applicant stated that LRPD-02 Section 3.5.B.3.b, "Parameters Monitored/Inspected," will be revised by replacing the second sentence with the following text:

> The parameters monitored are determined from the specific calibration, surveillance or testing performed and are based on the specific instrumentation circuit under surveillance or being calibrated, as documented in plant procedures.

The applicant also confirmed that cable testing is performed by plant procedures on cables in-scope of XI.E2 that are disconnected during instrument calibration.

The team verified that the applicant incorporated this change in LRPD-02. The team found the applicant's response acceptable because the revised program element "parameter monitored/inspected" was consistent with GALL AMP XI.E2.

The project team reviewed those portions of the applicant's Non-EQ Instrumentation Circuits Test Review Program for which the applicant claims consistency with GALL AMP XI.E2 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Non-EQ Instrumentation Circuits Test Review Program provides assurance that instrument cables exposed to adverse localized equipment environments caused by heat, radiation, and moisture can be maintained consistent with the CLB through the PEO. The project team found the applicant's Non-EQ Instrumentation Circuits Test Review Program acceptable because it conforms to the recommended GALL AMP XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits."

3.0.3.1.6 3 <u>Exceptions to the GALL Report</u>

None.

3.0.3.1.6 4 <u>Enhancements</u>

None.

3.0.3.1.6.5 <u>Operating Experience</u>

The applicant stated in the PNPS LRA that the Non-EQ Instrumentation Circuits Test Review Program at PNPS is a new program for which there is no operating experience. Industry and plant-specific operating experience will be considered in the development of this program, and future operating experience will be appropriately incorporated into the program.

GALL AMP XI.E2 indicates that operating experience has shown that degradation of cables and connections within the scope of XI.E2 may exist. Operating experience has identified a case where a change in temperature across a high-range monitor cable in containment resulted in substantial change in the reading of the monitor. Changes in instrument calibration can be caused by degradation of the circuit cable and are a possible indication of electrical cable degradation. The vast majority of site-specific and industrywide operating experience regarding neutron flux instrumentation circuits is related to cable/connector issues inside of containment near the reactor vessel (RV). The project team requested the applicant to provide industry and plant operating experience for this program. In its response, the applicant stated that LRA Section B.1.20 will be revised to state that the non-EQ Instrumentation Circuits Test Review Program at PNPS is a new program. Industry and plant-specific operating experience will be considered in the development of this program. Industry operating experience that forms the basis for the program is described in the operating experience of the GALL Report program

description. PNPS plant-specific operating experience is consistent with operating experience in the GALL Report program description.

The PNPS program is based on the program description in the GALL Report, which in turn is based on industry operating experience. As such, the operating experience used for implementation of the Non-EQ Instrumentation Circuits Test Review Program will provide assurance that effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the CLB for the PEO. The team found the applicant's response acceptable because the applicant has reviewed the plant-specific operating experience against the industry experience identified in GALL. As additional operating experience is obtained, lessons learned can be used to adjust the program elements. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Appendix B.1.20 operating experience as described above.

Operating experience at PNPS is controlled by procedure EN-OP-100, "Operating Experience Program." The program includes the following components: operating experience – information received from various industry sources that describes events, issues, and equipment failures that may represent opportunities to apply lessons learned to avoid negative consequences or to re-create positive experience as applicable. Internal operating experience – operating experience that originates as a CR or request from plant personnel which warrants consideration for possible Entergy-wide distribution. Internal operating experience can originate from any Entergy plant or headquarters. Impact evaluation – analysis of an operating experience event or problem that requires additional information and research to determine impact or potential impact, as it relates to plant condition and/or configuration. Impact evaluations are typically documented with a CR. CR action items and corrective actions are used to confirm program effectiveness and to modify the program as needed.

The project team also reviewed the basis document LRPD-05 to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team found that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Non-EQ Instrumentation Circuits Test Review Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.6.6 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the Non-EQ Instrumentation Circuits Test Review Program in PNPS LRA Appendix A, Section A.2.1.22, which states that the program calibration or surveillance results for non-EQ electrical cables in circuits with sensitive, high-voltage, low-level signals (i.e., neutron flux monitoring instrumentation) are reviewed. Most neutron flux monitoring system cables and connections are calibrated as part of the

instrumentation loop calibration at the normal calibration frequency, which provides sufficient indication of the need for corrective actions based on acceptance criteria related to instrumentation loop performance. The review of calibration results is performed once every 10 years.

For neutron flux monitoring system cables that are disconnected during instrument calibrations, testing is performed at least once every 10 years using a proven method for detecting deterioration for the insulation system (such as insulation resistance (IR) tests or time domain reflectometry).

The project team reviewed the UFSAR Supplement PNPS AMP B.1.20 and the amendment and determined that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. Under Commitment No. 16, the applicant will implement the Non-EQ Instrumentation Circuits Test Review Program as described in LRA Section B.1.20 by June 8, 2006.

3.0.3.1.6.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.7 NON-EQ INSULATED CABLES AND CONNECTIONS PROGRAM (PNPS AMP B.1.21)

In PNPS LRA Appendix B, Section B.1.21, the applicant stated that PNPS AMP B.1.21, ”Non-EQ Insulated Cables and Connections Program," is an existing plant program that is consistent with GALL AMP XI.E1, “Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements.”

3.0.3.1.7.1 Program Description

The applicant stated in the PNPS LRA that this program will provide assurance that intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation, or moisture can be maintained consistent with the CLB through the PEO. An adverse localized environment is significantly more severe than the specified service condition for the insulated cables or connections.

A representative sample of accessible insulated cables and connections within the scope of license renewal will be visually inspected for cable and connection jacket surface anomalies

such as embrittlement, discoloration, cracking, and surface contamination. The technical basis for sampling will be determined using EPRI document TR-109619, "Guideline for the Management of Adverse Localized Equipment Environments."

The program will be initiated before the PEO.

3.0.3.1.7.2 Consistency with the GALL Report

In PNPS LRA, the applicant stated that PNPS AMP B.1.21 is consistent with GALL AMP XI.E1.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report; PNPS AMP B.1.21, including LRPD-02, Revision 1, Section 3.6, "Non-EQ Insulated Cables and Connections Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.E1. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.21 and associated bases documents to determine consistency with GALL AMP XI.E1.

Also, the project team reviewed AMRE-01, Revision 2, "Electrical Screening and Aging Management Reviews," and LRPD-05, Revision 0, "Operating Experience Review Results."

During the audit and review, the project team noted that GALL AMP XI.E1 under "program description" states that the program described therein is written specifically to address cables and connections at plants whose configuration is such that most (if not all) cables and connections installed in adverse localized environments are accessible. This program, as described, can be thought of as a sampling program. Selected cables and connections from accessible areas (the inspection sample) are inspected and represent, with assurance, all cables and connections in the adverse localized environments. If an unacceptable condition or situation is identified for a cable or connection in the inspection sample, a determination is made as to whether the same condition or situation is applicable to other accessible or inaccessible cables or connections. PNPS AMP B.1.21, under the same element, states that a representative sample of accessible insulated cables and connections, within the scope of license renewal, will be visually inspected for cable and connection jacket surface anomalies such as embrittlement, discoloration, cracking, and surface contamination. The project team requested the applicant to explain the technical basis for cable sampling. In its response, the applicant stated that the LRA Appendix B.1.19 program description will be changed to read as follows:

> This program addresses cables and connections at plants whose configuration is such that most cables and connections installed in adverse localized environments are accessible. This program can be thought of as a sampling program. Selected cables and connections from accessible areas will be inspected and represent, with assurance, all cables and connections in the adverse localized environments. If an unacceptable condition or situation is identified for a cable or connection in the inspecting sample, a determination will be made as to whether the same condition or situation is applicable to other accessible cables or connections. The sample size will be increased based on an evaluation per the corrective program.

The project team found the applicant's response acceptable because it provided the technical basis for cable sampling; this basis is consistent with the GALL Report. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Section B.1.21 as described above.

GALL AMP XI.E1 under the "scope of program" element states that the inspection program applies to accessible electrical cables and connections within the scope of license renewal that are installed in adverse localized environments caused by heat or radiation in the presence of oxygen. PNPS LRPD-02, Section 3.6, under the same element states that this program will include accessible insulated cables and connections installed in structures within the scope of license renewal and prone to adverse localized environments. It was not clear to the project team if the scope of the program only includes insulated cables and connections installed within scope structures located in an adverse localized environment or insulated cables and connections installed within the scope of license renewal that are installed in adverse localized environments. The team requested the applicant to explain what "in a structure" meant and why structures were included within the scope of non-EQ cables and connections AMP. In its response, the applicant stated that "in a structure" means inside the plant and not outside. LRPD-02, Section 3.6.B.1.b,"Scope of Program," will be revised to state that the program applies to accessible electrical cables and connections within the scope of license renewal that are installed in adverse localized environments caused by heat or radiation in the presence of oxygen. The team found the applicant's response acceptable because it is consistent with the scope of GALL AMP XI.E1 and it will remove the confusion as described above. The project team verified that the applicant revised LRPD-02, Revision 2, to incorporate the changes.

The project team reviewed those portions of the applicant's Non-EQ Insulated Cables and Connections Program for which the applicant claims consistency with GALL AMP XI.E1 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Non-EQ Insulated Cables and Connections Program provides assurance that aging effects of cables and connectors within the scope of license renewal and exposed to adverse localized environments due to temperature, moisture, or radiation with the presence of oxygen will be managed to be consistent with CLB during the PEO. The project team found the applicant's Non-EQ Insulated Cables and Connections Program acceptable because it conforms to the recommended GALL AMP XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualifications Requirements."

3.0.3.1.7.3 <u>Exceptions to the GALL Report</u>

None.

3.0.3.1.7.4 <u>Enhancements</u>

None.

3.0.3.1.7.5 <u>Operating Experience</u>

The applicant stated, in the PNPS LRA, that the Non-EQ Insulated Cables and Connections Program at PNPS is a new program for which there is no operating experience.

GALL AMP XI.E1 indicated that operating experience had shown that degradation of cables and connection within the scope of XI.E1 may exist. Operating experience has shown that adverse localized environments caused by heat or radiation for electrical cables and connections may exist next to or above (within 3 feet of) steam generators, pressurizers, or hot process pipes, such as feedwater lines. These adverse localized environments have been found to cause degradation of the insulating materials on electrical cables and connections that is visually observable, such as in color changes or surface cracking. These visual indications can be used as indicators of degradation. The project team requested the applicant to provide industrial and plant operating experience for this program. In its response, the applicant stated that the non-EQ Insulated Cables and Connections Program at PNPS is a new program. Industry and plant-specific operating experience will be considered in the development of this program. Industry operating experience that forms the basis for the program is described in the operating experience element of the GALL Report program description. PNPS plant-specific operating experience is consistent with the operating experience in the GALL Report program description.

The PNPS program is based on the program description in the GALL Report, which in turn is based on industry operating experience. As such, the operating experience used for implementation of the Non-EQ Insulated Cables and Connections Program will provide assurance that effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the CLB for the PEO. The team found the applicant's response acceptable because the applicant has reviewed the plant-specific operating experience against the industry experience identified in the GALL Report. As additional operating experience is obtained, lessons learned can be used to adjust the program elements. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Appendix B.1.21 operating experience as described above.

The project team also reviewed basis document LRPD-05 to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team found that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Non-EQ Insulated Cables and Connections Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.7.6 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the Non-EQ Insulated Cables and Connections Program in PNPS LRA Appendix A, Section A.2.1.23, which states that the Non-EQ Insulated Cables and Connections Program provides assurance that intended functions of

insulated cables and connections exposed to adverse localized environments caused by heat, radiation, or moisture can be maintained consistent with the CLB through the PEO. An adverse localized environment is significantly more severe than the specified service condition for the insulated cable or connection.

A representative sample of accessible insulated cables and connections in adverse localized environments is visually inspected at least once every 10 years for cable and connection jacket surface anomalies such as embrittlement, discoloration, cracking, or surface contamination.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.21 and determined that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. In Commitment No. 17, the applicant will implement the Non-EQ Insulated Cables and Connections Program as described in LRA Section B.1.21 by June 8, 2012.

3.0.3.1.7.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.8 ONE-TIME INSPECTION PROGRAM (PNPS AMP B.1.32)

In PNPS LRA Appendix B, Section B.1.32, the applicant stated that PNPS AMP B.1.32, "One-Time Inspection Program," is an existing plant program that is consistent with GALL AMP XI.M32, "One-Time Inspection."

3.0.3.1.8.1 Program Description

The applicant stated in the PNPS LRA that this program is a new program that will be implemented before the PEO. The program will be comparable to the program described in NUREG-1801, Section XI.M32, “One-Time Inspection.” The one-time inspection (OTI) activity for small-bore piping in the RCS and associated systems that form the reactor coolant pressure boundary (RCPB) will also be comparable to the program described in NUREG-1801, Section XI.M35, “One-Time Inspection of American Society of Mechanical Engineers (ASME) Code Class I Small-Bore Piping.” The PNPS program will be consistent with the program elements described in NUREG-1801.

The program will include one activity to verify effectiveness of an AMP and activities to confirm the absence of aging effects as described below.

Water chemistry control programs	OTI activity will verify the effectiveness of the water chemistry control AMPs by confirming that unacceptable cracking, loss of material, and fouling is not occurring.
Internal surfaces of buried carbon steel pipe on the SGT system discharge to the stack	OTI activity will confirm that loss of material is not occurring or is so insignificant that an AMP is not warranted.
Internal surfaces of compressed air and emergency diesel generator (EDG)system components containing untreated air	OTI activity will confirm that cracking (EDG system) and loss of material (compressed air and EDG system) are not occurring or are so insignificant that an AMP is not warranted.
Internal surfaces of stainless steel (SS) radioactive waste and sanitary soiled waste and vent system components containing untreated water	OTI activity will confirm that loss of material is not occurring or is so insignificant that an AMP is not warranted.
Small-bore piping in the RCS and associated systems that form the RCPB	OTI activity will confirm that cracking and reduction of fracture toughness are not occurring or are so insignificant that an AMP is not warranted.
RV flange leakoff line	OTI activity will confirm that cracking is not occurring or is so insignificant that an AMP is not warranted.
MS flow restrictors (CASS)	OTI activity will confirm that loss of material, cracking, and reduction of fracture toughness are not occurring or are so insignificant that an AMP is not warranted.

The elements of the program include (a) determination of the sample size based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience; (b) identification of the inspection locations in the system or component based on the aging effect; (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined; and (d) evaluation of the need for followup examinations to monitor the progression of any aging degradation.

When evidence of an aging effect is revealed by an OTI, routine evaluation of the inspection results will identify appropriate corrective actions.

The inspection will be performed within the 10 years before the PEO.

3.0.3.1.8.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.23 is consistent with GALL AMP XI.M32. The applicant stated that this program is also consistent with GALL AMP XI.M35.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report, PNPS AMP B.1.23, including AMPER, LRPD-02, Revision 1, Section 3.7, "One-Time Inspection Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M32 and GALL AMP XI.M35. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.23 and associated bases documents to determine consistency with GALL AMP XI.M32 and GALL AMP XI.M35.

During the audit and review, the project team asked the applicant to provide a list of systems in the element of "scope of activity," where an OTI was performed. In its response, the applicant stated that as described in LRA Section B.1.23, the One-Time Inspection Program includes several activities. The activities to confirm the absence of aging effects identify the systems to which they apply. For instance, the activity for inspection of "internal surfaces of buried carbon steel pipe on the SGT system discharge to the stack" inspects components in the gas treatment system. The activities to verify effectiveness of the water chemistry control programs are applicable to many systems. The systems are not listed in LRA Section B.1.23. However, they may be found in tables in LRA Section 3.0, "Aging Management Review Results." In these tables, systems with line items containing one of the water chemistry control programs have components included in the sample population for this OTI activity. Based on a review of the AMPER and the associated AMPER for water chemistry control programs, the project team found the applicant's response to be acceptable.

During the audit and review, the project team asked the applicant how the sample of small piping welds 4 inches and smaller will be picked for performing nondestructive examination (NDE) inspection. In its response, the applicant stated that as described in the AMPER identified above, the One-Time Inspection Program will carry out an inspection of small-bore piping in the RCS and associated systems that form the RCPB. This activity will include the inspection of a statistically significant sample of welds of each material and environment combination in Class 1 piping less than or equal to 4-inch nominal pipe size (NPS). The initial population will include all Class 1 small-bore piping, and actual locations will be selected based on physical location, exposure levels, NDE techniques and locations identified in NRC Information Notice (IN) 97-46, "Un-Isolable Crack in High-Pressure Injection Piping." The project team further asked the applicant to clarify that volumetric examinations are used to detect cracking in butt welds. In its response, the applicant stated that the AMPER, LRPD -02, page 268, "Detection of Aging Effects," will be revised to state as follows:

> Combinations of non-destructive examinations (including VT-1, enhanced VT-1, ultrasonic, and surface techniques) will be performed by qualified personnel following procedures that are consistent with Section XI of ASME Code and 10CFR50, Appendix B. Volumetric examinations are used to detect cracking in butt welds. Actual inspection locations will be based on physical accessibility, exposure levels, NDE techniques and locations identified in NRC IN 97-46, "Un-isolable Crack in High-Pressure Injection piping." Based on the above, the project team found the response acceptable. The project team verified that the applicant incorporated this change in LRPD-02.

During the audit and review, the project team asked the applicant how it will handle the aging of small piping socket welds. In its response, the applicant stated that during the fourth Inservice Inspection (ISI) interval, PNPS plans to perform both VT-2 and PT examinations, at a minimum, of socket welds in accordance with the PNPS fourth interval ISI program plan. The OTI of small-bore piping does not exclude locations based on geometry. Therefore, Class 1 small-bore piping socket welds will be selected for OTI based on physical location and exposure levels. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the One-Time Inspection Program will also include destructive or nondestructive examination of one socket-welded connection using techniques proven by past industry experience to be effective for the identification of cracking in small-bore socket welds. Should an inspection opportunity not occur (e.g., socket weld failure or socket weld replacement), a susceptible small-bore socket weld will be examined either destructively or nondestructively prior to entering the PEO. This is Commitment No. 20. Since small-bore piping socket-weld connection will be either destructively or nondestructively examined at least once, the project team found the applicant's response acceptable.

The project team reviewed those portions of the applicant's One-Time Inspection Program for which the applicant claims consistency with GALL AMP XI.M32 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's One-Time Inspection Program provided assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's One-Time Inspection Program acceptable because it conforms to the recommended GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M35, "One-Time Inspection of ASME Code Class Small-Bore Piping."

3.0.3.1.8.3 Exceptions to the GALL Report

None.

3.0.3.1.8.4 Enhancements

None.

3.0.3.1.8.5 Operating Experience

The applicant stated in the PNPS LRA that the One-Time Inspection Program is a new program for which there is no operating experience. Industry and plant-specific operating experience will be considered in development of this program, as appropriate.

Since this is a new program, the project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, in general to determine if it included any small-pipe issues. This report provides information from CRs and program owner interviews and covers a period of the last 5 years. The project team determined that the applicant has a good corrective action program that identifies issues and age-related degradation in a timely manner.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's One-Time Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.8.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the One-Time Inspection Program in PNPS LRA Appendix A, Section A.2.1.25, which states that the elements of the One-Time Inspection Program include (a) determination of the sample size based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience; (b) identification of the inspection locations in the system or component based on the aging effect; (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined; and (d) evaluation of the need for followup examinations to monitor the progression of any aging degradation.

An OTI activity is used to verify the effectiveness of the water chemistry control programs by confirming that unacceptable cracking, loss of material, and fouling is not occurring on components within systems covered by water chemistry control programs (LRA Sections A.2.1.36, A.2.1.37, and A.2.1.38).

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

OTI activities are used on the following components to confirm that loss of material, cracking, and reduction of fracture toughness, as applicable, are not occurring or are so insignificant that an AMP is not warranted:

- Internal surfaces of buried carbon steel pipe on the SGT system discharge to the stack.
- Internal surfaces of compressed air and EDG system components containing untreated air.
- Internal surfaces of SS radioactive waste and sanitary soiled waste and vent system components containing untreated water.
- Small-bore piping in the RCS and associated systems that form the RCPB.
- RV flange leak-off line.
- MS flow restrictors.

When evidence of an aging effect is revealed by an OTI, routine evaluation of the inspection results will identify appropriate corrective actions.

During the audit and review, the project team noted that the applicant's description of the One-Time Inspection Program in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the implementation of the new program. The description in Appendix A did not indicate that this was a new program nor did it include a commitment to implement it. The applicant was asked to justify why Appendix A did not include a commitment for the new program. In response to this request, the applicant stated that the program description in Appendix A would be revised to identify the commitment. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included Commitment No. 20 for implementation of this new program. Commitment No. 20 also includes the one-time destructive or nondestructive examination of small-bore socket weld connections.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.23 including the amendment above; found that it was consistent with the GALL Report; and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.8.7 Conclusion

On the basis of its audit and review of the applicant's One-Time Inspection Program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement and amendment for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.9 SELECTIVE LEACHING PROGRAM (PNPS AMP B.1.27)

In PNPS LRA Appendix B, Section B.1.27, the applicant stated that PNPS AMP B.1.27, "Selective Leaching Program," is a new plant program that is consistent with GALL AMP XI.M33, "Selective Leaching of Materials."

3.0.3.1.9.1 Program Description

The applicant stated in the PNPS LRA that this program will ensure the integrity of components made of cast iron, bronze, brass, and other alloys exposed to raw water, treated water, or groundwater that may lead to selective leaching. The program will include a one-time visual inspection and hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of material due to selective leaching is occurring and whether the process will affect the ability of the components to perform their intended function for the PEO.

The program will be initiated before the PEO.

3.0.3.1.9.2 Consistency with the GALL Report

In PNPS LRA, the applicant stated that PNPS AMP B.1.27 will be consistent with GALL AMP XI.M33.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.27 including AMPER, LRPD-02, Revision 1, Section 3.8, "Selective Leaching Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M33. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.27 and associated bases documents to determine consistency with GALL AMP XI.M33.

The project team reviewed those portions of the applicant's Selective Leaching Program for which the applicant claims consistency with GALL AMP XI.M33 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Selective Leaching Program provides assurance that the selective leaching of materials will be adequately managed for the PEO. The project team found the applicant's Selective Leaching Program acceptable because it conforms to the recommended GALL AMP XI.M33, "Selective Leaching of Materials."

3.0.3.1.9.3 Exceptions to the GALL Report

None.

3.0.3.1.9.4 Enhancements

None.

3.0.3.1.9.5 Operating Experience

The applicant stated in the PNPS LRA that the Selective Leaching Program is a new program for which there is no (program) operating experience. However, as noted in the GALL Report, industry operating experience has shown that the components made of cast iron, bronze, brass, and other alloys exposed to a raw water, brackish water, treated water, or groundwater environment may lead to selective leaching of one of the metal components.

During the audit and review, the project team asked PNPS for operating experience regarding circulating water pumps replacement due to selective leaching. The applicant provided information that it replaced P-105A ("A" circulating sea water pump) in RFO 15 (April 2005) as a result of operating experience from the vendor (Flowserve) informing PNPS that a failure of a cast iron circulating water pump occurred at the New Boston Fossil Station in 2004 due to graphitization. That pump was of a similar design to the pump at PNPS with 6 additional years of submergence/operation in saltwater. Six core samples of the pump casing were sent out to a materials laboratory for analysis, and the results confirmed graphitization. Currently, PNPS plans to replace P-105B in RFO 17 based on the core sample analysis obtained from P-105A columns. PNPS has also purchased and has onsite the columns for P105B overhaul/replacement. The new pump columns are cast iron enhanced with the addition of 3- to

5-percent nickel to improve strength and resistance to graphitization. The original columns were ASTM A48 CL 35 with 1.75- to 2.25-percent nickel.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, as noted in the above example, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence that the effects of aging are adequately managed.

The project team also reviewed the operating experience provided in the basis document and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Selective Leaching Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.9.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Selective Leaching Program in PNPS LRA Appendix A, Section A.2.1.29, which states that the Selective Leaching Program ensures the integrity of components made of cast iron, bronze, brass, and other alloys exposed to raw water, treated water, or groundwater that may lead to selective leaching. The program includes a one-time visual inspection and hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of material due to selective leaching is occurring and whether the process will affect the ability of the components to perform their intended function for the PEO.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant submitted the PNPS LRA Amendment 5. The project team reviewed the applicant's license renewal commitment list in Appendix A of the PNPS LRA Amendment 5 and confirmed that this program is identified as item 23 of the commitments that will be implemented before the PEO.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.27, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.9.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.10 STRUCTURES MONITORING – MASONRY WALL PROGRAM (PNPS AMP B.1.29.1)

In PNPS LRA Appendix B, Section B.1.29.1, the applicant stated that PNPS AMP B.1.29.1, "Structures Monitoring – Masonry Wall Program," is an existing plant program that is consistent with GALL AMP XI.S5, "Masonry Wall Program."

3.0.3.1.10.1 Program Description

The applicant stated in the PNPS LRA that this program will manage aging effects so that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the PEO.

The program includes all masonry walls identified as performing intended functions in accordance with 10 CFR 54.4. Included components are the 10 CFR 50.48-required masonry walls, radiation shielding masonry walls, masonry walls with the potential to affect safety-related components, and the torus compartment water trough.

Masonry walls are visually examined at a frequency selected to ensure there is no loss of intended function between inspections.

3.0.3.1.10.2 Consistency with the GALL Report

In PNPS LRA, the applicant stated that PNPS AMP B.1.29.1 is consistent with GALL AMP XI.S5.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.29.1, including AMPER, LRPD-02, Revision 1, Section 4.21.2, "Masonry Wall Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.S5. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.29.1 and associated bases documents to determine consistency with GALL AMP XI.S5.

The project team also reviewed PNPS Procedure Nos. MRSSC58, Revision 1, "Building & Structures System 56;" and NE8.02, Revision 3, "Structure Inspection and Condition Monitoring."

The project team reviewed those portions of the applicant's Structures Monitoring – Masonry Wall Program for which the applicant claims consistency with GALL AMP XI.S5 and found that the PNPS Masonry Wall Program is consistent with the program described in the GALL Report, Section XI.S5. The Masonry Wall Program includes the guidance and lessons learned from NRC IEB 80-11 and IN 87-67. As indicated in AMPER, LRPD-02, Section 4.21.2, operating experience shows that this program has been effective in managing aging effects with consideration for recommendations and lessons learned from IEB 80-11 and IN 87-67. Masonry walls are visually examined at a frequency selected (at least once every 10 years) to ensure there is no loss of intended function between inspections. PNPS *Engineering Design Standards Manual* MCSB03.104 defines the procedure to maintain the qualification of safety-related masonry block walls in accordance with the provisions of NRC Inspection and Enforcement

Bulletin (IEB) 80-11, "Masonry Wall Design." PNPS Procedure No. NE8.02, "Structure Inspection and Condition Monitoring," Section 5.0, stated: "The inspection intervals are once every 3 years for accessible areas, once every 10 years for normally inaccessible areas." The applicant also stated that no additional masonry walls have been identified to be added to the scope of PNPS and thus they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Structures Monitoring – Masonry Wall Program provides assurance that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO. The project team found the applicant's Structures Monitoring – Masonry Wall Program acceptable because it conforms to the recommended GALL AMP XI.S5, "Masonry Wall Program."

3.0.3.1.10.3 Exceptions to the GALL Report

None.

3.0.3.1.10.4 Enhancements

None.

3.0.3.1.10.5 Operating Experience

The applicant stated in the PNPS LRA that examinations of masonry walls within the scope of license renewal in 2002 did not find evidence of cracking. A review of CRs from 1998 through 2004 did not reveal any instances of cracked masonry walls. Absence of cracking provides evidence that the program is effective for managing cracking of masonry walls.

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Structures Monitoring – Masonry Wall Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.10.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Structures Monitoring – Masonry Wall Program in PNPS LRA Appendix A, Section A.2.1.31, which states that the objective of the Masonry Wall Program is to manage cracking so that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the PEO.

The program includes all masonry walls identified as performing intended functions in accordance with 10 CFR 54.4. Included components are the 10 CFR 50.48- required masonry walls, radiation shielding masonry walls, masonry walls with the potential to affect safety-related components, and the torus compartment water trough.

Masonry walls are visually examined at a frequency selected to ensure there is no loss of intended function between inspections.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.29.1, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.10.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.11 SYSTEM WALKDOWN PROGRAM (PNPS AMP B.1.30)

In PNPS LRA Appendix B, Section B.1.30, the applicant stated that PNPS AMP B.1.30, "System Walkdown Program," is an existing plant program that is consistent with GALL AMP XI.M36, "External Surfaces Monitoring."

3.0.3.1.11.1 Program Description

The applicant stated in the PNPS LRA that this program entails inspections of external surfaces of components subject to AMR. The program is also credited with managing loss of material from internal surfaces, for situations in which internal and external material and environment combinations are the same such that external surface condition is representative of internal surface condition.

3.0.3.1.11.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.30 is consistent with GALL AMP XI.M36.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.30, including AMPER, LRPD-02, Revision 1, Section 4.22, "System Walkdown Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M36. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report)

contained in PNPS AMP B.1.30 and associated bases documents to determine consistency with GALL AMP XI.M36.

During the audit and review, the project team asked the applicant why an enhancement to the scoping of the System Walkdown Program is listed in the LRPD-02 but is not listed in the LRA. The applicant explained that this enhancement was identified after the LRA was submitted to the NRC for review and that this enhancement will be added to LRA Section B.1.30, as described in Section 3.0.3.1.11.4 of this report.

The project team reviewed those portions of the applicant's System Walkdown Program for which the applicant claims consistency with GALL AMP XI.M36 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's System Walkdown Program provides assurance that the effects of aging will be managed during the PEO. The project team found the applicant's System Walkdown Program acceptable because it conforms to the recommended GALL AMP XI.M36, "External Surfaces Monitoring."

3.0.3.1.11.3 Exceptions to the GALL Report

None.

3.0.3.1.11.4 Enhancements

During the audit and review, the project team noted that the LRPD-02 identifies an enhancement to the System Walkdown Program, but this enhancement was not listed in the LRA. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Section B.1.30 is revised to add the following enhancement:

Element:	1. Scope of Program
Enhancement:	Enhance system walkdown guidance documents to clarify a license renewal commitment. The commitment for license renewal is for periodic system engineer inspections of systems in scope and subject to AMR for license renewal in accordance with 10 CFR 54.4 (a)(1) and (a)(3). Inspections shall include areas surrounding the subject systems to identify hazards to those systems. Inspections of nearby systems that could impact the subject systems will include SSCs that are in scope and subject to AMR for license renewal in accordance with 10 CFR 54.4 (a)(2).

The GALL Report contains the following recommendation for the "scope of program" program element associated with the enhancement:

> *Scope of Program:* This program visually inspects the external surface of in-scope components and monitors external surfaces of steel components in systems within the scope of license renewal and subject to AMR for loss of material and leakage. Visual inspections are expected to identify loss of material due to general corrosion in accessible steel components. Loss of material due to pitting and crevice corrosion may not be detectable through these same visual inspections, however, general corrosion is

expected to be present and detectable such that, should pitting and crevice corrosion exist, general corrosion will manifest itself as visible rust or rust byproducts (e.g., discoloration or coating degradation) and be detectable prior to any loss of intended function. Therefore, this program is acceptable for use in inspecting for loss of material for general, pitting and crevice corrosion.

Surfaces that are inaccessible or not readily visible during plant operations are inspected during refueling outages. Surfaces that are inaccessible or not readily visible during both plant operations and refueling outages are inspected at such intervals that would provide assurance that the effects of aging will be managed such that applicable components will perform their intended function during the period of extended operation.

Surfaces that are insulated may be inspected when the external surface is exposed (i.e., maintenance) at such intervals that would provide assurance that the effects of aging will be managed such that applicable components will perform their intended function during the period of extended operation.

The program may also be credited with managing loss of material from internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces such that external surface condition is representative of internal surface condition. When credited, the program should describe the component internal environment and the credited similar external component environment inspected.

The project team reviewed the applicant's enhancement and the plant procedure (EN-DC-178, "System Walkdowns") and determined that this enhancement is acceptable because it will make the program consistent with GALL AMP XI.M36, Element 1.

On this basis, the project team found this enhancement acceptable because when enhancement is implemented, PNPS AMP B.1.30, "System Walkdown Program," will be consistent with GALL AMP XI.M36 and will provide the effects of aging will be adequately managed.

3.0.3.1.11.5 <u>Operating Experience</u>

The applicant stated in the PNPS LRA that system walkdowns between 1998 and 2004 identified evidence of aging effects, including corrosion and leakage. Examples include fire water storage tank and diesel fire pump fuel oil day tank leakage, through-wall leakage on SSW piping, signs of corrosion in fan room and auxiliary bays, and through-wall leakage on a drain line to the auxiliary bay sump. Corrective actions were accomplished in accordance with the site corrective action program. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects for passive components.

The project team reviewed the CRs related to through-wall leakage on a drain line to the auxiliary bay sump (CR-PNP-2003-04416), diesel fire pump fuel oil day tank leakage (CR-PNP-2001-01491), and through-wall leakage on SSW piping (CR-PNP-1999-09369), and found these CRs have been properly closed and the associated corrective actions have been taken to correct the identified problems. The project team also sample reviewed system health reports/system

performance reports on the salt service water (SSW) system, covering the period from January 1, 2006 to March 31, 2006. The reports indicate that the SSW system is classified as green, and the system continues to perform well without indication of any major issues.

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's System Walkdown Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.11.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the System Walkdown Program in PNPS LRA Appendix A, Section A.2.1.34, which states that the System Walkdown Program entails inspections of external surfaces of components subject to AMR. The program is also credited with managing loss of material from internal surfaces for situations in which internal and external material and environment combinations are the same such that external surface condition is representative of internal surface condition.

Surfaces that are inaccessible during plant operations are inspected during RFOs. Surfaces are inspected at selected frequencies to provide assurance that effects of aging will be managed such that applicable components will perform their intended function during the PEO.

During the audit and review, the project team noted that the LRPD-02 identifies an enhancement to the System Walkdown Program, but this enhancement was not listed in the LRA (see Section 3.0.3.1.11.4 of this audit and review report). In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Section B.1.30 is revised to add this enhancement and identified as License Renewal Commitment No. 28 in Appendix A to the PNPS LRA Amendment 5.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.30, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.11.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.12 THERMAL AGING AND NEUTRON IRRADIATION EMBRITTLEMENT OF CAST AUSTENITIC STAINLESS STEEL(CASS) PROGRAM (PNPS AMP B.1.31)

In PNPS LRA Appendix B, Section B.1.31, the applicant stated that PNPS AMP B.1.31, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program," is a new plant program that is consistent with GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)."

3.0.3.1.12.1 Program Description

The applicant stated in the PNPS LRA that this program will assure that reduction of fracture toughness due to thermal aging and radiation embrittlement will not result in loss of intended function. This program will evaluate CASS components in the RV internals and require NDEs as appropriate.

The applicant also stated in the PNPS LRA that EPRI, the BWR owners group, and other industry groups are focused on RV internals to ensure a better understanding of aging effects. Future Boiling Water Reactor Vessel Internals Project (BWRVIP) reports, EPRI reports, and other industry operating experience will provide additional bases for evaluations and inspections under this program. This program will supplement RV internals inspections required by the BWR Vessel Internals Program to assure that aging effects do not result in loss of the intended functions of RV internals during the PEO.

The program will be initiated before the PEO.

3.0.3.1.12.2 Consistency with the GALL Report

In PNPS LRA, the applicant stated that PNPS AMP B.1.31 will be consistent with GALL AMP X.M13.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.31, including AMPER, LRPD-02, Revision 1, Section 4.1, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program," which provides an assessment of the AMP elements' consistency with GALL AMP X.M13. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.31 and associated bases documents to determine consistency with GALL AMP X.M13.

The project team reviewed those portions of the applicant's Thermal Aging and Neutron Irradiation Embrittlement of CASS Program for which the applicant claims consistency with GALL AMP X.M13 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Thermal Aging and Neutron Irradiation Embrittlement of CASS Program provides assurance that the integrity of CASS components will be maintained during the PEO. The project team found the applicant's Thermal Aging and Neutron Irradiation Embrittlement of CASS Program acceptable because it conforms

to the recommended GALL AMP X.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)."

3.0.3.1.12.3 Exceptions to the GALL Report

None.

3.0.3.1.12.4 Enhancements

None.

3.0.3.1.12.5 Operating Experience

The applicant stated in the PNPS LRA that the Thermal Aging and Neutron Irradiation Embrittlement of CASS Program is a new program for which there is no operating experience.

The project team also reviewed the operating experience provided in the basis document and interviewed the applicant's technical staff to confirm that no industry operating experience with thermal aging and neutron irradiation embrittlement of CASS has emerged.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Thermal Aging and Neutron Irradiation Embrittlement of CASS Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.12.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Thermal Aging and Neutron Irradiation Embrittlement of CASS Program in PNPS LRA Appendix A, Section A.2.1.35, which states that the purpose of the Thermal Aging and Neutron Irradiation Embrittlement of CASS Program is to assure that reduction of fracture toughness due to thermal aging and radiation embrittlement will not result in loss of intended function during the PEO. This program evaluates CASS components in the RV internals and requires NDEs as appropriate.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant submitted the PNPS LRA Amendment 5. The project team reviewed the applicant's license renewal commitment list in Appendix A to the PNPS LRA Amendment 5 and confirmed that this program is identified as Item 29 of the commitments that will be implemented before the PEO.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.31, found that it was consistent with the GALL Report, and determined that it provided an adequate summary

description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.12.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.13 WATER CHEMISTRY CONTROL – BWR PROGRAM (PNPS AMP B.1.32.2)

In PNPS LRA Appendix B, Section B.1.32.2, the applicant stated that PNPS AMP B.1.32.2, "Water Chemistry Control – BWR Program," is an existing plant program that is consistent with GALL AMP XI.M2, "Water Chemistry."

3.0.3.1.13.1 Program Description

The applicant stated in the PNPS LRA that this program will manage aging effects caused by corrosion and cracking mechanisms. The program relies on monitoring and control of water chemistry based on EPRI Report 1008192 (BWRVIP-130). BWRVIP-130 has three sets of guidelines: one for primary water, one for condensate and feedwater, and one for CRD mechanism cooling water. EPRI guidelines in BWRVIP-130 also include recommendations for controlling water chemistry in the torus, condensate storage tanks, demineralized water storage tanks, and spent fuel pool.

The Water Chemistry Control – BWR Program optimizes the primary water chemistry to minimize the potential for loss of material and cracking. This is accomplished by limiting the levels of contaminants in the RCS that could cause loss of material and cracking. Additionally, PNPS has instituted hydrogen water chemistry (HWC) to limit the potential for intergranular stress corrosion cracking (IGSCC) through the reduction of dissolved oxygen in the treated water.

3.0.3.1.13.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.32.2 is consistent with GALL AMP XI.M2.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.32.2, including AMPER, LRPD-02, Revision 1, Section 4.23.2, "Water Chemistry Control – BWR Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M2. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this

audit and review report) contained in PNPS AMP B.1.32.2 and associated bases documents to determine consistency with GALL AMP XI.M2.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.28, "Water Chemistry Control – BWR Program," PNPS Procedure No. 7.8.1, Revision 40, "Chemistry Sample and Analysis Program Procedure," and PNPS Procedure No. 7.8.7, Revision 1, "Recording and Trending of Chemistry Data Procedure."

In the LRA, the applicant stated that the program relies on monitoring and control of water chemistry based on EPRI Report 1008192 (BWRVIP-130). BWRVIP-130 supersedes previous revisions of the BWR water chemistry guidelines, including BWRVIP-29 (TR-103515). The project team reviewed EPRI TR-1008192, which is based on updated industry experience with increased emphasis on fuel performance concerns while retaining chemistry parameters, action levels, and associated measurement frequencies essentially unchanged. The staff has previously performed a technical review of EPRI TR-1008192 (BWRVIP-130) and accepted it as documented in the Monticello Nuclear Plant SER. Based on the project team's review of the document and the staff's acceptance on the Monticello Plant, the project team found the use of BWRVIP-130 to be acceptable.

During the audit and review, the project team noted that GALL AMP XI.M2, Element 3, "parameters monitored/inspected," lists monitoring of chlorides, sulfates, dissolved oxygen, and hydrogen peroxide. However, LRPD-02, Section 4.23.2.B.3.b, which performs a comparison of GALL Element 3 with the PNPS AMP, does not mention monitoring of hydrogen peroxide and concludes that the PNPS AMP is consistent with the element. The project team asked the applicant to clarify how, if hydrogen peroxide is not monitored, the PNPS is consistent with this element. In its response, the applicant stated that reactor water hydrogen peroxide measurements are not practical even though they would be beneficial in determining the total oxidizing species affecting stress corrosion cracking (SCC). The results obtained through liquid sampling are inaccurate due to decomposition of hydrogen peroxide in the sample lines. No practical method exists for a BWR to obtain direct hydrogen peroxide measurements. In accordance with BWRVIP-130, reactor water electrochemical corrosion potential and dissolved oxygen measurements are used at PNPS to determine whether oxidizing species including hydrogen peroxide have been reduced sufficiently to minimize IGSCC. Measurement of electrochemical corrosion potential and dissolved oxygen, as recommended by BWRVIP-130, is used to ensure that oxidizing species including hydrogen peroxide have been reduced, which in turn minimizes IGSCC. On this basis, the project team found the applicant's response acceptable.

GALL Chapter XI.M2 recommends that for "susceptible locations," an OTI verification program may be appropriate. The project team asked the applicant if it intended to implement an OTI program for this water chemistry control program and, if so, why this is not included in the UFSAR Supplement Appendix A for this program. In its response, the applicant stated that the One-Time Inspection Program described in LRA Section B.1.23 does include inspections to verify the effectiveness of the water chemistry control AMPs by confirming that unacceptable cracking, loss of material, and fouling is not occurring. The discussions in LRA Section 3, Table 1, provide the link between the One-Time Inspection Program and water chemistry control

programs for susceptible components. However, for clarity, LRA Appendix A descriptions for the Water Chemistry Control – BWR Program will be amended to provide a link to the One-Time Inspection Program activities to confirm the effectiveness of these programs. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program." Based on changes to the Appendix A writeup, the applicant's response was found acceptable.

The project team reviewed those portions of the applicant's Water Chemistry – BWR Program for which the applicant claims consistency with GALL AMP XI.M2 and found that they are consistent with this GALL Report AMP. On the basis of its review, the project team concluded that the applicant's Water Chemistry – BWR Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Water Chemistry – BWR Program acceptable because it conforms to the recommended GALL AMP XI.M2, "Water Chemistry."

3.0.3.1.13.3 Exceptions to the GALL Report

None.

3.0.3.1.13.4 Enhancements

None.

3.0.3.1.13.5 Operating Experience

The applicant stated in the PNPS LRA that during the period from 1998 through 2004, several CRs were initiated due to adverse trends in parameters monitored by the Water Chemistry Control – BWR Program. Corrective actions were taken within the corrective action program to preclude reaching unacceptable values for the parameters. Continuous confirmation of water quality and corrective action before reaching control limits provide evidence that the program is effective in managing aging effects for applicable components.

During the period from 1998 through 2004, several CRs were initiated due to parameters monitored by the Water Chemistry Control – BWR Program outside of administrative limits, but still within EPRI acceptance criteria. Corrective actions were taken within the corrective action program to preclude violating EPRI acceptance criteria. Continuous confirmation of water quality and corrective action before reaching control limits provide evidence that the program is effective in managing aging effects for applicable components.

During the period from 1998 through 2004, the following two incidents occurred in which parameters monitored by the Water Chemistry Control – BWR Program were outside of EPRI acceptance criteria:

- Following a downpower on March 29, 2002, dissolved oxygen measurement from the B high-pressure feedwater (HPFW) train was approximately 28 parts per billion (ppb), which is below the minimum required reading of 30 ppb (EPRI Action Level 1). Dissolved oxygen measured from the A HPFW train and condensate demineralizer effluent were acceptable (approximately 70 to 80 ppb). Root cause was B HPFW sample line contamination, not actual low oxygen in the feedwater. The B HPFW sample line was replaced.

- On October 28, 2002, HPFW and condensate demineralizer effluent dissolved oxygen levels spiked to 400 to 500 ppb for about 15 minutes before returning to normal. EPRI Action Level 1 for HPFW dissolved oxygen is 200 ppb. Root cause was determined to be inadequate filling of the D demineralizer before its return to service. The procedure states, "It is EXTREMELY important that all air is vented from a condensate demineralizer before it is placed in service to prevent air injection into the Feedwater System." Procedural steps were emphasized that will insure proper venting and mitigate elevated oxygen levels in the feedwater system.

Continuous confirmation of water quality and timely corrective action provide evidence that the program is effective in managing aging effects for applicable components.

QA audits in 2000 and 2002 revealed no issues or findings that could impact effectiveness of the program.

A QA audit in 2004 revealed that reactor coolant sodium and lithium analyses were not being performed weekly during the first half of 2004. Corrective action was taken to replace the analysis instrument and ensure that required analyses are performed. Confirmation of water quality and timely corrective actions provide evidence that the program is effective in managing aging effects for applicable components.

A corporate assessment in 2003 identified areas for improvement in administrative controls, but revealed no issues or findings that could impact effectiveness of the program.

The project team also reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.28, "Water Chemistry Control – BWR Program." Several instances where the limit levels were exceeded are identified, with appropriate actions taken. The program is effective in managing aging effects. The project team also reviewed CR-PNP-2002-09754, which was generated because feedwater oxygen was below EPRI Action I guidelines. The project team reviewed the CR and determined that appropriate root cause analysis as required by this program was performed and the necessary corrective actions were completed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Water Chemistry Control – BWR Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.1.13.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Water Chemistry Control – BWR Program in PNPS LRA Appendix A, Section A.2.1.37, which states that the purpose of the Water Chemistry Control – BWR Program is to manage aging effects caused by corrosion and cracking mechanisms. The program relies on monitoring and control of water chemistry based on EPRI Report 1008192 (BWRVIP-130). BWRVIP-130 has three sets of guidelines: one for primary water, one for condensate and feedwater, and one for CRD mechanism cooling water. EPRI guidelines in BWRVIP-130 also include recommendations for controlling water chemistry in the torus, condensate storage tank, demineralized water storage tanks, and spent fuel pool.

The Water Chemistry Control – BWR Program optimizes the primary water chemistry to minimize the potential for loss of material and cracking. This is accomplished by limiting the levels of contaminants in the RCS that could cause loss of material and cracking. Additionally, PNPS has instituted HWC to limit the potential for IGSCC through the reduction of dissolved oxygen in the treated water.

As stated in Section 3.0.3.1.13.2 of this report, the UFSAR Supplement will be amended to provide a link to the One-Time Inspection Program activities to confirm the effectiveness of this water chemistry control program. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised this program to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.32.2 and the LRA amendment, found that it was consistent with the GALL Report, and determined that it provided an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.1.13.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those portions of the program for which the applicant claims consistency with the GALL Report are consistent with the GALL Report.

On the basis of its review of the UFSAR Supplement for this program, the project team found that it provided an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2 PNPS AMPs That Are Consistent with the GALL Report with Exceptions and/or Enhancements

3.0.3.2.1 BURIED PIPING AND TANKS INSPECTION PROGRAM (PNPS AMP B.1.2)

In PNPS LRA Appendix B, Section B.1.2, the applicant stated that PNPS AMP B.1.2, "Buried Piping and Tanks Inspection Program," is a new plant program that is consistent with GALL AMP XI.M34, "Buried Piping and Tanks Inspection," with an exception.

3.0.3.2.1.1 Program Description

The applicant stated in the PNPS LRA that this program includes (a) preventive measures to mitigate corrosion, and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, SS, and titanium components. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components are inspected when excavated during maintenance.

A focused inspection will be performed within the last 10 years and within the first 10 years of the PEO unless an opportunistic inspection (or an inspection via a method that allows assessment of pipe condition without excavation) occurs within this 10-year period.

3.0.3.2.1.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.2 is consistent with GALL AMP XI.M34 with an exception.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.2, including AMPER 3.1, "Buried Piping and Tanks Inspection Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M34. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.2 and associated bases documents to determine consistency with GALL AMP XI.M34.

3.0.3.2.1.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Exception

Element:	4: Detection of Aging Effects
Exception:	For cases of excavation solely for the purpose of inspection – methods such as "phased array" UT will be used to determine wall thickness.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> Inspections performed to confirm that coating and wrapping are intact are an effective method to ensure that corrosion of external surfaces has not occurred and the intended function is maintained. Buried piping and tanks are opportunistically inspected whenever they are excavated during maintenance. When opportunistic, the inspections are performed in areas with the highest likelihood of corrosion problems, and in areas with a history of corrosion problems, within the areas made accessible to support the maintenance activity.

The applicant stated in the PNPS LRA that for cases of excavation solely for the purpose of inspection, methods such as “phased array UT” will be used to determine wall thickness. This is considered preferable by PNPS since excavation could result in damage to coatings or wrappings.

The proposed exception eliminates the possibility of inadvertent damage during inspection, while still being able to assess the target component. On this basis, the project team found this exception acceptable.

3.0.3.2.1.4 Operating Experience

The applicant stated in the PNPS LRA that the Buried Piping and Tanks Inspection Program at PNPS is a new program for which there is no operating experience.

In the past 5 years, there has been limited experience with the inspection of buried piping at PNPS. This experience has occurred mainly on the fire water underground distribution system. This system is approximately 35 years old and consists of cement-lined malleable iron pipe with mechanical joints. There has been no history of significant leaks other than during two instances – one in 2001 and one in 2005. In the first event, the 8-inch underground line downstream of 8-L-22 failed. The probable cause of failure was most likely induced by minor fabrication anomalies compounded by marginal installation techniques. When this piping was examined, it was found to be in very good external condition overall except for a small area of surface corrosion attributed to marginal installation techniques. In the second event, the 8-inch underground pipe failed in the area of the N2 tank adjacent to the EDG building. Due to congestion and the presence of the tank (which was installed after the installation of the piping), it was not possible to dig up the piping to examine it and determine the cause of the failure (which may be related to the tank installation). In addition to these two instances, the excavation of a number of valves during maintenance found the valves and piping to be in good condition.

From an additional historical perspective, the SSW system at PNPS has experienced leaks on the buried inlet (screenhouse to auxiliary bays) piping as a result of internal corrosion. The original piping material was rubber-lined carbon steel wrapped with reinforced fiberglass wrapping and coal tar saturated felt and heavy Kraft paper. The leaks were determined to be the result of the degraded rubber lining being in contact with sea water. These pipes have since been replaced with the same external coating as the original pipe. The pipe replacement occurred in 1995 and 1997.

In addition, the SSW buried discharge piping (also rubber-lined carbon steel with external pipe wrapping) from the auxiliary bays to the discharge canal experienced severe internal corrosion due to failure of the rubber lining. Two 40-foot lengths of 22-inch diameter pipes (one on each loop) were replaced in 1999 as a result of the failed rubber lining and internal corrosion. These spools were replaced with carbon steel coated internally and externally with an epoxy coating. The piping that was removed was examined after its wrapping was removed and its external surface was found to be in good condition. Since that time, the entire length of both SSW buried discharge loops have been lined internally with cured-in-place pipe linings – “B” Loop in 2001 and “A” Loop in 2003.

The phased array inspection technique was provided merely as an example of a potential future examination technique. It and other remote techniques will potentially be able to assess the condition of extensive portions of buried piping without the need for excavation. This exception was taken to allow the potential use of this technique or others in lieu of excavating piping to provide a more effective assessment of overall piping conditions while eliminating the potential for damaging the piping during excavation.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Buried Piping and Tanks Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.1.5 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Buried Piping and Tanks Inspection Program in PNPS LRA Appendix A, Section A.2.1.2, which states that the Buried Piping and Tanks Inspection Program includes (a) preventive measures to mitigate corrosion, and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, SS, and titanium components. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components are inspected when excavated during maintenance. If trending within the corrective action program identifies susceptible locations, the areas with a history of corrosion problems are evaluated for the need for additional inspection, alternate coating, or replacement.

A focused inspection will be performed within the first 10 years of the PEO, unless an opportunistic inspection (or an inspection via a method that allows assessment of pipe condition without excavation) occurs within this 10-year period.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.2, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.1.6 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.2 BWR CONTROL ROD DRIVE RETURN LINE NOZZLE PROGRAM (PNPS AMP B.1.3)

In PNPS LRA Appendix B, Section B.1.3, the applicant stated that PNPS AMP B.1.3, “BWR Control Rod Drive Return Line Nozzle Program,” is an existing plant program that is consistent with GALL AMP XI.M6, “BWR Control Rod Drive Return Line Nozzle," with exceptions.

3.0.3.2.2.1 Program Description

The applicant stated in the PNPS LRA that this program is comparable to the program described in NUREG-1801, Section XI.M6, “BWR Control Rod Drive Return Line Nozzle.”

Under this program, PNPS has cut and capped the CRD return line nozzle to mitigate cracking, and continues ISI examinations to monitor the effects of crack initiation and growth on the intended function of the CRD return line nozzle and cap.

In 2003, a structural weld overlay was installed over a crack in the CRD return line nozzle-to-cap weld. The Inconel 52 weld metal used in the overlay is highly resistant to SCC.

3.0.3.2.2.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.3 is consistent with GALL AMP XI.M6, with exceptions.

The project team interviewed the applicant’s technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.3, including AMPER, LRPD-02, Revision 1, Section 4.2, “BWR Control Rod Return Line Nozzle,” which provides an assessment of the AMP elements’ consistency with GALL AMP XI.M6. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.3 and associated bases documents to determine consistency with GALL AMP XI.M6.

The project team also reviewed the documents listed in Attachment 5 to this audit and review report.

The project team reviewed those portions of the BWR Control Rod Drive Return Line Nozzle Program for which the applicant claims consistency with GALL AMP XI.M6 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concludes that the applicant’s BWR Control Rod Drive Return Line Nozzle Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant’s BWR Control Rod Drive Return Line Nozzle Program acceptable because it conforms to the recommended GALL AMP XI.M6, “BWR Control Rod Drive Return Line Nozzle,” with the exceptions as described below.

3.0.3.2.2.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Element:	3: Parameters Monitored/Inspected
Exception:	PNPS examines ½ inch of the volume next to the widest part of the N10 nozzle-to-vessel weld, rather than half of the vessel wall thickness.

The GALL Report identified the following recommendation for the "parameters monitored/inspected" program element associated with the exception taken:

> The aging management program (AMP) monitors the effects of cracking on the intended function of the CRDRL nozzles by detecting and sizing cracks by ISI in accordance with Table IWB 2500-1 and NUREG-0619.

The applicant stated in the PNPS LRA that extending the examination volume into the base metal as required by ASME Code Section XI, 1998 Edition, 2000 Addenda, Figure IWB-2500-7(b), prolongs the examination time significantly and results in no net increase in safety. The extra volume is base metal region which is not prone to inservice cracking and has been extensively examined before the vessel was put into service and during the first, second, and third interval examinations.

The project team asked the applicant to provide the regulatory basis for reducing the examination volume. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Appendix B.1.3 is revised to remove the exception to the "parameters monitored/inspected" program element pertaining to inspection volume. This reduction of the inspection volume for the adjacent base metal is now in accordance with ASME Code Case N-613-1, which has been approved for use by the NRC in RG 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1."

Since the reduction of volume is now in accordance with an NRC approved code case, the project team found the deletion of this exception acceptable.

Exception 2

Elements:	4: Detection of Aging Effects 5: Monitoring and Trending
Exception:	The extent and schedule of inspection, as delineated in NUREG 0619, are not followed. Specifically, liquid penetrant testing (PT) of control rod drive return line (CRDRL) nozzle blend radius and bore regions is not performed.

The GALL Report identified the following recommendations for the "detection of aging effects" and "monitoring and trending" program elements associated with the exception taken:

Detection of Aging Effects: The extent and schedule of inspection, as delineated in NUREG-0619, assures detection of cracks before the loss of intended function of the CRDRL nozzles. Inspection recommendations include liquid penetrant testing (PT) of CRDRL nozzle blend radius and bore regions and the RV wall area beneath the nozzle, return-flow-capacity demonstration, CRD-system-performance testing, and ultrasonic inspection of welded connections in the rerouted line. The inspection is to include base metal to a distance of one-pipe-wall thickness or 0.5 in., whichever is greater, on both sides of the weld.

Monitoring and Trending: The inspection schedule of NUREG-0619 provides timely detection of cracks.

The applicant stated in the PNPS LRA that the weld overlay installed over a crack in the CRD return line nozzle-to-cap weld covers the nozzle, the nozzle-to-cap weld, and part of the cap. The Inconel 52 weld overlay, which is highly resistant to SCC, is ultrasonically inspected in accordance with NRC Generic Letter (GL) 88-01 and BWRVIP-75. The weld overlay provides assurance of structural and pressure boundary integrity of the reactor pressure vessel (RPV) capped N10 nozzle and, thus, provides an acceptable level of quality and safety. Since the nozzle and original nozzle-to-cap weld are covered by the overlay, and the overlay is examined, examination of the nozzle and original nozzle-to-cap weld is not required.

The CRD return line nozzle N-10 weld overlay repair will continue to be inspected under the PNPS Inservice Inspection Program as a Category E weld in accordance with BWRVIP-75-A, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules" during PEO. The project team finds that this is an acceptable exception to these elements because this BWRVIP has been reviewed and accepted by the staff. On this basis, the project team found this exception acceptable.

<u>Exception 3</u>

Element:	6. Acceptance Criteria
Exception:	PNPS repaired the CRDRL nozzle by weld overlay rather than removing the crack by grinding and examines the overlay using UT in lieu of RT.

The GALL Report identified the following recommendations for the "acceptance criteria" program elements associated with the exception taken:

> Any cracking is evaluated in accordance with IWB-3100 by comparing inspection results with the acceptance standards of IWB-3400 and IWB-3500. All cracks found in the CRDRL nozzles are to be removed by grinding.

The applicant stated in the PNPS LRA that in a letter dated February 25, 2005, the NRC concluded that the proposed alternative provides assurance of structural and pressure boundary integrity of the RPV capped N10 nozzle and, thus, provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorized the use of ASME Code Case N-504-2, as modified, and the use of UT in lieu of RT, to perform a weld overlay repair of the CRD return line nozzle-to-cap weld (N10).

The project team asked the applicant to provide the basis for using the weld overlay. The applicant stated that a relief request was submitted to the NRC to use ASME Code Case N -504-2 for the CRD return line weld overlay and received NRC approval before startup of the N -10 nozzle repair outage. The applicant requested that alloys 152/52 be allowed for the weld overlay repair material and an alternate inspection plan be allowed in lieu of the hydrostatic pressure test.

The CRD return line nozzle weld overlay repair was designed and installed in accordance with the 1989 Edition of the ASME Code Section XI. ASME Code Section XI, nonmandatory Appendix Q, was first published as part of the 2004 Edition of ASME Code Section XI and therefore was not considered for the CRD return line nozzle weld overlay modification.

The CRD return line nozzle N-10 weld overlay repair will continue to be inspected under the PNPS Inservice Inspection Program as a category E weld in accordance with BWRVIP-71-A during the PEO.

In a letter dated February 25, 2005, the NRC staff concluded that the proposed alternative provides assurance of the structural and pressure boundary integrity of the capped N 10 nozzle and, thus, provides an acceptable level of quality and safety. The staff also approved the use of UT in lieu of RT for inspecting the overlay. In addition, this code case has been endorsed by the NRC staff and is included in RG 1.147, Revision 14. On the basis of the prior approval of this code case and the use of UT in place of RT and on the inclusion of this code case in RG 1.147, Revision 14, the project team finds this exception to be acceptable.

3.0.3.2.2.4 Enhancements

None.

3.0.3.2.2.5 Operating Experience

The applicant stated, in the PNPS LRA, that on October 1, 2003, a RCPB leak from the N10 nozzle-to-cap weld area was identified during a planned visual inspection of the drywell. Through-wall leakage from the N10 nozzle-to-cap butt weld was caused by an incipient crack or crevice condition remaining in the weld after repair welding performed as part of the nozzle-to-cap fabrication welding in 1977. Subsequent crack propagation continued through-wall by an interdendritic SCC mechanism due to high residual weld stresses in the alloy 82/182 weld metal as a result of the repair. A structural weld overlay was installed with alloy 52 weld metal, which is highly resistant to SCC. The weld overlay process also imparts a compressive residual stress due to the welding process, which prevents further crack growth.

The N10 nozzle-to-cap weld received all code-required preservice NDE examinations and was pressure-tested before returning to service. Ultrasonic examinations can detect incipient cracking, including hard-to-detect flaws related to SCC mechanisms and flaws that occur entirely within the weld metal. Thus, the examinations would have detected weld cracking. Since the weld overlay is highly resistant to cracking, and will continue to be examined as required, the BWR CRD Return Line Nozzle Program remains effective for managing the effect of cracking on the intended function of the CRD return line nozzle.

The CRD return line weld overlay was designed and installed in accordance with ASME Code Section XI, Code Case N-504-2, “Alternate Rules for Repair of Class 1, 2 and 3 Austenitic Stainless Steel Piping,” and Code Case N-638, “Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique,” and associated PNPS Relief Request (PRR) 36 and 38. Both code cases were approved for use in NRC RG 1.147, Revision 13. ASME Code Section XI, Code Case N-504-2 allows a repair to be performed by either removing the flaw or reducing it to an acceptable size. The weld overlay approach, by design, reduces the flaw to an acceptable size. The weld overlay assumes a flaw size through-wall for 360 degrees around the component. The weld overlay is designed to structurally replace the cross-section of the underlying component such that no structural credit is taken for the remaining ligaments of the component.

ASME Code Case N-504-2 is the basis for the design and implementation of the structural weld overlay repair method. ASME Code Case N-638 is used for the application of the temper bead technique for repair welding of dissimilar metals (DSMs) using the gas tungsten arc welding (GTAW) process. ASME Code Case N-638 provides the applicable procedure qualification requirements for welding with nickel-based alloys on a ferritic base metal, which in this case includes welding to both a P-No. 3 low-alloy carbon steel nozzle and a P-No. 43 nickel-chrome alloy pipe cap.

It was necessary to take exceptions to the specific alloys described in the ASME Code Case N-504-2 overlay repair method, which is based on the use of austenitic SS alloys only. These specific exceptions are described in PRR-36. Additionally, relief was requested, via PRR-38, to use an alternative program for implementation of ASME Code XI, Appendix VIII, Supplement 11, for ultrasonic examinations. The alternative program was implemented through the Performance Demonstration Initiative (PDI) program.

The CRD return line nozzle N-10 weld overlay repair will continue to be inspected under the PNPS Inservice Inspection Program as a category E weld in accordance with BWRVIP-75-A, “Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules” during PEO.

PNPS commits (Commitment No. 30) to perform a code repair of the CRD return-nozzle-to-cap weld as needed if the installed overlay weld repair is not approved via accepted code cases, revised codes, or subsequent approval of relief requests.

The N-10 nozzle weld overlay was inspected to the maximum extent physically possible based on the geometric limitations of the nozzle and examination equipment used. The examination volume is based on the component wall.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant’s technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant’s technical staff, the project team concluded that the applicant’s BWR CRD Return Line Nozzle Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.2.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the BWR Control Rod Drive Return Line Nozzle Program in PNPS, Appendix A, Section A.2.1.3, which states that the BWR Control Rod Drive Return Line Nozzle Program cut and capped the CRD return line nozzle to mitigate cracking and continues ISI examinations to monitor the effects of crack initiation and growth on the intended function of the CRD return line nozzle and cap. ISI examinations include ultrasonic inspection of the nozzle-to-vessel weld and ultrasonic inspection of the DSM weld overlay at the nozzle. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Section A.2.1.3, "BWR CRD Return Line Nozzle Program," is revised to add "License renewal commitment 30 specifies enhancement to this program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.3, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.2.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.3 BWR FEEDWATER NOZZLE PROGRAM (PNPS AMP B.1.4)

In PNPS LRA Appendix B, Section B.1.4, the applicant stated that PNPS AMP B.1.4, "BWR Feedwater Nozzle Program," is an existing plant program that is consistent with GALL AMP XI.M5, "BWR Feedwater Nozzle," with exceptions.

3.0.3.2.3.1 Program Description

The applicant stated in the PNPS LRA that under this program, PNPS has removed feedwater blend radii flaws, removed feedwater nozzle cladding, and installed a triple-sleeve-double-piston sparger to mitigate cracking. This program continues enhanced ISI of the feedwater nozzles in accordance with the requirements of ASME Code Section XI, Subsection IWB, and the recommendation of General Electric (GE) NE-523-A71-0594 to monitor the effects of cracking on the intended function of the feedwater nozzles.

3.0.3.2.3.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.4 is consistent with GALL AMP XI.M5, with exceptions.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.4, including AMPER, LRPD-02, Revision 1, Section B.1.4, "BWR Feedwater Nozzle Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M5. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.4 and associated bases documents to determine consistency with GALL AMP XI.M5. The project team also reviewed the documents listed in Attachment 5 to this audit and review report.

The project team reviewed those portions of the BWR Feedwater Nozzle Program for which the applicant claims consistency with GALL AMP XI.M5 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's BWR Feedwater Nozzle Program provides assurance that the effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's BWR Feedwater Nozzle Program acceptable because it conforms to the recommended GALL AMP XI.M5, "BWR Feedwater Nozzle," with the exceptions as described below.

3.0.3.2.3.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Elements: 2: Preventive Actions
Exception: A low-flow controller was not installed, and the reactor water cleanup system was not rerouted.

The GALL Report identified the following recommendations for the "preventive actions" program element associated with the exception taken:

> Mitigation occurs by systems modifications, such as removal of stainless steel cladding and installation of improved spargers. Mitigation is also accomplished by changes to plant-operating procedures, such as improved feedwater control and rerouting of the reactor water cleanup system, to decrease the magnitude and frequency of temperature fluctuations.

The applicant stated in the PNPS LRA that in its safety evaluation of BWR feedwater and CRD return line modifications at PNPS, the NRC noted that the intent of the requirements of NUREG-0619 and NEDE-21821-A had been satisfied with the PNPS modifications. Since the SS cladding has been removed and the improved spargers have been installed, an adequate margin of safety against feedwater nozzle crack growth exists. Therefore, the NRC concluded that, with continued inspections to monitor for crack initiation and growth, PNPS can operate without rerouting the RWCU and without installing a low-flow controller for the feedwater system. Since inspections to monitor for crack initiation and growth will continue, this conclusion remains valid for the PEO.

The project team reviewed the relevant documents and agreed that the previous staff conclusions remain valid for the PEO. On this basis, the project team found this exception acceptable.

Exception 2

Element: 3: Parameters Monitored/Inspected
Exception: The applicant reduced the examination volume next to the widest part of the feedwater nozzle-to-vessel welds from half the vessel wall thickness to ½ inch.

The GALL Report identified the following recommendations for the "parameters monitored/inspected" program element associated with the exception taken:

> The aging management program (AMP) monitors the effects of cracking on the intended function of the component by detection and sizing of cracks by ISI in accordance with ASME Section XI, Subsection IWB and the recommendation of GE NE-523-A71-0594.

The applicant stated in the PNPS LRA that extending the examination volume into the base metal as required by ASME Code Section XI, 1998 Edition, 2000 Addenda, Figure IWB-2500-7(b), prolongs the examination time significantly and results in no net increase in safety. The extra volume is base metal which is not prone to inservice cracking and has been extensively examined before the vessel was put into service and during the first, second, and third interval examinations.

The project team questioned the regulatory basis for reducing the examination volume. The applicant replied that the reduced volume inspected is in accordance with ASME Code Case –613-1, which has been endorsed by the NRC in RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1." The use of endorsed code cases is acceptable to the NRC staff. On this basis, the project team found this exception acceptable.

3.0.3.2.3.4 Enhancements

None.

3.0.3.2.3.5 Operating Experience

The applicant stated in the PNPS LRA that in October 1989, it was discovered that feedwater nozzles were not being examined with scans designed for the bore. Procedures were revised and subsequent examinations were performed in accordance with NUREG-0619. Since feedwater nozzle bores have subsequently been examined without recordable indications, and will continue to be examined as required, this programmatic error did not impact the ability of the BWR Feedwater Nozzle Program to manage the effect of cracking on the intended function of the feedwater nozzles.

UT of the feedwater nozzles during RFO 14 (April 2003) resulted in no recordable indications. Absence of recordable indications on the feedwater nozzles provides evidence that the program is effective for managing cracking of the nozzles.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's BWR Feedwater Nozzle Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.3.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the BWR Feedwater Nozzle Program in PNPS LRA Appendix A, Section A.2.1.4, which states that under the BWR Feedwater Nozzle Program, PNPS has removed feedwater blend radii flaws, removed feedwater nozzle cladding, and installed a triple-sleeve-double-piston sparger to mitigate cracking. This program continues enhanced ISI of the feedwater nozzles in accordance with the requirements of ASME Code Section XI, Subsection IWB, and the recommendation of GE NE-523-A71-0594 to monitor the effects of cracking on the intended function of the feedwater nozzles.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.4, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.3.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.4 BWR PENETRATIONS PROGRAM (PNPS AMP B.1.5)

In PNPS LRA Appendix B, Section B.1.5, the applicant stated that PNPS AMP B.1.5, "BWR Penetrations Program," is an existing plant program that is consistent with GALL AMP XI.M8, "BWR Penetrations," with exceptions.

3.0.3.2.4.1 Program Description

The applicant stated in the PNPS LRA that this program includes (a) inspection and flaw evaluation in conformance with the guidelines of staff-approved BWRVIP-27 and BWRVIP-49, and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 to ensure the long-term integrity of vessel penetrations and nozzles.

3.0.3.2.4.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.5, "BWR Penetrations Program," is consistent with GALL AMP XI.M8, with exceptions.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.5, including AMPER, LRPD-02, Revision 1, Section 4.4, "BWR Penetrations Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M8. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.5 and associated bases documents to determine consistency with GALL AMP XI.M8.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.4, "BWR Penetrations Program"; PNPS-RPT-05-001, Revision 0, "Fourth 10-Year ISI Program Plan" (ML051920157); BWRVIP-27, "BWR Standby Liquid Control System/Core Plate ΔP Inspection and Flaw Evaluation Guidelines," April 1997; and BWRVIP-49, "Instrument Penetration Inspection and Flaw Evaluation Guidelines," March 1998.

The project team also reviewed the applicant's reactor water chemistry program (PNPS AMP B.1.32.2, Water Chemistry Control - BWR), which is based on BWRVIP-130, against the recommendations in the GALL Report, Section XI.M2, "Water Chemistry," and found it to be acceptable. The project team's evaluation of PNPS AMP B.1.32.2, "Water Chemistry Control - BWR," is documented in Section 3.0.3.1.13 of this audit report.

The project team reviewed those portions of the BWR Penetrations Program for which the applicant claims consistency with GALL AMP XI.M8 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's BWR Penetrations Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's BWR Penetrations Program acceptable because it conforms to the recommended GALL AMP XI.M8, "BWR Penetrations," with the exceptions as described below.

3.0.3.2.4.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Elements: 1: Scope of Program
3: Parameters Monitored/Inspected
4: Detection of Aging Effects

Exception: Surface examinations are not performed on instrument penetration nozzle welds. In accordance with ASME Code Section XI, Code Case N-578 for elements classified as low risk, inspections to monitor the effects of cracking on the intended function of instrument penetration nozzles (N15A/B and N16A/B) include enhanced visual (VT-2 with insulation removed) examinations during system pressure testing. Also, a UT exam of the N16B safe end-to-reducer weld is performed once every 10 years. However, ASME Code Section XI, Table IWB-2500-1, and BWRVIP-49 (by reference) also recommend surface examinations.

The GALL Report identified the following recommendations for the "scope of program," "parameters monitored/inspected," and "detection of aging effects" program elements associated with the exception taken:

Scope of Program: The program is focused on managing the effects of cracking due to SCC or IGSCC. The program contains preventive measures to mitigate SCC or IGSCC, inservice inspection (ISI) to monitor the effects of cracking on the intended function of the components, and repair and/or replacement as needed to maintain the ability to perform the intended function.

The inspection and evaluation guidelines of BWRVIP-49 and BWRVIP-27 contain generic guidelines intended to present appropriate inspection recommendations to assure safety function integrity. The guidelines of BWRVIP-49 provide information on the type of instrument penetration, evaluate their susceptibility and consequences of failure, and define the inspection strategy to assure safe operation. The guidelines of BWRVIP-27 are applicable to plants in which the standby liquid control (SLC) system injects sodium pentaborate into the bottom head region of the vessel (in most plants, as a pipe within a pipe of the core plate ΔP monitoring system). The BWRVIP-27 guidelines address the region where the ΔP and SLC nozzle or housing penetrates the vessel bottom head and include the safe ends welded to the nozzle or housing. Guidelines for repair design criteria are provided in BWRVIP-57 for instrumentation penetrations, and BWRVIP-53 for SLC line.

Parameters Monitored/Inspected: The program monitors the effects of SCC/IGSCC on the intended function of the component by detection and sizing of cracks by ISI in accordance with the guidelines of approved BWRVIP-49 or BWRVIP-27 and the requirements of the ASME Code, Section XI, Table IWB 2500-1 (2001 edition including the 2002 and 2003 Addenda). An applicant may use the guidelines of BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry, provided that such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.

Detection of Aging Effects: The evaluation guidelines of BWRVIP-49 and BWRVIP-27 recommend that the inspection requirements currently in ASME Section XI continue to be followed. The extent and schedule of the inspection and test techniques prescribed by the ASME Section XI program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component. Inspection can reveal cracking and leakage of coolant. The NDE techniques appropriate for inspection of BWR vessel internals including the uncertainties inherent in delivering and executing NDE techniques in a BWR, are included in BWRVIP-03.

Instrument penetrations and SLC system nozzles or housings are inspected in accordance with the requirements of ASME Section XI, Subsection IWB. Components are examined and tested as specified in Table IWB-2500-1, examination categories B-E for pressure-retaining partial penetration welds in vessel penetrations, B-D for full penetration nozzle-to-vessel welds, B-F for pressure-retaining dissimilar metal nozzle-to-safe end welds, or B-J for similar metal nozzle-to-safe end welds. In addition, these components are part of examination category B-P for pressure-retaining boundary. Further details for examination are described in Chapter XI.M1, "ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD," of this report.

In an explanatory note in the PNPS LRA, the applicant stated that PNPS has implemented risk-informed ISI (RI-ISI) in accordance with ASME Code Section XI, Code Case N-578 and that the overall risk to the plant is reduced when RI-ISI is applied because the process concentrates on examining welds that have the greatest risk in terms of consequences of failure and potential degradation. The applicant's note stated that in addition, RI-ISI examinations are focused on those examination volumes where flaws are most likely to be located and that as such, RI-ISI does a better job in capturing risk than existing ASME Code Section XI requirements, which are based on design stresses and random selection. The applicant's note also stated that PNPS replaced the original IGSCC-susceptible 304 SS safe end extensions for the N15 and N16 nozzles with more IGSCC-resistant Inconel material.

During the audit and review, the project team asked the applicant to clarify which vessel penetration nozzles are included in the PNPS BWR Penetrations Program and whether these are the only RPV instrument penetrations at PNPS. In response to this request, the applicant stated that there are five RPV penetration nozzles in the program, instrument penetrations N15A/B and N16A/B, and SLC/core plate differential pressure instrument penetration N14. The applicant also stated that these are the only instrument partial-penetration weld nozzles at PNPS. The project team reviewed the PNPS piping and instrumentation drawings for nuclear boiler vessel instrumentation together with portions of BWRVIP-27 and BWRVIP-49, and based on that review, the project team confirmed that the five penetrations identified by the applicant are the only PNPS penetrations recommended by the GALL Report to be within the scope of the BWR Penetrations Program.

The project team noted that although RI-ISI has been approved for PNPS's fourth 10-year ISI interval, it has not been accepted as a basis for aging management during the period of extended operation. The project team asked the applicant to provide a more detailed discussion

and justification of why its BWR Penetrations Program, with the above-described exception, is adequate to manage the aging of the RPV instrument nozzles during the PEO. In response to this request, the applicant stated that for the instrument nozzles, the aging effect of cracking is managed by a combination of the BWR Water Chemistry Program and the BWR Penetrations Program. The applicant stated that the combination of mitigation and inspections provides adequate aging management for penetrations during the PEO for the following reasons:

> ASME Section XI, Subsection IWB-2500, without exclusions, requires a surface examination of these components. However, because the aging effect of interest originates on the inside diameter wall (exposed to treated water >140 deg-F), these surface examinations would only detect a flaw after the flaw propagated thru-wall. The surface examinations would not detect any flaws that are not thru-wall.
>
> The PNPS ISI program includes inspection of welds of the same material/environment combinations as the welds within the BWR Penetrations Program. These inspections will provide information on the aging of the subject components. If any indications are found on the similar component inspections (same material/environment combination), sample expansions will lead to more similar locations and, if appropriate, to the actual components in question. Inspection of representative sample locations is acceptable to confirm the aging of the components' material/environment combination.
>
> PNPS performs an enhanced VT-2 of these penetrations that is in excess of both code requirements and the recommendations of BWRVIP-27 and BWRVIP-49, which specify a VT-2 examination for these penetrations. The enhancement is that the insulation is removed from the penetrations so that the penetration and welds are viewed directly and specifically during the system leak test performed after each refueling outage, ensuring the detection of even very small amounts of leakage from these penetrations. PNPS will continue to follow BWRVIP-27 and BWRVIP-49 guidelines during the period of extended operation, including VT-2 examinations in excess of code requirements for the N15A/B, N16A/B and N14 penetrations. PNPS believes this is the most effective way to monitor the condition of these specific components. Given the code surface exams will only detect through wall failures from the ID, these enhanced VT-2 examinations will find the same thru-wall flaws that the surface exams would find.

The applicant's responses (1) confirm that all required penetrations are included within the scope of its BWR Penetrations Program; (2) state that aging management of penetrations is provided by the BWR Water Chemistry Program and the BWR Penetrations Program, plus examination of other components with the same material/environments by the Inservice Inspection Program; and (3) state that PNPS will continue to follow BWRVIP-27 and BWRVIP-49 guidelines during the PEO, including enhanced VT-2 examinations in excess of code requirements. The project team determined that the applicant's BWR Penetrations Program includes the appropriate components within its scope and that for these components the program provides both mitigation of aging effects and examinations to confirm the effectiveness

of the mitigation during the PEO. On this basis, the project team found this exception acceptable.

Exception 2

Element: 3: Parameters Monitored/Inspected
Exception: Table IWB-2500-1 from the 1998 Edition with 2000 Addenda of ASME Code Section XI is used, while the GALL Report specifies the 2001 Edition with 2002 and 2003 Addenda.

The GALL Report identified the following recommendation for the "parameters monitored/inspected" program element associated with the exception taken:

> The program monitors the effects of SCC/IGSCC on the intended function of the component by detection and sizing of cracks by ISI in accordance with the guidelines of approved BWRVIP-49 or BWRVIP-27 and the requirements of the ASME Code, Section XI, Table IWB 2500-1 (2001 edition including the 2002 and 2003 Addenda). An applicant may use the guidelines of BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry, provided that such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.

The applicant stated in the PNPS LRA that since ASME Code Section XI through the 2003 Addenda has been accepted by reference in 10 CFR 50.55a(b)(2), without modification or limitation on use of Table IWB-2500-1 from the 1998 Edition with 2000 Addenda for BWR components, use of this version is appropriate to assure that components crediting this program can perform their intended function consistent with the CLB during the PEO.

The project team noted that the ASME Section XI code edition and addenda identified in Exception 2 is the code of record for the applicant's ASME Section XI Fourth 10-Year Interval Inservice Inspection Program Plan, and that the applicant's fourth 10-year ISI interval extends approximately 3 years into the PEO. On the basis that Exception 2 is consistent with the applicant's current ASME Section XI code of record for ISI and that the ASME Section XI code edition and addenda referenced in the GALL Report was accepted without modification or limitation on use of Table IWB-2500-1 from the 1998 edition with 2000 addenda for BWR components, the project team found the applicant's use of the earlier code edition/addenda to be satisfactory and this exception to be acceptable.

3.0.3.2.4.4 Enhancements

None.

3.0.3.2.4.5 Operating Experience

The applicant stated in the PNPS LRA that in January 2005, three 2½-inch piping butt welds in the SLC system piping adjacent to nozzle N14 were found to be unidentified on inspection drawings and not included in ISI weld population totals. Two of the welds (RPV-N14-T1 and

RPV-N14-T2) are shop welds in a vendor-supplied tee. The third weld (RPV-14-2) is the connection field weld between the tee and the SLC nozzle (N14) safe end extension piece. This weld was included in surface examinations of the N14 nozzle safe end weld and safe end extension piece performed in RFO 11. Corrective actions included adding the welds to ISI weld population totals and performing a nozzle surface examination of weld RPV-N14-2 during RFO 15. Since RPV-N14-2 has been examined without recordable indications and will continue to be examined as required, this programmatic error did not impact the ability of the BWR Penetrations Program to manage the effect of cracking on the intended function of the SLC nozzle.

Inservice examination of the SLC nozzle (including weld RPV-N14-2 as discussed above) during RFO 15 (April 2005), resulted in no recordable indications. Absence of recordable indications on the SLC nozzle and adjacent welds provides evidence that the program is effective for managing cracking of the nozzle.

Liquid penetrant examination of instrument penetration nozzle N15A in 1990 resulted in no recordable indications. Absence of recordable indications on the instrument nozzles provides evidence that the program is effective for managing cracking of the instrument penetration nozzles.

Inservice examination of instrument penetration nozzles during RFO 15 (April 2005) resulted in no recordable indications. Absence of recordable indications on the instrument nozzles provides evidence that the program is effective for managing cracking of the nozzles.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the BWR Penetrations Program and did not find any evidence of PNPS equipment degradation or failures that are outside the envelope of industry experience.

On the basis of its review of operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's BWR Penetrations Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.4.6 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the BWR Penetrations Program in PNPS LRA Appendix A, Section A.2.1.5, which states that the BWR Penetrations Program includes (a) inspection and flaw evaluation in conformance with the guidelines of staff-approved BWRVIP-27 and BWRVIP-49, and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 to ensure the long-term integrity of vessel penetrations and nozzles.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.5, found that it was consistent with the GALL Report, and determined that it provides an adequate summary

description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.4.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.5 BWR STRESS CORROSION CRACKING PROGRAM (PNPS AMP B.1.6)

In PNPS LRA Appendix B, Section B.1.6, the applicant stated that PNPS AMP B.1.6, "BWR Stress Corrosion Cracking Program," is an existing plant program that is consistent with GALL AMP XI.M7, "BWR Stress Corrosion Cracking," with an exception and an enhancement.

3.0.3.2.5.1 Program Description

The applicant stated in the PNPS LRA that this program includes (a) preventive measures to mitigate IGSCC, and (b) inspection and flaw evaluation to monitor IGSCC and its effects on RCPB components made of SS or CASS.

3.0.3.2.5.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.6 is consistent with GALL AMP XI.M7, with an exception and an enhancement.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.6, including AMPER, LRPD-02, Revision 1, Section 4.5, "BWR Stress Corrosion Cracking Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M7. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.6 and associated bases documents to determine consistency with GALL AMP XI.M7.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.5, "BWR Stress Corrosion Cracking Program"; NRC GL 88-01, "NRC Position on IGSCC in BWR Austinetic Stainless Steel Piping"; NRC GL 88-01, Supplement 1; and ASME Code Section XI, 1998 Edition with 2000 Addenda, Subsection IWB-3600, "Analytical Evaluation of Flaws."

The project team reviewed those portions of the BWR Stress Corrosion Cracking Program for which the applicant claims consistency with GALL AMP XI.M7 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's BWR

Stress Corrosion Cracking Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's BWR Stress Corrosion Cracking Program acceptable because it conforms to the recommended GALL AMP XI.M7, "BWR Stress Corrosion Cracking," with the exception and enhancement as described below.

3.0.3.2.5.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Element: 6: Acceptance Criteria
Exception: The 1998 Edition with 2000 Addenda of ASME Code Section XI, Subsection IWB-3600, is used for flaw evaluation, while the GALL Report specifies the 1986 Edition of ASME Code Section XI, Subsection IWB-3600, for flaw evaluation.

The GALL Report identified the following recommendation for the "acceptance criteria" program element associated with the exception taken:

> As recommended in NRC GL 88-01, any indication detected is evaluated in accordance with ASME Section XI, IWB-3600 of Section XI of the 1986 Edition of the ASME Boiler and Pressure Vessel Code and the guidelines of NUREG-0313.
>
> Applicable and approved BWRVIP-14, BWRVIP-59, BWRVIP-60, and BWRVIP-62 documents provide guidelines for evaluation of crack growth in SSs, nickel alloys, and low-alloy steels. An applicant may use BWRVIP-61 guidelines for BWR vessel and internals induction heating stress improvement effectiveness on crack growth in operating plants.

The applicant stated in the PNPS LRA that since ASME Code Section XI through the 2003 Addenda has been accepted by NRC in 10 CFR 50.55a(b)(2) without modification or limitation on use of Subsection IWB-3600 from the 1998 Edition with 2000 Addenda, use of this version for flaw evaluation is appropriate to assure that components crediting this program can perform their intended function consistent with the CLB during the PEO.

During the audit and review, the project team asked the applicant to identify which specific paragraphs of Subsection IWB-3600, "Analytical Evaluation of Flaws," differ between the 1986 Edition of ASME Code Section XI identified in the GALL Report and the 1998 Edition with 2000 Addenda of ASME Code Section XI used by the applicant's program. In response to this request, the applicant provided a comparison table listing the differences in Subsection IWB-3600 between the requested editions of ASME Code Section XI. The project team reviewed the applicant's response together with NRC GL 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," issued January 25, 1988; and NRC GL 88-01, Supplement 1, issued February 4, 1992. On the basis of this review, the project team determined that the reference to the 1986 Code Edition in NRC GL 88-01 is a reference to the approved ASME Code Section XI edition at the time that NRC GL 88-01 was issued and that neither the original GL nor its later

supplement include a requirement that analytical evaluation of flaws be performed in accordance with only the 1986 Code Edition, and not a later edition that has been accepted by the NRC. Because ASME Code Section XI, 1998 Edition with 2000 Addenda, has been accepted by the NRC without modification or limitation on use of Subsection IWB-3600, the project team determined that the applicant's use of Subsection IWB-3600 of ASME Code Section XI, 1998 Edition with 2000 Addenda, for analytical evaluation of flaws is acceptable. On this basis, the project team found this exception acceptable.

3.0.3.2.5.4 Enhancements

The applicant stated in the PNPS LRA that the enhancement in meeting the GALL Report program element is as follows:

Element:	5: Monitoring and Trending
Enhancement:	The implementing procedure for ASME Code Section XI ISI and testing will be enhanced to specify that the guidelines of NRC GL 88-01 or approved BWRVIP-75 shall be considered in determining sample expansion if indications are found in NRC GL 88-01 welds.

The GALL Report identified the following recommendation for the "monitoring and trending" program element associated with the enhancement:

> The extent and schedule for inspection, in accordance with the recommendations of NRC GL 88-01 or approved BWRVIP-75 guidelines, provide timely detection of cracks and leakage of coolant. Based on inspection results, NRC GL 88-01 or approved BWRVIP-75 guidelines provide guidelines for additional samples of welds to be inspected when one or more cracked welds are found in a weld category.

The applicant stated in the PNPS LRA that this enhancement will be initiated before the PEO.

During the audit and review, the project team observed that the LRA describes this and other enhancements as "initiated" before the PEO. The project team noted that in describing an enhancement as something to be "initiated" rather than "implemented," the LRA wording is ambiguous as to whether the enhancement will be fully implemented before the PEO. The project team asked the applicant to clarify or resolve the ambiguity in the LRA's descriptions of enhancements. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the intent of stating that enhancements will be initiated before the PEO is that the enhancements will be fully implemented before the PEO. Since this response provided the clarification requested, the project team found it to be acceptable.

During the audit and review, the project team asked the applicant to clarify PNPS's current basis for determining sample expansion if indications are found in NRC GL 88-01 welds. In response to this request, the applicant provided the following information:

> If cracking is determined in NRC GL 88-01 Category A welds, the scope expansion rules of the PNPS Risk-Informed Inservice Inspection Program in

> accordance with EPRI Topical Report TR-112657 will be used to determine scope expansion size and content. Scope expansion caused by cracking detected in any other GL 88-01 category (B through G) will be determined by the scope expansion criteria of BWRVIP-75A used in conjunction with NRC GL 88-01.

Since the applicant uses appropriate bases for determining sample expansion if indications are found in NRC GL 88-01 welds, the project team found the applicant's response to be acceptable.

The project team reviewed the applicant's evaluation of the "monitoring and trending" element of its current BWR Stress Corrosion Cracking Program, documented in the PNPS AMPER, which stated that the applicable section of its implementing procedure for ASME Code ISI and inservice testing will be enhanced to specify that the guidelines in NRC GL 88-01 or approved BWRVIP-75 shall be considered in determining sample expansions if indications are found in NRC GL 88-01 welds. The project team reviewed the applicable implementing procedure section and found that the current procedure states that PNPS design engineering is to determine sample expansion if ASME Code Section XI does not specify the expansion sample; the current procedure does not provide a specific reference to NRC GL 88-01 or BWRVIP-75 requirements. On the basis that the GALL Report states that NRC GL 88-01 or approved BWRVIP-75 guidelines provide guidelines for additional samples of welds to be inspected when one or more cracked welds are found in a weld category, the project team determined that the applicant's enhancement to add references to NRC GL 88-01 and BWRVIP-75 into the implementing procedure is needed to bring the current program into conformance with the GALL Report recommendations and is acceptable.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.6, "BWR Stress Corrosion Cracking Program," will be consistent with GALL AMP XI.M7 and the effects of aging will be adequately managed.

3.0.3.2.5.5 <u>Operating Experience</u>

The applicant stated in the PNPS LRA that ultrasonic examinations of NRC GL 88-01 nozzle safe end welds and austenitic SS reactor coolant piping with 4-inch and greater nominal diameter and operating temperature greater than 200° Fahrenheit (F) during RFO 14 (April 2003) resulted in no recordable indications. Absence of recordable indications on the nozzles and piping provides evidence that the program is effective for managing cracking of austenitic SS components.

Ultrasonic examinations of nozzle safe end welds and austenitic SS reactor coolant piping with 4-inch and greater nominal diameter and operating temperature greater than 200°F during RFO 15 (April 2005) resulted in no recordable indications. Absence of recordable indications on the nozzles and piping provides evidence that the program is effective for managing cracking of the nozzles and piping.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project

Operating Experience Review Report for the BWR Stress Corrosion Cracking Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's BWR Stress Corrosion Cracking Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.5.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the BWR Stress Corrosion Cracking Program PNPS LRA Appendix A, Section A.2.1.6, which states that the BWR Stress Corrosion Cracking Program includes (1) preventive measures to mitigate IGSCC, and (2) inspection and flaw evaluation to monitor IGSCC and its effects on RCPB components made of SS or CASS.

PNPS has acted to prevent IGSCC and will continue to use materials resistant to IGSCC for component replacements and repairs following the recommendations delineated in NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping"; NRC GL 88-01; and the staff-approved BWRVIP-75 report. Inspection of piping identified in NRC GL 88-01 to detect and size cracks is performed in accordance with the staff positions on schedule, method, personnel qualification, and sample expansion included in the GL and the staff-approved BWRVIP-75 report.

During the audit and review, the project team noted that the applicant's description of the BWR Stress Corrosion Cracking Program in the UFSAR Supplement in LRA Appendix A, did not include, as a commitment, the enhancement described in LRA Appendix B.1.6, "BWR Stress Corrosion Cracking." The project team asked the applicant to include a description of the enhancement to PNPS's BWR Stress Corrosion Cracking Program in the UFSAR Supplement in LRA Appendix A. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number associated with the enhancement for the BWR Stress Corrosion Cracking Program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Section A.2.1.6, "BWR Stress Corrosion Cracking Program," is revised to add "License renewal commitment 2 specifies enhancement to this program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.6, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.5.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to

manage the aging effects for which it is credited. Also, the project team has reviewed the enhancement and determined that the implementation of the enhancement before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained for the PEO, as required by 10 CFR 54.21(a)(3). The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.6 BWR VESSEL ID ATTACHMENT WELDS PROGRAM (PNPS AMP B.1.7)

In PNPS LRA Appendix B, Section B.1.7, the applicant stated that PNPS AMP B.1.7, "BWR Vessel ID Attachment Welds Program," is an existing plant program that is consistent with GALL AMP XI.M4, "BWR Vessel ID Attachment Welds," with an exception.

3.0.3.2.6.1 Program Description

The applicant stated in the PNPS LRA that this program includes (a) inspection and flaw evaluation in accordance with the guidelines of staff-approved BWRVIP-48, and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 (EPRI Report 1008192) to ensure the long-term integrity and safe operation of RV inside diameter (ID) attachment welds and support pads.

3.0.3.2.6.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.7 is consistent with GALL AMP XI.M4, with an exception.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.7, including AMPER, LRPD-02, Revision 1, Section 4.4, "BWR Vessel ID Attachment Welds Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M4. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.7 and associated bases documents to determine consistency with GALL AMP XI.M4.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.6, "BWR Vessel ID Attachment Welds Program"; PNPS-RPT-05-001, Revision 0, "Fourth 10-Year ISI Program Plan" (ML051920157); and BWRVIP-48, "Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines," February 1998.

The project team reviewed those portions of the BWR Vessel ID Attachment Welds Program for which the applicant claims consistency with GALL AMP XI.M4 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's BWR Vessel ID Attachment Welds Program provides assurance that effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with

the CLB for the PEO. The project team found the applicant's BWR Vessel ID Attachment Welds Program acceptable because it conforms to the recommended GALL AMP XI.M4, "BWR Vessel ID Attachment Welds," with the exception as described below.

3.0.3.2.6.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Exception

Element: 3: Parameters Monitored/Inspected
Exception: Table IWB-2500-1 from the 1998 Edition with 2000 Addenda of ASME Code Section XI is used, while the GALL Report specifies the 2001 Edition with 2002 and 2003 Addenda.

The GALL Report identified the following recommendation for the "parameters monitored/inspected" program element associated with the exception taken:

> The program monitors the effects of SCC and IGSCC on the intended function of vessel attachment welds by detection and sizing of cracks by ISI in accordance with the guidelines of approved BWRVIP-48 and the requirements of the ASME Code, Section XI, Table IWB 2500-1 (2001 edition P-62 for inspection relief for vessel internal components with hydrogen water chemistry provided that such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.

The applicant stated in the PNPS LRA that since ASME Code Section XI through the 2003 Addenda has been accepted by reference in 10 CFR 50.55a(b)(2) without modification or limitation on use of Table IWB-2500-1 from the 1998 Edition with 2000 Addenda for BWR components, this version is appropriate to assure that components crediting this program can perform their intended function consistent with the CLB during the PEO.

During the audit and review, the project team asked the applicant to confirm that PNPS performs the more stringent inspections of applicable vessel ID attachment welds as recommended in BWRVIP-48 and described in the GALL Report, Section XI.M4, "BWR Vessel ID Attachment Welds Program," "detection of aging effects" program element. The project team also asked the applicant to provide a list of the Category B-N-2 vessel ID attachment welds that are inspected using the more stringent enhanced VT-1 examination techniques. In response to these requests, the applicant provided the following information:

> PNPS follows the requirement of BWRVIP-48 as approved by the NRC for inspections. The components that are inspected using the enhanced VT-1 techniques recommended in BWRVIP-48 are (1) jet pump riser brace – primary brace attachments, (2) core spray piping – primary bracket attachments, (3) steam dryer support brackets, and (4) feedwater bracket attachments.

The project team reviewed the applicant's response together with the inspection recommendations in BWRVIP-48. Based on this review, the project team determined that the attachment welds listed by the applicant as subject to the enhanced VT-1 examination technique are the same welds for which the modified ("enhanced") VT-1 examination technique is recommended in BWRVIP-48, Table 3-2, "Bracket Attachment Inspection Recommendations." Based on consistency between the components listed in the applicant's response and the components listed in BWRVIP-48, the project team found the applicant's response acceptable.

During the audit and review, the project team asked the applicant to confirm that the PNPS BWR Vessel ID Attachment Welds Program implements the evaluation guidelines of BWRVIP-14, BWRVIP-59, and BWRVIP-60, which are listed in the GALL Report's description of the "acceptance criteria" program element for the BWR Vessel ID Attachment Welds Program. In response to this request, the applicant provided the following statement:

> PNPS plant procedures require that flaws be evaluated in accordance with BWRVIP Inspection and Flaw Evaluation Guidelines for components that perform a safety function. Subsequent BWRVIP correspondence that has been approved by the BWRVIP Executive Committee must also be considered when evaluating flaws. For components that do not perform a safety function, flaw evaluation shall be established by Design Engineering using the Condition Report process. Any flaw evaluation done by PNPS would consider all pertinent information available at that time, including the three BWRVIP documents listed in the GALL Report, Section XI.M4.

Because the PNPS flaw evaluation process includes the BWRVIP evaluation guidelines recommended in the GALL Report, the project team found the applicant's response acceptable.

The project team reviewed the applicant's responses together with the applicant's fourth 10-year ISI program plan (ADAMS Accession Number ML051920157) and confirmed that the applicant's use of ASME Code Section XI, 1998 Edition with 2000 Addenda, as the basis for its BWR Vessel ID Attachment Welds Program is consistent with the applicant's fourth 10-year inspection program plan. The project team also determined on the basis of the applicant's responses that the PNPS BWR Vessel ID Attachment Welds Program is consistent with recommendations of the GALL Report and the BWRVIP reports referenced therein for other program elements. On this basis, the project team found this exception acceptable.

3.0.3.2.6.4 Enhancements

None.

3.0.3.2.6.5 Operating Experience

The applicant stated in the PNPS LRA that visual and enhanced visual examinations of vessel attachment welds (feedwater bracket attachment and jet pump riser braces) during RFO 14 (April 2003) resulted in no recordable indications. Previous visual and enhanced visual examinations of vessel attachment welds resulted in no recordable indications. Absence of

recordable indications on the vessel attachment welds provides evidence that the program is effective for managing cracking of the welds.

Visual and enhanced visual examinations of vessel attachment welds (core spray piping bracket, guide rod bracket attachment, steam dryer support brackets, steam dryer hold-down brackets, and surveillance specimen holder brackets) during RFO 15 (April 2005) resulted in no recordable indications. Absence of recordable indications on the vessel attachment welds provides evidence that the program is effective for managing cracking of the welds.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the BWR Vessel ID Attachment Welds Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's BWR Vessel ID Attachment Welds Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.6.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the BWR Vessel ID Attachment Welds Program in PNPS LRA Appendix A, Section A.2.1.7, which states that the BWR Vessel ID Attachment Welds Program includes (1) inspection and flaw evaluation in accordance with the guidelines of staff-approved BWRVIP-48, and (2) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 to ensure the long-term integrity and safe operation of RV ID attachment welds and support pads.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.7, found that it is consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.6.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.7 BWR VESSEL INTERNALS PROGRAM (PNPS AMP B.1.8)

In PNPS LRA Appendix B, Section B.1.8, the applicant stated that PNPS AMP B.1.8, "BWR Vessels Internals Program," is an existing plant program that is consistent with GALL AMP XI.M9, "BWR Vessels Internals," with exceptions and an enhancement.

3.0.3.2.7.1 Program Description

The applicant stated in the PNPS LRA that this program includes (a) inspection, flaw evaluation, and repair in conformance with the applicable staff-approved reactor vessel BWRVIP documents, and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 to ensure the long-term integrity of vessel internals components.

3.0.3.2.7.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.8 is consistent with GALL AMP XI.M9, with exceptions and an enhancement.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.8, including AMPER, LRPD-02, Revision 1, Section 4.7, "BWR Vessel Internals Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M9. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.8 and associated bases documents to determine consistency with GALL AMP XI.M9.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.7, "BWR Vessel Internals Program"; BWRVIP-42, "BWR LPCI Coupling Flaw Inspection and Flaw Evaluation Guidelines," December 1997; BWRVIP-26, "BWR Top Guide Inspection and Flaw Evaluation Guidelines," December 1996; PNPS Calculation Number M-1017, Revision 0, "Top Guide Weld and Hold Down Assembly Inspection Evaluation"; PNPS-NE21.01, Revision 5, "Reactor Vessel Internals Inspection Implementing Procedure"; PNPS-EP-06-0001, Revision 0, Entergy Nuclear Engineering Report, "Reactor Vessel Internals Inspection Program"; BWRVIP-18, "BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines," July 1996; BWRVIP-41, "BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines," October 1997; PNPS-RPT-05-001, Revision 0, "Fourth 10-Year ISI Program Plan" (ADAMS Accession Number ML051920157); PNPS UFSAR Section 3.3.4.1.1, "Core Shroud"; BWRVIP-25, "BWR Core Plate Inspection and Flaw Evaluation Guidelines," December 1996; and BWRVIP-139, Steam Dryer Inspection and Flaw Evaluation Guidelines, April 2005.

The project team reviewed those portions of the BWR Vessel Internals Program for which the applicant claims consistency with GALL AMP XI.M9 and found that they are consistent with the GALL Report AMP. The project team also reviewed the applicant's response to BWRVIP applicant action items as documented in Appendix C of the PNPS LRA. The project team noted that the applicant's response to BWRVIP action items as described in PNPS LRA, Appendix C, is consistent with the actions required by the respective BWRVIP safety evaluations. On the

basis that the applicant's responses are consistent with the required actions, the project team determined that PNPS's responses to BWRVIP applicant action items are acceptable.

The project team noted that in addition to the components listed in GALL AMP XI.M9, PNPS has included the steam dryer as a component within its BWRVIP. In PNPS LRA Section 3.1.2.2.11, the applicant states that cracking due to flow-induced vibration in the SS steam dryers is managed by the BWRIP and that the BWRVIP incorporates the guidelines of GE-SIL-644, Revision 1. The PNPS LRA further states that PNPS will evaluate BWRVIP-139 upon approval by the NRC staff and either include its recommendations in the PNPS BWRVIP or inform the staff of PNPS's exceptions to that document.

The project team concluded that the applicant's BWR Vessel Internals Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's BWR Vessel Internals Program acceptable because it conforms to the recommended GALL AMP XI.M9, "BWR Vessel Internals," with the exceptions and enhancement as described below.

3.0.3.2.7.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Elements: 1: Scope of Program
4: Detection of Aging Effects
Exception: Low Pressure Coolant Injection (LPCI) Coupling**:** BWRVIP-42 guidelines are not applicable to PNPS.

The GALL Report identified the following recommendations for the "scope of program" and "detection of aging effects" program elements associated with the exception taken:

> **Scope of Program:** The program is focused on managing the effects of cracking due to SCC, IGSCC, or irradiation-assisted stress corrosion cracking (IASCC). The program contains preventive measures to mitigate SCC, IGSCC, or IASCC; inservice inspection (ISI) to monitor the effects of cracking on the intended function of the components; and repair and/or replacement as needed to maintain the ability to perform the intended function of BWR vessel internals.
>
> The BWRVIP documents provide generic guidelines intended to present the applicable inspection recommendations to assure safety function integrity of the subject safety-related reactor pressure vessel internal components. The guidelines include information on component description and function; evaluate susceptible locations and safety consequences of failure; provide recommendations for methods, extent, and frequency of inspection; discuss acceptable methods for evaluating the structural integrity significance of flaws

detected during these examinations; and recommend repair and replacement procedures.

The applicable BWRVIP guidelines are as follows:

Low-pressure coolant injection (LPCI) coupling: BWRVIP-42 provides guidelines for inspection and evaluation; BWRVIP-56 provides guidelines for repair design criteria.

Detection of Aging Effects: The extent and schedule of the inspection and test techniques prescribed by the applicable and approved BWRVIP guidelines are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of BWR vessel internals. Inspection can reveal cracking. Vessel internal components are inspected in accordance with the requirements of ASME Section XI, Subsection IWB, examination category B-N-2. The ASME Section XI inspection specifies visual VT-1 examination to detect discontinuities and imperfections, such as cracks, corrosion, wear, or erosion, on the surfaces of components. This inspection also specifies visual VT-3 examination to determine the general mechanical and structural condition of the component supports by (a) verifying parameters, such as clearances, settings, and physical displacements, and (b) detecting discontinuities and imperfections, such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion.

The applicable and approved BWRVIP guidelines recommend more stringent inspections, such as enhanced visual VT-1 examinations or ultrasonic methods of volumetric inspection, for certain selected components and locations. The nondestructive examination (NDE) techniques appropriate for inspection of BWR vessel internals including the uncertainties inherent in delivering and executing NDE techniques in a BWR, are included in BWRVIP-03.

The applicant stated in the PNPS LRA that Exception 1, affecting inspection of the LPCI coupling, is acceptable because BWRVIP-42 provides guidelines for inspection and evaluation of the LPCI coupling and PNPS has no LPCI coupling.

During the audit and review, the project team reviewed BWRVIP-42 together with applicable PNPS reactor vessel design drawings. On the basis of this review, the project team determined that the LPCI coupling is a feature of newer BWR/4, BWR/5, and BWR/6 plants; and that PNPS is an earlier BWR/3 plant which does not have a LPCI coupling. On the basis that PNPS does not have a LPCI coupling, the project team found Exception 1 to the BWR Vessel Internals Program as described in the GALL Report to be acceptable.

Exception 2

Elements: 1: Scope of Program
4: Detection of Aging Effects

Exception: **Top Guide:** Inspections of the four top guide hold-down assemblies and four guide aligner assemblies is not performed at PNPS. The top guide rim weld does not exist at PNPS and is therefore exempt.

The GALL Report identified the following recommendations for the "scope of program" and "detection of aging effects" program elements associated with the exception taken:

> **Scope of Program:** *Top guide:* BWRVIP-26 provides guidelines for inspection and evaluation; BWRVIP-50 provides guidelines for repair design criteria. Additionally, for top guides with neutron fluence exceeding the IASCC threshold (5E20, E>IMeV) prior to the period of extended operation, inspect five percent (5%) of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation.
>
> An additional 5 percent of the top guide locations will be inspected within 12 years after entering the period of extended operation. Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5 percent of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5 percent of the top guide locations will be inspected within 12 years after the date projected for exceeding the threshold. The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold. The extent of the examination and its frequency will be based on a 10-percent sample of the total population, which includes all grid beam and beam-to-beam crevice slots.

The applicant stated in the PNPS LRA that Exception 2, affecting inspection of the top guide, is acceptable because PNPS has a plant-specific analysis to account for plant-specific dynamic loading of the top guide hold-down and aligner assemblies, which concludes that less than 20 percent of the weld area on the top guide hold-down and aligner assemblies is needed to resist load; and therefore, in accordance with Table 3-2 of BWRVIP-26, inspection of the four top guide hold-down assemblies and four top guide aligner assemblies is not performed at PNPS.

During the audit and review, the project team asked the applicant to provide a technical basis to support the LRA's statement that inspection of the four top guide hold-down assemblies and four top guide aligners is not required if 20 percent or less of the weld area is sufficient to resist loads from the top guide during faulted events. In response to this request, the applicant referred to BWRVIP-26, Table 3-2, "Matrix of Inspection Options," examination locations (2, 3) aligner pins and sockets in the top guide and shroud, and examination location (8) hold-down assemblies. The applicant noted that, with regard to inspection of the aligner pins and sockets, BWRVIP-26 states that if an analysis of plant-specific dynamic loading has determined that less than 20 percent of the weld is required, no inspection is needed. The applicant noted that, with regard to inspection of the hold-down assemblies, BWRVIP-26 recommends a VT-1 inspection only for

plants whose faulted vertical loads exceed the top guide weight. The applicant provided a copy of the plant-specific evaluation that shows less than 20 percent of the weld area is sufficient to resist loads from the top guide during faulted events. In addition, the applicant stated that BWRVIP-26, Figure A-1, "Evaluation of Need for Hold Down Devices," includes a data point for the PNPS top guide, and the plant-specific data show that vertical loads during a faulted event do not exceed the weight of the PNPS top guide. The project team reviewed applicable sections of BWRVIP-26 and the plant-specific evaluations. The project team noted that BWRVIP-26 itself provides the criteria on which the applicant based its determination that inspection of the top guide hold-down assemblies and top guide aligners is not required; and consequently, the applicant's decision not to inspect these components is not an exception to the recommendations of BWRVIP-26. Based on these reviews, the project team determined that PNPS has completed appropriate plant-specific evaluations consistent with the BWRVIP-26 recommendations so that inspections of the PNPS top guide hold-down assemblies and top guide aligners are not required. On this basis, the project team found the applicant's response to be acceptable.

During the audit and review, the project team asked the applicant to further discuss the LRA's statement that the top guide rim weld does not exist at PNPS. Specifically, the project team asked the applicant to clarify whether the top guide rim weld does not exist at PNPS or whether the top guide rim weld is assumed to be fully cracked. Furthermore, if the rim weld has never existed at PNPS, the project team asked the applicant to discuss how the bottom plate of the top guide is attached to the rim of the top guide. In response to this request the applicant stated that the rim of the top guide and the bottom plate of the top guide were fabricated as one machined piece; so they are one integral piece without an attachment weld. The applicant also provided a fabrication drawing for the top guide that included a detail showing that the rim and the bottom plate of the top guide are one integral piece.

On the basis that the additional information provided by the applicant confirmed that there is no attachment weld between the top guide's rim and bottom plate at PNPS, the project team found the applicant's response to be acceptable.

Based on the project team's questions and the acceptability of the applicant's responses as described above, the project team found Exception 2 to the BWR Vessel Internals Program as described in the GALL Report to be acceptable.

<u>Exception 3</u>

Elements:	1: Scope of Program 4: Detection of Aging Effects
Exception:	**Core Spray:** PNPS defers inspection of three inaccessible welds inside each of the two core spray nozzles until a delivery system for UT of the hidden welds is developed. Thus, PNPS does not meet the BWRVIP-18 requirement to perform an ultrasonic inspection of a full target weld set every other RFO.

The GALL Report identified the following recommendations for the "scope of program" and "detection of aging effects" program elements associated with the exceptions taken:

> **Scope of Program:** *Core spray*: BWRVIP-18 provides guidelines for inspection and evaluation; BWRVIP-16 and 19 provide guidelines for replacement and repair design criteria, respectively.

The applicant stated in the PNPS LRA that Exception 3, affecting the recommended inspection for three inaccessible welds inside each core spray nozzle, is acceptable because inspection of similar creviced and uncreviced welds (including junction box-to-pipe welds, upper elbow welds, junction box cover plate weld, P1 weld, and down comer sleeve welds) showed no indication of cracking. The applicant stated that, therefore, deferral of inspection of the inaccessible welds is justified.

During the audit and review, the project team reviewed the PNPS BWRVIPs inspection and implementing procedure and the technical justification for inspection deferral of core spray hidden welds contained therein. The PNPS technical justification states that there are three hidden welds inside each of the two core spray nozzle thermal sleeves, the hidden welds are not accessible for visual examination, and currently no inspection technique has been developed to inspect the thermal sleeve welds either with some degree of component disassembly or through development of specialized tooling. The technical justification further states that, according to BWRVIP-18, a qualitative assessment of thermal sleeve integrity can be based on a plant-specific evaluation of similar core spray piping welds (evaluation welds); the technical justification further states that none of the evaluation welds at PNPS (28 welds in all) show any indications of cracking. The technical justification also states that, according to BWRVIP-18, if a thermal sleeve weld were to crack to the point of separation, the thermal sleeve and attached core piping might undergo some displacement. However, the brackets holding the piping and/or the tight clearance between the thermal sleeve and nozzle wall would prevent gross separation and, in such an extreme scenario, core spray would still be provided but with some leakage.

During the audit and review, the project team also reviewed the PNPS BWR Reactor Vessel Internals Program's inspection program document and determined that the program includes a requirement that when tooling becomes available, the core spray hidden welds shall be inspected per the requirements of BWRVIP-18. The project team asked the applicant to provide a status summary of current industry activities to develop a delivery system for UT of the hidden welds in PNPS's core spray system. In response to this request, the applicant provided the following information:

> The BWRVIP/EPRI NDE Center recently acquired blade probes to demonstrate UT capability. Plans for 2007 are to develop a white paper to document the inspection capability to examine the hidden thermal sleeve welds. This project excludes tooling development as it is left to inspection vendors.

In addition, in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided License Renewal Commitment No. 33 to perform inspection of the inaccessible core spray thermal sleeve welds if and when the necessary technique and equipment become available and the technique is demonstrated by the vendor, including delivery system.

Based on review of the applicant's technical justification for deferring inspection of the hidden core spray thermal sleeve welds and on the applicant's response, the project team determined that (1) currently there is no qualified tooling that would support inspection of the hidden core spray thermal sleeve welds; (2) PNPS currently examines other welds in the RV that have the same material and environment conditions as the hidden welds; (3) the industry, through BWRVIP/EPRI, is planning to develop a white paper to document capability to examine the hidden welds; and (4) PNPS's BWR Vessel Internals Program guidance document and its License Renewal Commitment No. 33 include a requirement to inspect the hidden welds when appropriate tooling is developed. Based on these determinations, the project team found Exception 3 to the BWR Vessel Internals Program as described in the GALL Report to be acceptable.

<u>Exception 4</u>

Elements: 1: Scope of Program
4: Detection of Aging Effects

Exception: **Jet Pump Assembly:** PNPS defers inspection of jet pump inaccessible welds until a delivery system for UT of the hidden welds is developed. Thus, PNPS does not meet the BWRVIP-41 requirement to perform a modified VT-1 of 100 percent of these welds over two 6-year inspection cycles and 25 percent per inspection cycle thereafter.

The GALL Report identified the following recommendations for the "scope of program" and "detection of aging effects" program elements associated with the exceptions taken:

> **Scope of Program:** *Jet pump assembly:* BWRVIP-41 provides guidelines for inspection and evaluation; BWRVIP-51 provides guidelines for repair design criteria.

The applicant stated in the PNPS LRA that Exception 4, affecting the recommended inspection of jet pump assembly inaccessible welds, is acceptable because the hidden jet pump welds are far enough into the nozzle that failure at these welds would not result in the thermal sleeve disengaging from the nozzle before the riser contacted the shroud. Further, if the jet pump thermal sleeve was severed, the riser brace would maintain the geometry of the jet pump well past the time that leakage would be detected through operational parameters and the plant could be safely shut down. The applicant further stated that, in addition, PNPS instituted HWC in 1991 to mitigate cracking in the reactor internals and to address crack growth in the jet pump thermal sleeve welds in particular. Therefore, deferral of inspection of the inaccessible welds is justified.

During the audit and review, the project team reviewed the PNPS BWR Reactor Vessel Internals Program's inspection and implementing procedure and the technical justification for inspection deferral of jet pump hidden welds contained therein. The applicant's technical justification states that there are two hidden welds (TS-3 and TS-4) inside each of the jet pump recirculation inlet nozzles, and these are described as circumferential welds that attach the thermal sleeve in a trombone arrangement inside each of the 10 jet pump recirculation inlet nozzles. The project team reviewed BWRVIP-41, Figure 2.3.3-1, "Configurations for Thermal Sleeves," and

determined that the TS-4 weld attaches the outer thermal sleeve to the vessel nozzle wall and the TS-3 weld attaches the inner thermal sleeve to the outer thermal sleeve. The applicant's technical justification further states that the hidden welds are not accessible for visual examination and that there is currently no inspection technique developed to inspect the thermal sleeve welds either with some degree of component disassembly or through development of specialized tooling. The applicant's technical justification states that there are three accessible welds in each of the 10 jet pump risers (RS-1, RS-2, and RS-3) that are made of similar material, in a similar environment, and subject to similar operational loading. These riser welds can be considered to be similar indicator welds for the hidden thermal sleeve welds. The technical justification notes that no cracking was found in the hidden thermal sleeve welds when they were accessible during the recirculation piping replacement performed at RFO 6 (1984). The justification states that PNPS has inspected the similar riser sleeve welds, as recommended by BWRVIP-41, during recent RFOs and will continue to do so during the PEO. It also states that all of the similar riser sleeve welds have been found to be free of cracks. The justification states that technical specifications contain jet pump operability criteria for monitoring jet pump integrity and that even if the jet pump thermal sleeve was severed, the riser brace would maintain the geometry of the jet pump well past the time when failure of the weld would be detected through operational parameters. This would ensure that the plant could be safely shut down.

During the audit and review, the project team also reviewed the PNPS BWR Reactor Vessel Internals Program's inspection program document and determined that the program includes a requirement that when tooling becomes available, the hidden welds in the jet pump thermal sleeves shall be inspected per the requirements of BWRVIP-41. The project team asked the applicant to provide a status summary of current industry activities to develop a delivery system for UT of the hidden welds in PNPS's core spray system. In response to this request, the applicant provided the following information:

> The BWRVIP/EPRI NDE Center recently acquired blade probes to demonstrate UT capability. Plans for 2007 are to develop a white paper to document the inspection capability to examine the hidden thermal sleeve welds. This project excludes tooling development as it is left to inspection vendors.

In addition, in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided License Renewal Commitment No. 33 to perform inspection of the inaccessible welds in the jet pump thermal sleeves if and when the necessary technique and equipment become available and the technique is demonstrated by the vendor, including delivery system.

Based on review of the applicant's technical justification for deferring inspection of the hidden welds in the jet pump thermal sleeves and on the applicant's response, the project team determined that (1) currently there is no qualified tooling that would support inspection of the hidden welds in the jet pump thermal sleeves; (2) PNPS currently examines other welds in the RV that have the same material and environment conditions as the hidden welds; (3) the industry, through BWRVIP/EPRI, is planning to develop a white paper to document capability to examine the hidden welds; and (4) PNPS's BWR Vessel Internals Program guidance document and its License Renewal Commitment No. 33 include a requirement to inspect the hidden welds

when appropriate tooling is developed. Based on these determinations, the project team found Exception 4 to the BWR Vessel Internals Program as described in the GALL Report to be acceptable.

During review of the applicant's technical justification for deferral of inspection of hidden welds in the jet pump thermal sleeves, the project team noted that the technical justification states that PNPS has known cracking in nine out of 10 of the thermal sleeves (but not in the TS-3 and TS-4 welds) and that this was discovered by a combination of PT and radiography when the thermal sleeves were accessible during the recirculation pipe replacement in RFO 6 (1984). The technical justification states that the thermal sleeve cracking was intermittent cracking and was predominantly, but not exclusively, confined to the heat affected zones (HAZ) of pallet fillet welds on the outer thermal sleeve where pads were shop welded onto the outer thermal sleeve as an assembly aid, and that the indications were quite limited in extent. The technical justification further states that the plans were to leave the existing thermal sleeves in place and suppress further cracking through the use of HWC. The project team asked the applicant to provide a more detailed discussion of aging management that will be provided for the jet pump thermal sleeves, including considerations of the cracking that was observed during the recirculation pipe replacement. In response to this request, the applicant provided the following information:

> No periodic examination of the heat affected zone for the sleeve-to-pallet fillet welds is currently performed at PNPS. VT-1 examinations will be conducted when appropriate techniques and tooling are developed by the BWRVIP organization. No repair of the cracks in the heat affected zone of the jet pump thermal sleeve has been performed and none is planned. The aging management of the jet pumps will be in accordance with BWRVIP-41, October 1997, which recommends modified VT-1 inspections of the jet pump thermal sleeves once the technique and tooling are available.
>
> PNPS submitted several letters to the Commission with regard to cracking in the heat affected zone of the jet pump thermal sleeves. The main technical report that was docketed by PNPS was General Electric Calculation NEDC-30730-P, Pilgrim Nuclear Power Station Recirculation Nozzle Repair Program and Hydrogen Water Chemistry Materials Qualification, September 1984.

The project team reviewed the applicant's response, the docketed calculation, and the NRC's "Safety Evaluation Relative to Inspection and Repairs of the Reactor Coolant System" attached to the letter from Harold Denton of the NRC to William Harrington of Boston Edison Company, dated December 4, 1984 (ADAMS Accession No. ML8412170035). The project team also reviewed a report, "Pilgrim Nuclear Power Station Recirculation Inlet Thermal Sleeve Mock Up Fabrication and Evaluation," submitted to the NRC by the applicant in a letter from James Lydon of Boston Edison Company to Harold Denton of the NRC, dated January 2, 1987 (ADAMS Accession No. ML8701150216), which had been requested by the NRC in the 1984 safety evaluation. The 1987 report provided results of an evaluation by GE which concluded that the likely cause of PNPS's thermal sleeve cracking was IGSCC and that crack growth due to IGSCC would be arrested by implementation of HWC at PNPS. The project team noted that the applicant has implemented HWC at PNPS and that HWC was credited with arresting growth of the cracks in the jet pump thermal sleeves. The project team also noted that the jet pump

thermal sleeves are not part of the RCPB and are not required to support the jet pump's safety function of maintaining two-thirds core coverage during a LOCA. The project team noted that the applicant's letter of September 13, 2006 (ADAMS Accession Number ML062650072), includes a commitment (Item 33) that PNPS will inspect the inaccessible jet pump thermal sleeve welds if and when the necessary technique and tooling to perform the inspection are developed by the BWRVIP and supporting equipment vendors. On the basis that crack growth was arrested by PNPS's implementation of HWC, that the jet pump thermal sleeves do not perform and are not required to support a safety function, and that the applicant included a license renewal commitment to perform an inspection of currently inaccessible jet pump thermal sleeve welds if and when the equipment to perform such an inspection becomes available through the BWRVIP, the project team found the applicant's response to be acceptable.

During the audit and review, the project team asked the applicant to confirm whether PNPS has installed the core plate wedges that are described in BWRVIP-25 or whether PNPS will perform the inspection of core plate rim hold-down bolts recommended in BWRVIP-25 if wedges are not installed. In response to this question, the applicant stated that the core plate wedges have been installed, and they are described in UFSAR Section 3.3.4.1.1, "Core Shroud." The project team reviewed the description in UFSAR Section 3.3.4.1.1 and the requirements in BWRVIP-25. On the basis of its review, the project team determined that PNPS has installed the core plate wedges described in BWRVIP-25 and that, with the wedges installed, the recommendations in BWRVIP-25, Table 3-2, "Summary of Results and Inspection Recommendations," do not require examination of the core plate rim hold-down bolts.

Based on its evaluation of Exception 4 to the PNPS BWR Vessel Internals Program as described in the preceding discussions, the project team found the applicant's technical justification of this exception to the BWR Vessel Internals Program as described in the GALL Report to be acceptable. In addition, as summarized in the preceding discussions, the project team found the applicant's responses to additional, clarifying questions to be acceptable. On this basis, the project team found this exception acceptable.

<u>Exception 5</u>

Elements:	3: Parameters Monitored/Inspected
Exception:	Table IWB-2500-1 from the 1998 Edition with 2000 Addenda of ASME Code Section XI is used, while GALL Report specifies the 2001 Edition with 2002 and 2003 Addenda.

The GALL Report identified the following recommendations for the "Parameters Monitored/inspected" program elements associated with the exception taken:

> The program monitors the effects of cracking on the intended function of the component by detection and sizing of cracks by inspection in accordance with the guidelines of applicable and approved BWRVIP documents and the requirements of the ASME Code, Section XI, Table IWB 2500-1 (2001 edition including the 2002 and 2003 Addenda). An applicant may use the guidelines of BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry

> provided such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.

The applicant stated in the PNPS LRA that ASME Code Section XI through the 2003 Addenda has been accepted by reference in 10 CFR 50.55a(b)(2) without modification or limitation on use of Table IWB-2500-1 from the 1998 Edition with 2000 Addenda for BWR components. Therefore, use of this version is appropriate to assure that components crediting this program can perform their intended function consistent with the CLB during the PEO.

During the audit and review, the project team asked the applicant to to substantiate that all exceptions to the GALL Report's program recommendations had been identified by reconfirming that PNPS's BWR Vessel Internals Program performs the inspections recommended in the applicable and approved BWRVIP guidelines, including those inspections that have more stringent requirements than ASME Code Section XI except as documented in PNPS LRA under the discussion of "Exceptions to NUREG-1801." In response to this question, the applicant provided the following information:

> The PNPS BWR Vessel Internals Program will perform the more stringent inspections in the BWRVIP inspection and evaluation guidelines approved by the NRC for referencing for license renewal. Any exceptions to the approved BWRVIPs are discussed as exceptions to NUREG-1801.
>
> Note that some of the specific BWRVIPs are considered part of subprograms such as the BWR Penetrations Program or the BWR Vessel ID Attachment Welds Program; however, all are implemented through the Reactor Vessel Internals Program implementing procedure at the PNPS site.

The project team reviewed the applicant's responses, together with the applicant's fourth 10-year inspection program plan (ADAMS Accession Number ML051920157). The project team also reviewed the applicant's response to BWRVIP applicant action items as documented for PNPS in Appendix C of the LRA. Based on these reviews, the project team determined that the applicant's use of ASME Code Section XI, 1998 Edition with 2000 Addenda, as the basis for its BWR Vessel Internals Program is consistent with the applicant's fourth 10-year inspection program plan. In addition the project team determined that the applicant has complied with the applicant action items identified in NRC SERs for BWRVIP documents credited for license renewal. Based on these determinations, the project team found Exception 5 to the BWR Vessel Internals Program as described in the GALL Report to be acceptable. On this basis, the project team found this exception acceptable.

3.0.3.2.7.4 <u>Enhancements</u>

The applicant stated in the PNPS LRA that the enhancement in meeting the GALL Report program element is as follows:

Element:	1: Scope of Program
Enhancement:	The PNPS top guide fluence is projected to exceed the threshold for IASCC ($5x10^{20}$ n/cm^2) before the PEO. Therefore, 10 percent of the top guide locations will be inspected using enhanced visual inspection technique (EVT-1) within the first 12 years of the PEO, with one-half of the inspections (50 percent of locations) to be completed within the first 6 years of the PEO. Locations selected for examination will be areas that have exceeded the neutron fluence threshold.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the enhancement:

> *Top guide:* BWRVIP-26 provides guidelines for inspection and evaluation; BWRVIP-50 provides guidelines for repair design criteria. Additionally, for top guides with neutron fluence exceeding the IASCC threshold (5E20, E>IMeV) prior to the period of extended operation, inspect 5 percent of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation. An additional 5 percent of the top guide locations will be inspected within 12 years after entering the period of extended operation. Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5 percent of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5 percent of the top guide locations will be inspected within 12 years after the date projected for exceeding the threshold. The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold. The extent of the examination and its frequency will be based on a 10-percent sample of the total population, which includes all grid beam and beam-to-beam crevice slots.

The applicant stated in the PNPS LRA that this enhancement will be initiated before the PEO.

During the audit and review, the project team noted that the LRA describes this and other enhancements as "initiated" before the PEO. The project team noted that in describing an enhancement as something to be "initiated" rather than "implemented," the LRA wording is ambiguous with regard to whether the enhancement will be fully implemented before the PEO. The project team asked the applicant to clarify or resolve the ambiguity in the LRA's descriptions of enhancements. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the intent of stating that enhancements will be initiated before the PEO is that the enhancements will be fully implemented before the PEO. Since this response provided the clarification requested, the project team found it to be acceptable.

During the audit and review, the project team noted that the enhancement, as described in the LRA, does not provide for any examination of the top guide during the final 8 years of the PEO. The project team asked the applicant to describe its plans for inspection of top guide locations during the final 8 years of the 20-year PEO. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a revision to the enhancement to

require inspection of at least 15 percent of the top guide locations during the first 18 years of the PEO and identified the revised enhancement as License Renewal Commitment No. 3. The applicant provided License Renewal Commitment No. 3, which reads as follows:

> Inspect fifteen (15) percent of the top guide locations using enhanced visual inspection technique, EVT-1, within the first 18 years of the period of extended operation. Five (5) percent of the top guide locations will be inspected during the first six years of the period of extended operation, five (5) percent during the second six year period, and five (5) percent during the third six year period. Locations selected will be areas that have exceeded the neutron fluence threshold.

The project team reviewed the applicant's response together with the applicant's evaluation of the "scope of program" program element of its current BWR Vessel Internals Program documented in the PNPS AMPER. The project team determined that the applicant's program evaluation report identifies that the enhancement to inspect top guide locations, as described in the LRA's description of the enhancement, is necessary to bring the PNPS BWR Vessel Internals Program into conformance with the recommendations of BWRVIP-26 guidelines. The project team also reviewed selected PNPS implementing procedures and found that the current PNPS BWR Vessel Internals Program does not include a requirement inspection the top guide when neutron fluence has exceeded the IASCC threshold as recommended in the GALL Report. On the basis that the enhancement is necessary to ensure conformance with recommendations for the top guide in the GALL Report, Section XI.M9 (BWR Vessel Internals) during the PEO and that the applicant has revised the enhancement as originally described in the LRA to include appropriate examinations during the final 8 years of the PEO, the project team found that the enhancement to the PNPS BWR Vessel Internals Program is acceptable.

On this basis, the project team found this enhancement acceptable because when the enhancement is implemented, PNPS AMP B.1.8, "BWR Vessel Internals Program," will be consistent with GALL AMP XI.M9 and the effects of aging will be adequately managed.

3.0.3.2.7.5 <u>Operating Experience</u>

The applicant stated in the PNPS LRA that visual and enhanced visual examinations of vessel internals (shroud support plate gusset welds, core spray piping, jet pump riser braces, jet pump diffusers, CRD guide tube handle attachment, steam dryer, and feedwater spargers) during RFO 14 (April 2003) resulted in no new recordable indications. Previous visual and enhanced visual examinations of vessel internals revealed indications on core spray piping welds and steam dryer leveling screw tack welds. Absence of new recordable indications on the vessel internals provides evidence that the program is effective for managing cracking of the welds.

Visual and enhanced visual examinations of vessel internals (core spray piping welds, core spray spargers, integrally welded core support structures, jet pump restrainer wedges, shroud vertical welds, shroud top guide ring, shroud support, steam dryer, steam dryer level screw tack weld cracks, steam separator/shroud head, and top guide grid beams) during RFO 15 (April 2005) resulted in no new recordable indications. Absence of new recordable indications on the

vessel internals provides evidence that the program is effective for managing cracking of the welds.

The core shroud provides two-thirds core coverage in case of a LOCA. Because IGSCC cracking of sensitized shroud welds was an industry issue, PNPS implemented a preemptive shroud hold-down modification during RFO 10 in 1995.

During the audit and review, the project team noted that the discussion of operating history in the LRA included little discussion of operating history earlier than approximately 2000. The project team asked the applicant to discuss the limitations on its discussion of operating history in the LRA and whether its presentation of "operating history" is consistent with the requirements described in NUREG-1800, SRP-LR Appendix A, Section A.1.2.3.10 (Branch Technical Position RLSB-1, "Operating Experience"). In response to this request, the applicant provided the following statement:

> SRP Section A.1.2.3.10 states, "Operating experience with existing programs should be discussed." To identify operating experience for license renewal, Entergy focused on operating experience with the existing programs rather than operating experience from the program that existed 10 or 15 years ago. Entergy did not own the plant 10 years ago. Entergy focused on operating experience from the existing programs rather than operating experience from the program that existed 10 or 15 years ago because results of the earlier inspections do not provide information regarding existing program effectiveness. In addition, BWRVIP programs incorporate industry operating experience from the entire BWR fleet. The PNPS programs are based on NUREG-1801 programs which are also based on industry experience.

The project team determined that the applicant's response provided a explanation of its decisions regarding presentation of "operating experience" in the LRA and that, based on this response, the LRA presentation of "operating experience" is consistent with the recommendations of SRP-LR Appendix A, Section A.1.2.3.10. On this basis, the project team found the applicant's response to be acceptable.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the BWR Vessel Internals Program and did not find any evidence of PNPS equipment degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's BWR Vessel Internals Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.7.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the BWR Vessel Internals Program in PNPS LRA Appendix A, Section A.2.1.8, which states that the BWR Vessel Internals Program includes (a) inspection, flaw evaluation, and repair in conformance with the applicable staff-approved BWRVIP documents; and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-130 to ensure the long-term integrity of vessel internals components.

During the audit and review, the project team noted that the applicant's description of the BWR Vessel Internals Program in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancement described in LRA Appendix B.1.8, "BWR Vessel Internals." The project team asked the applicant to include a description of the enhancement to PNPS's BWR Vessel Internals Program in the UFSAR Supplement in LRA Appendix A. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number associated with the enhancement for the BWR Vessel Internals Program as described in LRA Appendix B. In its letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Section A.1.2.8, BWR Vessel Internals Program, to add, "License renewal commitments 3 and 33 specify enhancements to this program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.8, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.7.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. Also, the project team has reviewed the enhancement and determined that the implementation of the enhancement before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.8 DIESEL FUEL MONITORING PROGRAM (PNPS AMP B.1.10)

In PNPS LRA Appendix B, Section B.1.10, the applicant stated that PNPS AMP B.1.10, "Diesel Fuel Monitoring Program," is an existing plant program that is consistent with GALL AMP XI.M30, "Fuel Oil Chemistry," with exceptions and enhancements.

3.0.3.2.8.1 Program Description

The applicant stated in the PNPS LRA that the program entails sampling to ensure that adequate diesel fuel quality is maintained to prevent plugging of filters, fouling of injectors, and corrosion of fuel systems. Exposure to fuel oil contaminants such as water and microbiological organisms is minimized by periodic draining and cleaning of tanks and by verifying the quality of new oil before its introduction into the storage tanks. Sampling and analysis activities are in accordance with technical specifications on fuel oil purity and the guidelines of ASTM Standards D4057-81 and D975-81 (or later revisions of these standards).

3.0.3.2.8.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.10 is consistent with GALL AMP XI.M30 with exceptions and enhancements.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.10, including AMPER, LRPD-02, Revision 1, Section 4.9, "Diesel Fuel Monitoring Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M30. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.10 and associated bases documents to determine consistency with GALL AMP XI.M30.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.9, "Diesel Fuel Monitoring Program"; ASTM D 1796, "Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)"; ASTM D 2276, "Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling"; ASTM D 6217, "Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration"; ASTM D 975, "Standard Specification for Diesel Fuel Oils"; ASTM D 4057, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products"; ASTM D 2709, "Standard Method for Water and Sediment in Middle Distillate Fuels by Centrifuge"; and ASTM D 6217, "Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration."

The project team reviewed those portions of the Diesel Fuel Monitoring Program for which the applicant claims consistency with GALL AMP XI.M30 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Diesel Fuel Monitoring Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Diesel Fuel Monitoring Program acceptable because it conforms to the recommended GALL AMP XI.M30, "Fuel Oil Chemistry," with the exceptions and enhancements as described below.

3.0.3.2.8.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Elements: 1: Scope of Program
6: Acceptance Criteria

Exception: PNPS indicated in the LRA that sampling and analysis activities are in accordance with technical specifications on fuel oil purity and the guidelines of ASTM Standards D 4057-81 and D 975-81. However, NUREG-1801, Revision 1, specifies ASTM Standards D 1796, D 2276, D 2709, and D 6217.

The GALL Report identified the following recommendations for the "scope of program" and "acceptance criteria" program elements associated with the exception taken:

> **Scope of Program:** The program is focused on managing the conditions that cause general, pitting, and microbiologically-influenced corrosion (MIC) of the diesel fuel tank internal surfaces in accordance with the plant's technical specifications (i.e., NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433) on fuel oil purity and the guidelines of ASTM Standards D 1796, D 2276, D 2709, D 6217, and D 4057. The program serves to reduce the potential of exposure of the tank internal surface to fuel oil contaminated with water and microbiological organisms.
>
> **Acceptance Criteria:** The ASTM Standard D 4057 is used for guidance on oil sampling. The ASTM Standards D 1796 and D 2709 are used for guidance on the determination of water and sediment contamination in diesel fuel. ASTM D 6217 and Modified D 2276, Method A are used for guidance for determination of particulates. The modification to D 2276 consists of using a filter with a pore size of 3.0 mm, instead of 0.8 mm.

The applicant stated in the PNPS LRA that PNPS technical specifications specify use of ASTM D975-81, which recommends use of ASTM D2276. Therefore, the guidelines of D2276 are appropriate for determination of particulates.

During the audit and review, the project team asked the applicant to provide justification for not using all ASTM specifications as indicated in GALL Report, Revision 1. In its response, the applicant stated that the Diesel Fuel Monitoring Program makes use of the guidelines of ASTM D-2276 for determination of particulates in lieu of ASTM D-6217. ASTM D-2276 provides guidance on determining particulate contamination using a field monitor. It provides for rapid assessment of changes in contamination level without the time delay required for rigorous laboratory procedures. It also provides a laboratory filtration method using a 0.8 micron filter. ASTM D-6217 provides guidance on determining particulate contamination by sample filtration at an offsite laboratory. The acceptance criterion of D-2276 is 10 milligrams (mg) per liter while that of D-6217 is 24 mg/liter. Therefore, the D-2276 criterion is more stringent than that of D-6217. Since ASTM D-2276 is an accepted method of determining particulates and is a method recommended by ASTM D-975, the D-2276 method is used at PNPS.

On this basis, the project team found this exception acceptable.

<u>Exception 2</u>

Elements: 2: Preventive Actions
Exception: The applicant indicated that no additives are used beyond those added by the refiner. The applicant does not add biocides, stabilizers, or corrosion inhibitors as required by GALL Report, Revision 1, XI.M30.

The GALL Report identified the following recommendation for the "preventive actions" program element associated with the exception taken:

> The quality of fuel oil is maintained by additions of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, and corrosion inhibitors to mitigate corrosion. Periodic cleaning of a tank allows removal of sediments, and periodic draining of water collected at the bottom of a tank minimizes the amount of water and the length of contact time. Accordingly, these measures are effective in mitigating corrosion inside diesel fuel oil tanks. Coatings, if used, prevent or mitigate corrosion by protecting the internal surfaces of the tank from contact with water and microbiological organisms.

The applicant stated in the PNPS LRA that PNPS does not add biocides, stabilizers, or corrosion inhibitors to the diesel fuel. Plant-specific operating experience has not indicated significant problems related to MIC. Since water contamination in the diesel fuel storage tanks is minimized, the potential for MIC is limited.

During the audit and review, the project team found program documentation indicating that tanks, except the security diesel generator fuel storage tank, are periodically drained, cleaned, and inspected. The quality of new oil is verified before it is introduced to storage tanks. This exception to GALL Report, Revision 1, is acceptable for all tanks, except the security diesel generator fuel storage tank, because no degradation of or water contamination in the fuel storage tanks has been detected to date and the Diesel Fuel Monitoring Program will be enhanced to include UT of the bottoms of tanks (except the security diesel generator fuel storage tank as explained under Exception 3 below). If indications of degradation or water contamination are found in the future, PNPS will consider additions of corrosion inhibitors and biocides during the corrective action process. On this basis, the project team found this exception acceptable.

<u>Exception 3</u>

Elements: 2: Preventive Actions
Exception: The security diesel generator fuel storage tank is not periodically cleaned and inspected because the internals are inaccessible.

The GALL Report identified the following recommendation for the "preventive actions" program element associated with the exception taken:

> The quality of fuel oil is maintained by additions of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, and corrosion inhibitors to mitigate corrosion. Periodic cleaning of a tank allows removal of sediments, and periodic draining of water collected at the bottom of a

> tank minimizes the amount of water and the length of contact time. Accordingly, these measures are effective in mitigating corrosion inside diesel fuel oil tanks. Coatings, if used, prevent or mitigate corrosion by protecting the internal surfaces of the tank from contact with water and microbiological organisms.

The applicant stated in the PNPS LRA that the security diesel fuel storage tank does not have manways or other means of access to the internals. Therefore, no preventive action is taken for the security diesel generator fuel storage tank because the internals are inaccessible (there are no manways or other means to access the internals).

During the audit and review, the project team asked the applicant to provide justification for not cleaning and visually inspecting the security diesel generator fuel storage tank on a periodic basis. In its response to this request, the applicant provided information with regard to how loss of material due to MIC and general corrosion will be managed. The security diesel generator fuel storage tank is a double-walled tank. Instrumentation will be added to monitor leakage between the two walls of the tank, and the fuel will be sampled for water contamination at the bottom of the tank. A modification to provide instrumentation will be installed before the PEO. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Commitment No. 5 is added to enhance the Diesel Fuel Monitoring Program to install instrumentation to monitor for leakage between the two walls of the security diesel generator fuel storage tank to ensure that significant degradation is not occurring. Water is necessary for MIC and general corrosion in the fuel oil environment. Verification that water is not present at the tank bottom will ensure that loss of material is not occurring. This exception to GALL Report, Revision 1, is acceptable for the security diesel generator fuel storage tank because the two enhancements to the program will ensure corrective action before the tank is breached due to loss of material. On this basis, the project team found this exception acceptable.

<u>Exception 4</u>

Elements:	3: Parameters Monitored/Inspected 6: Acceptance Criteria
Exception:	Determination of particulates may be according to ASTM Standard D 2276 rather than modified ASTM D 2276 Method A.

The GALL Report identified the following recommendations for the “parameters monitored/inspected” and “acceptance criteria” program elements associated with the exception taken:

> **Parameters Monitored/Inspected:** The AMP monitors fuel oil quality and the levels of water and microbiological organisms in the fuel oil, which cause the loss of material of the tank internal surfaces. The ASTM Standard D 4057 is used for guidance on oil sampling. The ASTM Standards D 1796 and D 2709 are used for determination of water and sediment contamination in diesel fuel. For determination of particulates, modified ASTM D 2276, Method A, is used. The modification consists of using a filter with a pore size of 3.0 mm, instead of 0.8 mm. These are the principal parameters relevant to tank structural integrity.

> **Acceptance Criteria:** The ASTM Standard D 4057 is used for guidance on oil sampling. The ASTM Standards D 1796 and D 2709 are used for guidance on the determination of water and sediment contamination in diesel fuel. ASTM D 6217 and Modified D 2276, Method A are used for guidance for determination of particulates. The modification to D 2276 consists of using a filter with a pore size of 3.0 mm, instead of 0.8 mm.

The applicant stated in the PNPS LRA that determination of particulates may be according to ASTM Standard D2276, which conducts particulate analysis using a 0.8 micron filter, rather than the 3.0 micron filter specified in the GALL Report. Use of a filter with a smaller pore size results in a larger sample of particulates because smaller particles are retained. Thus, use of a 0.8 micron filter is more conservative than use of the 3.0 micron filter specified in the GALL Report.

During the audit and review, the project team determined that the procedure used by the applicant to conduct particulate levels is more conservative than that of the GALL Report, Revision 1. It was therefore concluded that the testing methods adequately detect unacceptable levels of particulates. During the site audit and review, the project team reviewed ASTM D 6217-98 and ASTM D 2276-00 and could not find the acceptance criteria in either of these standard test methods. The project team asked the applicant to provide additional explanation as to the source of the acceptance criteria. In its response, the applicant indicated that there are no acceptance criteria in ASTM D 6217-98 and ASTM D 2276-00, and the sources of the acceptance criteria are in ASTM D975, Table 1, for water and sediment, and VV-F-800D, "Federal Specification, Fuel Oil Diesel," for particulates. The project team reviewed ASTM D975, Table 1 and VV-F-800D and found the acceptance criteria adequate to manage water, sediment, and particulate contamination. On this basis, the project team found this exception acceptable.

3.0.3.2.8.4 <u>Enhancements</u>

The applicant stated in the PNPS LRA that the enhancements in meeting the GALL Report program element are as follows:

<u>Enhancement 1</u>

Element:	1: Scope of Program
Enhancement:	The Diesel Fuel Monitoring Program will be enhanced to include periodic sampling of the security diesel generator fuel storage tank, near the bottom, to determine water content.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the enhancement:

> **Scope of Program:** The program is focused on managing the conditions that cause general, pitting, and microbiologically-influenced corrosion (MIC) of the diesel fuel tank internal surfaces in accordance with the plant's technical specifications (i.e., NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433) on fuel oil purity and the guidelines of ASTM Standards D1796, D2276, D2709,

> D6217, and D4057. The program serves to reduce the potential of exposure of the tank internal surface to fuel oil contaminated with water and microbiological organisms.

The applicant stated in the PNPS LRA that the Diesel Fuel Monitoring Program will be enhanced to include sampling the bottom of the security diesel generator fuel storage tank for water. Any indication of water contamination will be handled by the corrective action program, where additions of biocides and corrosion inhibitors will be considered. Since the effect of any water contamination is minimized, the potential for MIC and general corrosion will be limited, providing loss of material will be adequately managed.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.10, "Diesel Fuel Monitoring Program," will be consistent with GALL AMP XI.M30 and the effects of aging will be adequately managed

<u>Enhancement 2</u>

Element:	4: Detection of Aging Effects
Enhancement:	The Diesel Fuel Monitoring Program will be enhanced to include periodic ultrasonic measurement of the bottom surface of the security diesel generator fuel storage tank to ensure that significant degradation is not occurring.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the enhancement:

> Degradation of the diesel fuel oil tank cannot occur without exposure of the tank internal surfaces to contaminants in the fuel oil, such as water and microbiological organisms. Compliance with diesel fuel oil standards in item 3 above and periodic multi-level sampling provide assurance that fuel oil contaminants are below unacceptable levels. Internal surfaces of tanks that are drained for cleaning are visually inspected to detect potential degradation. However, corrosion may occur at locations in which contaminants may accumulate, such as a tank bottom, and an ultrasonic thickness measurement of the tank bottom surface ensures that significant degradation is not occurring.

The applicant stated in the PNPS LRA that the Diesel Fuel Monitoring Program would be enhanced to provide periodic ultrasonic inspection of the bottom surface of the security diesel generator fuel storage tank. However, during the site audit, the applicant indicated that UT is not possible at the bottom of the security diesel generator fuel storage tank because of tank geometry and installation configuration. Therefore, this enhancement was revised to add instrumentation to monitor leakage between the two walls of this double-walled tank. This enhancement to the Diesel Fuel Monitoring Program will ensure corrective action will be implemented before the outer tank wall is breached due to loss of material, providing the effects of aging will be adequately managed. This enhancement is Item 5 on the applicant's list of commitments for license renewal and will be completed before the PEO.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.10, "Diesel Fuel Monitoring Program," will be consistent with GALL AMP XI.M30 and the effects of aging will be adequately managed.

Enhancement 3

Element:	6: Acceptance Criteria
Enhancement:	UT measurements of tank bottom surfaces will have an acceptance criterion of greater than 60 percent nominal thickness (Tnom).

The GALL Report identified the following recommendation for the "acceptance criteria" program element associated with the enhancement:

> The ASTM Standard D 4057 is used for guidance on oil sampling. The ASTM Standards D 1796 and D 2709 are used for guidance on the determination of water and sediment contamination in diesel fuel. ASTM D 6217 and Modified D 2276, Method A are used for guidance for determination of particulates. The modification to D 2276 consists of using a filter with a pore size of 3.0 mm, instead of 0.8 mm.

The applicant stated in the PNPS LRA that UT measurements of tank bottom surfaces will have an acceptance criterion of greater than 60 percent Tnom.

During the audit and review, the project team asked the applicant to provide justification for the "greater than or equal to 60 percent of nominal thickness" acceptance criterion. In its original response, the applicant stated that the acceptance criterion was based on one set of UT measurements where the minimum wall thickness found was 95 percent of the nominal wall thickness. During the site audit, the applicant stated that although it is likely that this is due to normal variation of the wall thickness during fabrication, it was assumed that the difference in wall thickness was the result of aging degradation. Projection of this thinning rate indicated that the "greater than or equal to 60 percent of nominal thickness" acceptance criterion will not be exceeded during the PEO even if the thinning rate was doubled. However, the project team indicated that there was no basis showing the tanks would perform their intended functions with wall thinning down to 60 percent of the nominal wall thickness. Therefore, the applicant revised this enhancement to specify acceptance criterion for UT measurements of the EDG fuel storage tanks (T-126A&B). In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated in Appendix B, Audit Item 320, that LRA Appendix A is revised to include Appendix A Commitment No. 6. The applicant committed to specify acceptance criterion for UT measurements of EDG fuel storage tanks (T-126A&B) before the PEO.

During the audit and review, the project team asked two additional questions regarding UT measurements of the diesel fuel tanks:

(1) Will tank bottoms be subjected to 100-percent UT inspection?

In its response, the applicant stated that tank bottoms would not be 100-percent inspected. Rather, a periodic UT measurement is performed on the bottom surface of the underground emergency diesel fuel oil storage tanks. During these inspections, UT measurements are made at several random locations on the bottom of these tanks. This response is acceptable because random measurements will be able to trend any loss of material to the tank bottoms.

(2) If reduction of thickness is discovered during UT, will microbiological activity be monitored and biocide added in the future? If not, the project team asked the applicant to provide a justification for not doing so.

In its response, the applicant stated that in accordance with the corrective action program, an engineering evaluation into the cause will be performed if test acceptance criteria are not met and corrective actions will be implemented to ensure that the intended function of the tanks can be maintained consistent with the CLB for the PEO. If appropriate to address the cause, biocide addition may be an element of the corrective action. This response is acceptable because no evidence of MIC in diesel fuel storage tanks has been discovered to date, and biocide addition will be considered during the corrective action if evidence of MIC is discovered (e.g., during UT measurements or visual examinations).

The project team found this enhancement acceptable because when the enhancement is implemented, PNPS AMP B.1.10, “Diesel Fuel Monitoring Program,” will be consistent with GALL AMP XI.M30 and will provide the effects of aging will be adequately managed.

3.0.3.2.8.5 Operating Experience

The applicant stated in the PNPS LRA that in 2001, two diesel fuel oil deliveries were rejected; one because the oil viscosity was too low and one because the oil had detectable visible particulate contamination. Rejection of inferior fuel shipments maintains diesel fuel quality to prevent loss of material and cracking of fuel system components.

Monthly sampling of the B EDG fuel oil tank and the B SBO fuel oil tank in August 2003 indicated a small amount of water was in the tanks. Gaskets were replaced although the indication of water was determined to be a false positive. The tanks were confirmed to be water-free during subsequent testing. Sampling of the B EDG fuel oil tank in January 2005 indicated a small amount of water was in the tank. However, subsequent testing confirmed the tank to be water-free. Other fuel oil sampling results from 2000 through August 2005 reveal that fuel oil quality is being maintained in compliance with acceptance criteria. A 1998 visual and ultrasonic inspection of A and B diesel fuel oil storage tank internals revealed no degradation. A 2002 visual inspection of A and B SBO fuel oil storage tank internals revealed no degradation. Continuous confirmation of diesel fuel quality, timely corrective actions, and absence of degradation in the fuel oil storage tanks provide evidence that the program is effective in managing loss of material and cracking of fuel system components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant’s technical staff to confirm that the plant-specific operating experience did not

reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the Diesel Fuel Monitoring Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Diesel Fuel Monitoring Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.8.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Diesel Fuel Monitoring Program in PNPS LRA Appendix A, Section A.2.1.10, which states that the Diesel Fuel Monitoring Program entails sampling to ensure that adequate diesel fuel quality is maintained to prevent plugging of filters, fouling of injectors, and corrosion of fuel systems. Exposure to fuel oil contaminants such as water and microbiological organisms is minimized by periodic draining and cleaning of tanks and by verifying the quality of new oil before its introduction into the storage tanks.

During the audit and review, the project team noted that the applicant's description of the B.1.10 program in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancements described in LRA Appendix B.1.10. The project team asked the applicant to include a description of the enhancements to PNPS's B.1.10 program in the UFSAR Supplement in LRA Appendix A, as recommended by NUREG-1800, Section 3.X.2.4. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number(s) associated with the enhancement(s) for that program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), License Renewal Commitment Nos. 4, 5, and 6 specify enhancements to this program.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.10, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.8.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. Also, the project team has reviewed the enhancements and determined that the implementation of the enhancements before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.9 FATIGUE MONITORING PROGRAM (PNPS AMP B.1.12)

In PNPS LRA Appendix B, Section B.1.12, the applicant stated that PNPS AMP B.1.12, "Fatigue Monitoring Program," is an existing plant program that is consistent with GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," with exceptions.

3.0.3.2.9.1 Program Description

The applicant stated in the PNPS LRA that in order not to exceed design limits on fatigue usage, the Fatigue Monitoring Program tracks the number of critical thermal and pressure transients for selected RCS components. The program ensures the validity of analyses that explicitly assumed a specified number of thermal and pressure fatigue transients by assuring that the actual effective number of transients is not exceeded.

3.0.3.2.9.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.12 is consistent with GALL AMP X.M1, with exceptions.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.12, including AMPER, LRPD-02, Revision 1, Section 4.11, "Fatigue Monitoring Program," which provides an assessment of the AMP elements' consistency with GALL AMP X.M1. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.12 and associated bases documents to determine consistency with GALL AMP X.M1.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.11, "Fatigue Monitoring Program," PNPS Procedure No. 1.3.118, Revision 1, "Reactor Vessel Fatigue Cyclic Duty Monitoring Program Procedure," and License Renewal Project Reports, LRPD-03, Revision 0, and LRPD-06, Revision 0, TLAAs.

In the comparison to GALL Element 6 "acceptance criteria," the applicant stated that PNPS AMP B.1.12 was consistent with the GALL Report. However, the comparison statement does not address environmental fatigue and, as written, is not consistent with the GALL Report. The project team asked the applicant to clarify how it addressed environmental fatigue for this element and to justify why the element, as written, is consistent with the GALL Report. In its response, the applicant stated that an exception was not identified in Element 6 in the LRA AMP since the exception addressed under Element 2 was considered adequate. For clarification, the applicant agreed to revise LRPD-02, Revision 0, Section 4.1.11 to show an exception for Element 6.

Also, in a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant agreed to add Element 6 to the existing Exception 1 in the LRA. Section 3.0.3.2.9.3 of this audit and review report addresses this exception.

The project team reviewed those portions of the Fatigue Monitoring Program for which the applicant claims consistency with GALL AMP X.M1 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Fatigue Monitoring Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Fatigue Monitoring Program acceptable because it conforms to the recommended GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," with exceptions as described below.

3.0.3.2.9.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Element: 2: Preventive Actions
6: Acceptance Criteria
Exception: The Fatigue Monitoring Program only involves tracking the number of transient cycles and does not include assessment of the impact of the reactor water environment on critical components.

The GALL Report identified the following recommendation for the "preventive actions" program element associated with the exception taken:

> Maintaining the fatigue usage factor below the design code limit and considering the effect of the reactor water environment, as described under the program description, will provide adequate margin against fatigue cracking of reactor coolant system components due to anticipated cyclic strains.

The GALL Report identified the following recommendation for the "corrective action" program element associated with the exception taken:

> The acceptance criteria involves maintaining the fatigue usage below the design code limit considering environmental fatigue effects as described under the program description.

The applicant stated in the PNPS LRA that the effect of the reactor water environment on fatigue is addressed in LRA Section 4.3.3. In LRA Section 4.3.3, "Effects of Reactor Water Environment on Fatigue Life," the applicant has appropriately addressed the effect of reactor water environment and committed to implementing a program to address those locations where the cumulative usage factor (CUF) will exceed 1.0. Based on the review of LRA Section 4.3.3, the project team found this exception acceptable.

Exception 2

Element: 4: Detection of Aging Effects
Exception: The PNPS program does not provide for periodic update of the fatigue usage calculations.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> The program provides for periodic update of the fatigue usage calculations.

The applicant stated in the PNPS LRA that updates of fatigue usage calculations are not necessary unless the number of accumulated fatigue cycles approaches the number of assumed design cycles. The PNPS program provides for periodic assessment of the number of accumulated cycles. If a design cycle assumption is approached, corrective action is taken which may include update of the fatigue usage calculation.

This exception is acceptable because this is an alternative method for ensuring that the design code limit is not exceeded.

3.0.3.2.9.4 Enhancements

None.

3.0.3.2.9.5 Operating Experience

The applicant stated in the PNPS LRA that industry experience has been factored into the PNPS Fatigue Monitoring Program through incorporation of RGs and BWRVIP documents. The locations at which CUFs are calculated include those identified in NUREG/CR-6260.

Industry experience has identified thermal stresses that were not considered in the original design of PNPS. These thermal stresses have been evaluated. PNPS will continue to evaluate future industry experience on fatigue of Class 1 components.

For recent reactor shutdowns and startups, cycle limitations did not trend toward exceeding the allowable number of cycles. This demonstrates that the program continues to monitor plant transients and track the accumulation of these transients.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Fatigue Monitoring Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.9.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Fatigue Monitoring Program in PNPS LRA Appendix A, Section A.2.1.12, which states that in order not to exceed design limits on fatigue usage, the Fatigue Monitoring Program tracks the number of critical thermal and pressure transients for selected RCS components. The program ensures the validity of analyses that explicitly assumed a fixed number of thermal and pressure fatigue transients by assuring that the actual effective number of transients does not exceed the assumed limit.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.12, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.9.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.10 FIRE PROTECTION PROGRAM (PNPS AMP B.1.13.1)

In PNPS LRA Appendix B, Section B.1.13.1, the applicant stated that PNPS AMP B.1.13.1, "Fire Protection Program," is an existing plant program that is consistent with GALL AMP XI.M26, "Fire Protection," with exceptions and enhancements.

3.0.3.2.10.1 Program Description

The applicant stated in the PNPS LRA that this program includes a fire barrier inspection and a diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration 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 requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The program also includes periodic inspection and testing of the halon fire suppression system.

Corrective actions, confirmation process, and administrative controls in accordance with the requirements of 10 CFR Part 50, Appendix B are applied to the Fire Protection Program.

3.0.3.2.10.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.13.1 is consistent with GALL AMP XI.M26, with exceptions and enhancements.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.13.1, including AMPER, LRPD-02, Revision 1, Section 4.12, "Fire Protection Programs," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M26. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.13.1 and associated bases documents to determine consistency with GALL AMP XI.M26.

The project team also reviewed PNPS Procedure No. 8.B.1, Revision 64, "Fire Pump Test Procedure," PNPS Procedure No. 8.B.15, Revision 36, "Functional Tests of Fire Pumps – P-135, P-140, and P-181 Procedures," PNPS Procedure No. 8.B.17.1, Revision 17, "Inspection of Fire Door Assemblies Procedure," PNPS Procedure No. 8.B.17.2, Revision 9, "Inspection of Fire Damper Assemblies Procedure," PNPS Procedure No. 8.B.22, Revision 28, "HALON 1301 System – Cable Spreading Room Procedure," and PNPS Procedure No. 8.B.29, Revision 7, "Inspection of Fire Barriers Procedure."

The project team identified a difference for Element 3, "Parameters to Be Monitored or Inspected," in that the exception taken for frequency for Element 4, "Detection of Aging Effects," was not taken for Element 3. The project team asked the applicant to justify why this exception did not also apply to Element 3. In its response, the applicant stated that per SRP-LR, Section A.1.2.3.4, Element 4 describes "when," "where," and "how" program data are collected. Therefore, the exception to inspection frequency was applied to Element 4. PNPS did not take exception to the parameters to be monitored or inspected for penetration seals. Therefore, the exception does not apply to Element 3. Based on a review of the SRP-LR guidelines, the project team found the applicant's response to be acceptable.

The project team also identified a difference for Element 4, "Detection of Aging Effects." The GALL Report states that the periodic function test and inspection performed at least once every 6 months detects degradation of the halon/CO_2 fire suppression system before the loss of the component's intended function. However, per review of LRPD-02, Revision 1, Section 4.12.1.B.4.b, PNPS performs this test once each operating cycle, which differs from the GALL Report frequency. The project team asked the applicant to justify why this is not an exception to Element 4 and, if it is an exception, to revise the LRA to include it.

In response, the applicant stated that an exception should have been included in the LRA for AMP B.1.13.1, "Fire Protection Program," Element 4. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant identified this exception for Element 4 of AMP B.1.13.1. The project team's evaluation of this exception is provided in Section 3.0.3.2.10.3 of this audit and review report.

In Element 3, the GALL Report states that visual inspection of the fire barrier walls, ceilings, and floors examines any sign of degradation such as cracking, spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. PNPS Procedure No. 8.B.29 addresses cracking, spalling, etc.; however, loss of material is not addressed. The project team asked the applicant where inspection of loss of material is addressed. In its response, the applicant stated that loss of material for fire barrier walls, ceilings, and floors is addressed in PNPS Procedure No. 8.B.29, Section 8.2. This procedure section describes how each fire

barrier is to be inspected. It directs inspectors to take note of any damaged portions of the barrier and lists cracks/voids/gaps in walls as examples of damage to be noted. It further states that if a major defect exists in any barrier, it will be evaluated and entered into the corrective action process. The project team reviewed PNPS Procedure No. 8.B.29, determined that it provides an acceptance criteria for each type of barrier, and found the applicant's response to be acceptable.

The project team reviewed those portions of the Fire Protection Program for which the applicant claims consistency with GALL AMP XI.M26 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Fire Protection Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Fire Protection Program acceptable because it conforms to the recommended GALL AMP XI.M26, "Fire Protection," with the exceptions and enhancements as described below.

3.0.3.2.10.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exceptions to the GALL Report program elements are as follows:

Exception 1

Element: 1: Scope of Program
Exception: This program is not necessary to manage aging effects for carbon dioxide fire protection system components.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the exception taken:

> For operating plants, the AMP manages the aging effects on the intended function of the penetration seals, fire barrier walls, ceilings, and floors, and all fire rated doors (automatic or manual) that perform a fire barrier function. It also manages the aging effects on the intended function of the fuel supply line. The AMP also includes management of the aging effects on the intended function of the halon/CO_2 fire suppression system.

The applicant stated in the PNPS LRA that the CO_2 fire suppression system is not subject to AMR.

The project team asked the applicant to provide justification as to why the CO_2 fire suppression system is not subject to AMR. In its response, the applicant stated that the CARDOX system is required for insurance purposes but is not required to protect safety-related systems. Therefore, the system has no intended functions for 10 CFR 54.4(a)(1) or (a)(3). Also, since the system does not contain liquids that could leak and cause physical interaction with safety-related components, it does not have any intended functions for 10 CFR 54.4(a)(2). Based on the above, since the system does not have any license-renewal-related intended functions, the

applicant's response is acceptable. On the basis that this system does not have any intended functions for 10 CFR 54.4(a)(1), (a)(2), or (a)(3), and is therefore not in scope of license renewal, the project team found this exception acceptable.

Exception 2

Element: 4: Detection of Aging Effects
Exception: The NUREG-1801 program states that approximately 10 percent of each type of penetration seal should be visually inspected at least once every RFO. The PNPS program specifies inspection of approximately 20 percent of the seals each operating cycle, with all accessible fire barrier penetration seals being inspected at least once every five operating cycles.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> Visual inspection of penetration seals detects cracking, seal separation from walls and components, and rupture and puncture of seals. Visual inspection by fire protection qualified inspectors of approximately 10 percent of each type of seal in walkdowns is performed at least once every refueling cycle. If any sign of degradation is detected within that sample, the scope of the inspection is expanded to include additional seals. Visual inspection by fire protection qualified inspectors of the fire barrier walls, ceilings, and floors, performed in walkdowns at least once every refueling outage ensures timely detection of concrete cracking, spalling, and loss of material. Visual inspection by fire protection qualified inspectors detects any sign of degradation of the fire door such as wear and missing parts. Periodic visual inspection and function tests detect degradation of the fire doors before there is a loss of intended function.
>
> Periodic tests performed at least once every refueling outage, such as flow and discharge tests, sequential starting capability tests, and controller function tests performed on diesel-driven fire pump ensure fuel supply line performance. The performance tests detect degradation of the fuel supply lines before the loss of the component intended function. Visual inspections of the halon/CO_2 fire suppression system detect any sign of added degradation, such as corrosion, mechanical damage, or damage to dampers. The periodic function test and inspection performed at least once every six months detects degradation of the halon/CO_2 fire suppression system before the loss of the component intended function.

The applicant stated in the PNPS LRA that since aging effects are typically manifested over several years, this variation in inspection frequency is insignificant.

The GALL AMP XI.M26 specifies approximately 10 percent of each type of seal should be visually inspected at least once every RFO (2 years). The exception taken in the LRA calls for inspection of approximately 20 percent of seals each operating cycle, with all accessible

penetration seals being inspected at least once every five operating cycles (10 years). The project team asked the applicant to identify if each type of seal is included in this 20-percent sample. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant responded that the exception in LRA Section B.1.13.1 is revised to read as follows:

> The NUREG-1801 program states that approximately 10 percent of each type of penetration seal should be visually inspected at least once every refueling outage. The PNPS program specifies inspection of approximately 20 percent of the seals, including at least one seal of each type, each operating cycle, with all accessible fire barrier penetration seals being inspected at least once every five operating cycles.

On the basis that each type of seal will be included in each operating cycle, and since aging effects are typically manifested over several years, the project team found this exception acceptable.

The following addresses the new exception identified by the applicant in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072):

<u>Exception 3</u>

Element:	4. Detection of Aging Effects
Exception:	The NUREG-1801 program recommends that functional testing and inspection of the halon fire suppression system occur at least once every 6 months. However, PNPS performs inspections at least once every 6 months and conducts functional testing annually.

The GALL Report identified the following recommendation for the “detection of aging effects” program element associated with the exception taken:

> Visual inspection of penetration seals detects cracking, seal separation from walls and components, and rupture and puncture of seals. Visual inspection by fire protection qualified inspectors of approximately 10 percent of each type of seal in walkdowns is performed at least once every refueling cycle. If any sign of degradation is detected within that sample, the scope of the inspection is expanded to include additional seals. Visual inspection by fire protection qualified inspectors of the fire barrier walls, ceilings, and floors, performed in walkdowns at least once every refueling outage ensures timely detection of concrete cracking, spalling, and loss of material. Visual inspection by fire protection qualified inspectors detects any sign of degradation of the fire door such as wear and missing parts. Periodic visual inspection and function tests detect degradation of the fire doors before there is a loss of intended function.
>
> Periodic tests are performed at least once every refueling outage, such as flow and discharge tests, sequential starting capability tests, and controller function tests performed on diesel-driven fire pump to ensure fuel supply line performance. The performance tests detect degradation of the fuel supply lines

> before the loss of the component intended function. Visual inspections of the halon/CO_2 fire suppression system detect any sign of added degradation such as corrosion, mechanical damage, or damage to dampers. The periodic function test and inspection performed at least once every six months detects degradation of the halon/CO_2 fire suppression system before the loss of the component intended function.

The applicant stated that the variation in functional test frequency is insignificant with relation to detection of aging effects because functional tests are designed to verify the operability of active system components. Since system inspections are performed at least once every 6 months, aging effects are identified before loss of passive component intended function.

On the basis that inspections are performed at least once every 6 months, which does provide a better detection of passive intended function and is followed by a functional test once a year, the project team found this exception acceptable.

3.0.3.2.10.4 Enhancements

The applicant stated in the PNPS LRA that the enhancements in meeting the GALL Report program element are as follows:

Enhancement 1

Element:	3: Parameters Monitored/Inspected 6: Acceptance Criteria
Enhancement:	Procedures will be enhanced to state that the diesel engine subsystems (including the fuel supply line) shall be observed while the pump is running. Acceptance criteria will be enhanced to verify that the diesel engine did not exhibit signs of degradation while it was running, such as fuel oil, lube oil, coolant, or exhaust gas leakage.

The GALL Report identified the following recommendations for the “parameters monitored/inspected” and “acceptance criteria” program elements associated with the enhancement:

> **Parameters Monitored/Inspected:** Visual inspection of approximately 10% of each type of penetration seal is performed during walkdowns carried out at least once every refueling outage. These inspections examine any sign of degradation such as cracking, seal separation from walls and components, separation of layers of material, rupture and puncture of seals, which are directly caused by increased hardness, and shrinkage of seal material due to weathering. Visual inspection of the fire barrier walls, ceilings, and floors examines any sign of degradation such as cracking, spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. Fire-rated doors are visually inspected on a plant-specific interval to verify the integrity of door surfaces and for clearances. The plant-specific inspection intervals are to be

determined by engineering evaluation to detect degradation of the fire doors prior to the loss of intended function.

The diesel-driven fire pump is under observation during performance tests such as flow and discharge tests, sequential starting capability tests, and controller function tests for detection of any degradation of the fuel supply line.

The periodic visual inspection and function test is performed at least once every six months to examine the signs of degradation of the halon/CO_2 fire suppression system. Material conditions that may affect the performance of the system, such as corrosion, mechanical damage, or damage to dampers, are observed during these tests.

Acceptance Criteria: Inspection results are acceptable if there are no visual indications (outside those allowed by approved penetration seal configurations) of cracking, separation of seals from walls and components, separation of layers of material, or ruptures or punctures of seals; no visual indications of concrete cracking, spalling and loss of material of fire barrier walls, ceilings, and floors; no visual indications of missing parts, holes, and wear and no deficiencies in the functional tests of fire doors. No corrosion is acceptable in the fuel supply line for the diesel-driven fire pump. Also, any signs of corrosion and mechanical damage of the halon/CO_2 fire suppression system are not acceptable.

This enhancement is acceptable since this will make the program consistent with Element 3 of the GALL AMP XI.M26, which states that the diesel fire pump is under observation during performance tests for detection of any degradation of fuel supply line. This enhancement is also acceptable since this will make the program consistent with Element 6 of GALL AMP XI.M26, which states that no corrosion is acceptable in the fuel supply line for the diesel-driven fire pump. PNPS Procedure No. 8.B.22 was reviewed to confirm that these elements are consistent with the GALL Report.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.13.1, "Fire Protection Program," will be consistent with GALL AMP XI.M26 and will provide the effects of aging will be adequately managed.

<u>Enhancement 2</u>

Element:	3: Parameters Monitored/Inspected 6: Acceptance Criteria
Enhancement:	The procedure for halon system functional testing will be enhanced to state that the halon 1301 flex hoses shall be replaced if leakage occurs during the system functional test.

The GALL Report identified the following recommendations for the "parameters monitored/inspected" and "acceptance criteria" program elements associated with the enhancement:

Parameters Monitored/Inspected: Visual inspection of approximately 10 percent of each type of penetration seal is performed during walkdowns carried out at least once every refueling outage. These inspections examine any sign of degradation such as cracking, seal separation from walls and components, separation of layers of material, rupture and puncture of seals, which are directly caused by increased hardness, and shrinkage of seal material due to weathering. Visual inspection of the fire barrier walls, ceilings, and floors examines any sign of degradation such as cracking, spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. Fire-rated doors are visually inspected on a plant-specific interval to verify the integrity of door surfaces and for clearances. The plant-specific inspection intervals are to be determined by engineering evaluation to detect degradation of the fire doors prior to the loss of intended function.

The diesel-driven fire pump is under observation during performance tests such as flow and discharge tests, sequential starting capability tests, and controller function tests for detection of any degradation of the fuel supply line.

The periodic visual inspection and function test is performed at least once every six months to examine the signs of degradation of the halon/CO_2 fire suppression system. Material conditions that may affect the performance of the system, such as corrosion, mechanical damage, or damage to dampers, are observed during these tests.

Acceptance Criteria: Inspection results are acceptable if there are no visual indications (outside those allowed by approved penetration seal configurations) of cracking, separation of seals from walls and components, separation of layers of material, or ruptures or punctures of seals; no visual indications of concrete cracking, spalling and loss of material of fire barrier walls, ceilings, and floors; no visual indications of missing parts, holes, and wear and no deficiencies in the functional tests of fire doors. No corrosion is acceptable in the fuel supply line for the diesel-driven fire pump. Also, any signs of corrosion and mechanical damage of the halon/CO_2 fire suppression system are not acceptable.

This enhancement is acceptable since this will make the program consistent with the acceptance criteria in GALL AMP XI.M26, which states that any signs of mechanical damage of the halon system are not acceptable.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.13.1, “Fire Protection Program,” will be consistent with GALL AMP XI.M26 and will provide the effects of aging will be adequately managed.

3.0.3.2.10.5 Operating Experience

The applicant stated in the PNPS LRA that inspections of fire stops, fire barrier penetration seals, fire barrier walls, ceilings, and floors from 1998 through 2004 revealed signs of degradation such as cracks, gaps, voids, holes, or missing material. Identification of

degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects for fire barrier components.

Visual inspections and functional tests of fire doors from 1998 through 2004 detected degradation of fire doors, such as corrosion, wear, and missing parts. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material for fire doors.

Observation of the diesel-driven fire pump during a performance test in 2000 revealed leakage from the cooling system. The cause was determined to be corrosion of the heat exchanger shell, which was repaired. Observation of the diesel-driven fire pump during performance tests in 2001 revealed degradation of several components in the engine oil and coolant systems. The pump also failed a flow test. Therefore, the entire assembly (engine, controller, and pump) was replaced in 2002. Identification of degradation and corrective action provide evidence that the program is effective for managing aging of diesel-driven fire pump subsystem components.

Recent (2002 and 2003) visual inspections of cable spreading room halon cylinders, associated hoses, valves, and piping detected no evidence of damage or corrosion. Absence of cracks or corrosion provides evidence that the program is effective for managing aging effects for cable spreading room halon system components.

On July 31, 2003, the NRC completed a triennial fire protection team inspection to assess whether PNPS had implemented an adequate fire protection program and that post-fire safe shutdown capabilities had been established and were being properly maintained at PNPS. Results confirmed that PNPS was maintaining the fire protection systems in accordance with its fire protection program and that PNPS was identifying program deficiencies and implementing appropriate corrective actions. The team also evaluated the material condition of fire walls, fire doors, fire dampers, and fire barrier penetration seals and concluded that PNPS was maintaining passive features in a state of readiness.

A QA audit in May 2004 and an NRC inspection in June 2005 revealed no issues or findings that could impact effectiveness of the program to manage aging effects for fire protection components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.12, "Fire Protection Program." The project team further reviewed CR-PNP-2000-09345, which was written to address cooling system leakage during the fire pump test of the diesel fire pump. The cause was determined to be degraded condition of the filler tube. Appropriate corrective action was taken.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Fire Protection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.10.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Fire Protection Program in PNPS LRA Appendix A, Section A.1.12, which states that the Fire Protection Program includes a fire barrier inspection and a diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration 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 requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The program also includes periodic inspection and testing of the halon fire suppression system.

Corrective actions, confirmation process, and administrative controls in accordance with the requirements of 10 CFR Part 50, Appendix B, are applied to the Fire Protection Program.

During the audit and review, the project team noted that the applicant's description of the Fire Protection Program in UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancements described in LRA Appendix B.1.13.1, "Fire Protection." The project team asked the applicant to include a description of the enhancements to PNPS's Fire Protection Program in the UFSAR Supplement in LRA Appendix A. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment numbers associated with the enhancements for the Fire Protection Program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that License Renewal Commitment Nos. 7 and 8 specify enhancements to this program.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.13.1 and the amendment, and found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.10.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report, are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. Also, the project team has reviewed the enhancements and determined that the implementation of the enhancements prior to the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.11 FIRE WATER SYSTEM PROGRAM (PNPS AMP B.1.13.2)

In PNPS LRA Appendix B, Section B.1.13.2, the applicant stated that PNPS AMP B.1.13.2, "Fire Water System Program," is an existing plant program that is consistent with GALL AMP XI.M27, "Fire Water System," with an exception and enhancements.

3.0.3.2.11.1 Program Description

The applicant stated in the PNPS LRA that this AMP applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, and aboveground and underground piping and components that are tested in accordance with applicable National Fire Protection Association (NFPA) codes and standards. Such testing assures functionality of systems. Also, many of these systems are normally maintained at required operating pressure and monitored such that leakage resulting in loss of system pressure is immediately detected and corrective actions are initiated.

In addition, a sample of sprinkler heads will be inspected using the guidance of NFPA 25 (2002 Edition), Section 5.3.1.1.1. NFPA 25 states that, "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." NFPA 25 also contains guidance to perform this sampling every 10 years after initial field service testing.

3.0.3.2.11.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.13.2 is consistent with GALL AMP XI.M27, with an exception and enhancements.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.13.2, including AMPER, LRPD-02, Revision 1, Section 4.12.2, "Fire Water System Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M27. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.13.2 and associated bases documents to determine consistency with GALL AMP XI.M27.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.13, "Fire Water System Program"; PNPS Procedure No. 8.B.3.1, Revision 14, "Fire Hose Station Equipment Inspection – FSAR Related Procedure"; PNPS Procedure No. 8.B.6.1, Revision 5, "EDG A Pre-Action Sprinkler System Functional Test Procedure"; PNPS Procedure No. 8.B.6.2, Revision 6, "EDG Pre-Action Sprinkler System Functional Test Procedure"; PNPS Procedure No. 8.B.6.8, Revision 8, :"Recirc. Pump MG Set Oil Skid Pre-Action Sprinkler System Functional Test Procedure"; PNPS Procedure No. 8.B.6.10, Revision 5, "Hydrogen Seal Oil Supply Pre-Action System Functional Test Procedure"; PNPS Procedure No. 8.B.6.13, Revision 4, "Pre-Action Sprinkler System Water Flow Alarm Functional Test Procedure"; PNPS Procedure No. 8.B.8, Revision 16, "Fire Hydrant Operability Procedure"; PNPS Procedure No. 8.B.9.1, Revision 4, "Wet and Dry Pipe Sprinklers Main Drain Test Procedure"; and PNPS Procedure No. 8.B.9.1.1, Revision 5, "Reactor Building Sprinklers Main Drain Test Procedure."

The project team reviewed those portions of the Fire Water System Program for which the applicant claims consistency with GALL AMP XI.M27 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Fire Water System Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Fire Water System Program acceptable because it conforms to the recommended GALL AMP XI.M27, "Fire Water System," with the exception and enhancements as described below.

3.0.3.2.11.3 Exceptions to the GALL Report

Exception

Element: 4: Detection of Aging Effects
Exception: NUREG-1801 specifies annual fire hydrant hose hydrostatic tests. Under the PNPS program, hydrostatic test of hoses occurs once per 3 years. NUREG-1801 specifies annual gasket inspections. Under the PNPS program, visual inspection, reracking, and replacement of gaskets in couplings occurs at least once per operating cycle. NUREG-1801 specifies annual fire hydrant flow tests. Under the PNPS program, verification of operability and no-flow blockage occurs at least once every two fuel cycles.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> Fire protection system testing is performed to assure that the system functions by maintaining required operating pressures. Wall thickness evaluations of fire protection piping are performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections are performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. As an alternative to non-intrusive testing, the plant maintenance process may include a visual inspection of the internal surface of the fire protection piping upon each entry to the system for routine or corrective maintenance, as long as it can be demonstrated that inspections are performed (based on past maintenance history) on a representative number of locations on a reasonable basis. These inspections must be capable of evaluating (1) wall thickness to ensure against catastrophic failure and (2) the inner diameter of the piping as it applies to the design flow of the fire protection system. If the environmental and material conditions that exist on the interior surface of the below-grade fire protection piping are similar to the conditions that exist within the above-grade fire protection piping, the results of the inspections of the above-grade fire protection piping can be extrapolated to evaluate the condition of below grade fire protection piping. If not, additional inspection activities are needed to ensure that the intended function of below-grade fire protection piping will be maintained consistent with the CLB for the period of extended operation.

Continuous system pressure monitoring, system flow testing, and wall thickness evaluations of piping are effective means to ensure that corrosion and biofouling are not occurring and the system's intended function is maintained.

General requirements of existing fire protection programs include testing and maintenance of fire detection and protection systems and surveillance procedures to ensure that fire detectors as well as fire protection systems and components are operable.

Visual inspection of yard fire hydrants performed annually in accordance with NFPA 25 ensures timely detection of signs of degradation, such as corrosion. Fire hydrant hose hydrostatic tests, gasket inspections, and fire hydrant flow tests, performed annually, ensure that fire hydrants can perform their intended function and provide opportunities for degradation to be detected before a loss of intended function can occur.

Sprinkler heads are inspected before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the extended period of operation to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

The applicant stated in the PNPS LRA that since aging effects are typically manifested over several years, differences in inspection and testing frequencies are insignificant. The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, to determine any age-related issues with fire water system components. The review determined a few instances of age-related degradation over the last 5 years. However, these were all detected by the program.

The project team found these frequencies to be adequate to manage the aging effects. On this basis, the project team found this exception to be acceptable.

3.0.3.2.11.4 Enhancements

The applicant stated in the PNPS LRA that the enhancements in meeting the GALL Report program elements are as follows:

Enhancement 1

Elements:	3: Parameters Monitored/Inspected 6: Acceptance Criteria
Enhancement:	Procedures will be enhanced to include inspection of hose reels for corrosion. Acceptance criteria will be enhanced to verify no significant corrosion.

The GALL Report identified the following recommendations for the "parameters monitored/inspected" and "acceptance criteria" program elements associated with the enhancement:

Parameters Monitored/Inspected: Loss of material due to corrosion and biofouling could reduce wall thickness of the fire protection piping system and result in system failure. Therefore, the parameters monitored are the system's ability to maintain pressure and internal system corrosion conditions. Periodic flow testing of the fire water system is performed using the guidelines of NFPA 25, or wall thickness evaluations may be performed to ensure that the system maintains its intended function.

This enhancement is acceptable since this will make the program consistent with GALL AMP XI.M27, Element 3.

Acceptance Criteria: The acceptance criteria are (a) the ability of a fire protection system to maintain required pressure, (b) no unacceptable signs of degradation observed during non-intrusive or visual assessment of internal system conditions, and (c) that no biofouling exists in the sprinkler systems that could cause corrosion in the sprinkler heads.

This enhancement is acceptable since this will make the program consistent with GALL AMP XI.M27, Element 6.

The project team found these enhancements acceptable since when they are implemented, PNPS AMP B.1.13.2, "Fire Water System Program," will be consistent with GALL AMP XI.M27 and the effects of aging will be adequately managed.

<u>Enhancement 2</u>

Element:	4: Detection of Aging Effects
Enhancement:	A sample of sprinkler heads will be inspected using the guidance of NFPA 25 (2002 Edition), Section 5.3.1.1.1. NFPA 25 also contains guidance to repeat this sampling every 10 years after initial field service testing.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the enhancement:

> Fire protection system testing is performed to assure that the system functions by maintaining required operating pressures. Wall thickness evaluations of fire protection piping are performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections are performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. As an alternative to non-intrusive testing, the plant maintenance process may include a visual inspection of the internal surface of the fire protection piping upon each entry to the system for routine or corrective maintenance, as long as it can be demonstrated that inspections are performed (based on past maintenance history) on a representative number of locations on a reasonable basis. These inspections must be capable of evaluating (1) wall

thickness to ensure against catastrophic failure and (2) the inner diameter of the piping as it applies to the design flow of the fire protection system. If the environmental and material conditions that exist on the interior surface of the below grade fire protection piping are similar to the conditions that exist within the above grade fire protection piping, the results of the inspections of the above grade fire protection piping can be extrapolated to evaluate the condition of below grade fire protection piping. If not, additional inspection activities are needed to ensure that the intended function of below grade fire protection piping will be maintained consistent with the current licensing basis for the period of extended operation. Continuous system pressure monitoring, system flow testing, and wall thickness evaluations of piping are effective means to ensure that corrosion and biofouling are not occurring and the system's intended function is maintained.

General requirements of existing fire protection programs include testing and maintenance of fire detection and protection systems and surveillance procedures to ensure that fire detectors, as well as fire protection systems and components are operable.

Visual inspection of yard fire hydrants performed annually in accordance with NFPA 25 ensures timely detection of signs of degradation, such as corrosion. Fire hydrant hose hydrostatic tests, gasket inspections, and fire hydrant flow tests, performed annually, ensure that fire hydrants can perform their intended function and provide opportunities for degradation to be detected before a loss of intended function can occur.

Sprinkler heads are inspected before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the extended period of operation to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.13.2, "Fire Water System Program," will be consistent with GALL AMP XI.M27, Element 4, and will provide the effects of aging will be adequately managed.

<u>Enhancement 3</u>

Element:	4: Detection of Aging Effects
Enhancement:	Wall thickness evaluations of fire protection piping will be performed on system components using nonintrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections will be performed before the end of the current operating term and at intervals thereafter during the PEO. Results of the initial evaluations will be used to determine the appropriate inspection interval to ensure aging effects are identified before loss of intended function.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the enhancement:

> Fire protection system testing is performed to assure that the system functions by maintaining required operating pressures. Wall thickness evaluations of fire protection piping are performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections are performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. As an alternative to non-intrusive testing, the plant maintenance process may include a visual inspection of the internal surface of the fire protection piping upon each entry to the system for routine or corrective maintenance, as long as it can be demonstrated that inspections are performed (based on past maintenance history) on a representative number of locations on a reasonable basis. These inspections must be capable of evaluating (1) wall thickness to ensure against catastrophic failure and (2) the inner diameter of the piping as it applies to the design flow of the fire protection system. If the environmental and material conditions that exist on the interior surface of the below grade fire protection piping are similar to the conditions that exist within the above grade fire protection piping, the results of the inspections of the above grade fire protection piping can be extrapolated to evaluate the condition of below grade fire protection piping. If not, additional inspection activities are needed to ensure that the intended function of below grade fire protection piping will be maintained consistent with the current licensing basis for the period of extended operation. Continuous system pressure monitoring, system flow testing, and wall thickness evaluations of piping are effective means to ensure that corrosion and biofouling are not occurring and the system's intended function is maintained.
>
> General requirements of existing fire protection programs include testing and maintenance of fire detection and protection systems and surveillance procedures to ensure that fire detectors, as well as fire protection systems and components are operable.
>
> Visual inspection of yard fire hydrants performed annually in accordance with NFPA 25 ensures timely detection of signs of degradation, such as corrosion. Fire hydrant hose hydrostatic tests, gasket inspections, and fire hydrant flow tests, performed annually, ensure that fire hydrants can perform their intended function and provide opportunities for degradation to be detected before a loss of intended function can occur.
>
> Sprinkler heads are inspected before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the extended period of operation to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

The project team found this enhancement acceptable since when it is implemented, PNPS AMP B.1.13.2, "Fire Water System Program," will be consistent with GALL AMP XI.M27, Element 4, and will provide the effects of aging will be adequately managed.

3.0.3.2.11.5 Operating Experience

The applicant stated in the PNPS LRA that a fire hose station inspection in 1999 identified a degraded hose station. The hose reel was replaced. Hydrostatic testing and visual inspections of fire hose station equipment in 2004 and 2005 revealed no loss of material. Absence of significant corrosion provides evidence that the program is effective for managing loss of material for fire water system components.

Inspection of a fire water storage tank, T-107A, in 2001 revealed minimal localized leakage, probably due to loss of material on the tank bottom. The leakage is being monitored and repair is scheduled. Also, inspection of a fire water storage tank, T-107B, in 2003 revealed that MIC is occurring at spots (less than 1/16 inch in diameter) on internal surfaces. Similar corrosion was seen before tank recoating in 1993. Results of the next inspection (2008) will be compared with the 2003 results to determine the need for tank repair. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material for fire water system components. Full flow tests of fire main segments and hydrant inspections from 2001 through 2004 found no evidence of obstruction or loss of material. Spray and sprinkler system functional tests, and visual inspections of piping and nozzles, in 2003 found no evidence of blockage or loss of material. Confirmation of absence of degradation provides evidence that the program is effective for managing loss of material for fire water system components.

In 2001, an underground fire main broke due to fabrication and installation anomalies. A 16-foot section of the pipe was replaced. Inspection of internal and external surfaces of the removed pipe section revealed only one small spot of corrosion on the external surface where the coating was cracked. Confirmation of absence of degradation provides evidence that the program is effective for managing loss of material for fire water system components.

On July 31, 2003, the NRC completed a triennial fire protection team inspection to assess whether PNPS has implemented an adequate fire protection program and that post-fire safe shutdown capabilities have been established and are being properly maintained at PNPS. Results confirmed that PNPS was maintaining the fire protection systems in accordance with its fire protection program and that PNPS was identifying program deficiencies and implementing appropriate corrective actions. The team also evaluated the material condition of selected wet pipe sprinkler systems, standpipe systems, and hose reels and concluded that PNPS was maintaining passive features in a state of readiness.

A QA audit in May 2004 revealed no issues or findings that could impact effectiveness of the program to manage loss of material for fire water system components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. The project team also reviewed the

PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.13, "Fire Water System Program." The project team further reviewed CR-PNP-2001-09700, which addresses the inspection of the fire water storage tank discussed above. The project team confirmed that appropriate corrective actions were identified and completed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Fire Water System Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.11.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Fire Water System Program in PNPS LRA Appendix A, Section A.2.1.14, which states that the Fire Water System Program applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, and aboveground and underground piping and components that are tested in accordance with applicable NFPA codes and standards. Such testing assures functionality of systems. To determine if significant corrosion has occurred in water-based fire protection systems, periodic flushing, system performance testing and inspections are conducted. Also, many of these systems are normally maintained at required operating pressure and monitored such that leakage resulting in loss of system pressure is immediately detected and corrective actions initiated.

In addition, wall thickness evaluations of fire protection piping are periodically performed on system components using nonintrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion.

A sample of sprinkler heads will be inspected using the guidance of NFPA 25 (2002 Edition), Section 5.3.1.1.1, which states, "Where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." This sampling will be repeated every 10 years after initial field service testing.

During the audit and review, the project team noted that the applicant's description of the Fire Water System Program in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancements described in LRA Appendix B.1.13.2, "Fire Water System." The project team asked the applicant to include a description of the enhancements to PNPS's Fire Water System Program in the UFSAR Supplement in LRA Appendix A. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment numbers associated with the enhancements for the Fire Water System Program as described in LRA Appendix B. In its letter dated September 13, 2006 (ADAMs Accession Number ML062650072), the applicant revised LRA Section A.2.1.14, "Fire Water System Program," to add "License renewal commitments 9, 10, and 11 specify enhancements to this program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.13.2, found that it was consistent with the GALL Report, and determined that it provides an adequate summary

description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.11.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. Also, the project team has reviewed the enhancements and determined that the implementation of the enhancements before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.12 METAL-ENCLOSED BUS INSPECTION PROGRAM (PNPS AMP B.1.18)

In PNPS LRA Appendix B, Section B.1.18, the applicant stated that PNPS AMP B.1.18, "Metal-Enclosed Bus Inspection Program," is a new plant program that is consistent with GALL AMP XI.E4, "Metal-Enclosed Bus," with exceptions.

3.0.3.2.12.1 Program Description

The applicant stated in the PNPS LRA that this program will manage the effects of aging on the nonsegregated phase bus which connects the 4.16 kV switchgear (A3 through A6) through visual inspection of enclosure assemblies and interior portions of the bus. This inspection will also verify the absence of water or debris.

The program will be initiated before the PEO.

3.0.3.2.12.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.18 is consistent with GALL AMP XI.E4, with exceptions.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.18, including LRPD-02, Revision 1, Section 3.3, "Metal-Enclosed Bus Inspection Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.E4. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.18 and associated bases documents to determine consistency with GALL AMP XI.E4.

Also, the project team reviewed AMRE-01, Revision 2, "Electrical Screening and Aging Management Reviews," and LRPD-05, Revision 0, "Operating Experience Reviews."

The project team reviewed those portions of the Metal-Enclosed Bus Inspection Program for which the applicant claims consistency with GALL AMP XI.E4 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Metal-Enclosed Bus Inspection Program provides assurance that aging effects of metal-enclosed bus (MEB) caused by cracked insulation, moisture or debris in the bus enclosure, or loosening of bolted connections will be managed to be consistent with CLB during the PEO. The project team found the applicant's Metal-Enclosed Bus Inspection Program acceptable because it conforms to the recommended GALL AMP XI.E4, "Metal-Enclosed Bus," with exceptions as described below.

3.0.3.2.12.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Exception 1

Elements: 3: Parameters Monitored/Inspected
4: Detection of Aging Effects
Exception: MEB enclosure assemblies will be inspected in addition to internal surfaces.

The GALL Report identified the following recommendations for the "parameters monitored/inspected" and "detection of aging effects" program elements associated with the exception taken:

> **Parameters Monitored/Inspected:** A sample of accessible bolted connections will be checked for loose connection. Alternatively, bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., may be visually inspected for insulation material surface anomalies. This program provides for the inspection of the internal portion of the MEBs for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion. The bus insulation will be inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The internal bus supports will be inspected for structural integrity and signs of cracks.
>
> **Detection of Aging Effects:** A sample of accessible bolted connections will be checked for loose connection by using thermography or by measuring connection resistance using a low-range ohmmeter. MEB internal surfaces will be visually inspected for aging degradation of insulating material and for foreign debris and excessive dust buildup, and evidence of moisture intrusion. Bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. Internal bus supports will be visually inspected for structural integrity and signs of cracks. This program will be completed before the period of extended operation and every 10 years thereafter provided visual inspection is not used to check bolted connections. A 10-year inspection interval will provide two data points during a

> 20-year period, which can be used to characterize the degradation rate. This is an adequate period to preclude failures of the MEBs since experience has shown that aging degradation is a slow process.
>
> As an alternative to thermography or measuring connection resistance of bolted connections, for the accessible bolted connections that are covered with heat shrink tape, sleeving, insulating boots, etc., the applicant may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination. When this alternative visual inspection is used to check bolted connections, the first inspection will be completed before the period of extended operation and every five years thereafter.

The applicant stated in the PNPS LRA, under Exception Note 1, that inspection of MEB enclosure under the Metal-Enclosure Bus Inspection Program assures that effects of aging will be identified before loss of intended functions.

Section VI, Items VI.A-12 and VI-13, of the GALL Report reference the Structures Monitoring Program for inspecting the external of the MEB for loss of material due to general corrosion and inspecting the enclosure seals for hardening and loss of strength due to elastomers degradation. In LRA Section B.1.18, the applicant stated that the program attribute of MEB inspection program would be consistent with the program attribute in GALL AMP XI.E4 with an exception. The exception is to inspect MEB enclosure assemblies in addition to internal surfaces using the MEB inspection program. The project team asked the applicant if the enclosure seals were included in the scope of its MEB inspection program and what were the acceptance criteria for inspecting the externals of enclosure assemblies. In its response, the applicant stated that the PNPS MEB program will visually inspect the enclosure assemblies for evidence of loss of material and that enclosure assembly elastomers will be visually inspected and manually flexed. The applicant will revise LRPD-02 to read as follows:

> (Section 3.3.B.6.b – “Acceptance Criteria” – add after first paragraph)
>
> The acceptance criteria for enclosure assemblies will be no loss of material due to general corrosion. The acceptance criteria for elastomers will be no hardening and loss of strength due to degradation.

The project team found the applicant‘s response to be acceptable because it will inspect externals of the MEB, including seals, and the acceptance criteria for inspecting the components of external of the MEB will be provided in the plant’s basis document (LRPD). The project team verified that LRPD-02 was revised as described. On this basis, the project team found this exception to be acceptable.

<u>Exception 2</u>

Elements:	4: Detection of Aging Effects
Exception:	MEB-bolted connections will be visually inspected every 10 years, rather than every 5 years as stated in NUREG-1801.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> **Detection of Aging Effects:** A sample of accessible bolted connections will be checked for loose connection by using thermography or by measuring connection resistance using a low-range ohmmeter. MEB internal surfaces will be visually inspected for aging degradation of insulating material and for foreign debris and excessive dust buildup, and evidence of moisture intrusion. Bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. Internal bus supports will be visually inspected for structural integrity and signs of cracks. This program will be completed before the period of extended operation and every 10 years thereafter provided visual inspection is not used to check bolted connections. A 10-year inspection interval will provide two data points during a 20-year period, which can be used to characterize the degradation rate. This is an adequate period to preclude failures of the MEBs since experience has shown that aging degradation is a slow process.
>
> As an alternative to thermography or measuring connection resistance of bolted connections, for the accessible bolted connections that are covered with heat shrink tape, sleeving, insulating boots, etc., the applicant may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination. When this alternative visual inspection is used to check bolted connections, the first inspection will be completed before the period of extended operation and every five years thereafter.

The applicant stated in the PNPS LRA, under Footnote 2, that in the GALL Report for the other inspections, a 10-year inspection interval will provide two data points during a 20-year period, which can be used to characterize the degradation rate. This is an adequate period to preclude failures of the MEBs since experience has shown that aging degradation is a slow process.

GALL AMP XI.E4 states that as "an alternative to thermography or measuring connection resistance of bolted connections, for the accessible bolted connections that are covered with heat shrink tape, sleeving, insulated boots, etc., the applicant may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination." When this alternate visual inspection is used to check bolted connections, the first inspection will be completed before the PEO and every 5 years thereafter. Since the visual inspection is less effective than testing, this visual inspection is to be performed once every 5 years instead of once every 10 years. In the LRA, the applicant stated that visual inspection of MEB bolted connections will occur every 10 years. The project team asked the applicant if all bolted connections are covered with heat shrink tape, sleeving, or insulated boots and, if so, that the applicant justify the 10-year inspection frequency versus the 5 year frequency as recommended by GALL AMP XI.E4. In its response, the applicant stated that since MEB bolted connections are covered with heat shrink tape or insulating boots per the manufacturer's recommendations, a sample of accessible bolted connections will be visually inspected for insulation material surface anomalies. Internal portions of the MEBs will be inspected for cracks,

corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion. Bus insulation will be inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. Internal bus supports will be inspected for structural integrity and signs of cracking. An inspection will occur before the initial 40-year license term and every 5 years thereafter. If degradation is found in the MEB materials, an engineering evaluation will be performed when the inspection acceptance criteria are not met in order to ensure that the intended functions of the MEB can be maintained consistent with the CLB. This evaluation is performed in accordance with the Entergy correction process per PNPS Procedure No. EN-LI-102. This procedure provides the elements to be considered, including the extent of the concern, the potential root causes for not meeting the test acceptance criteria, the corrective action required, and likelihood of recurrence. This engineering evaluation will determine the frequency of the next inspection, which will not exceed 5 years. In addition, the applicant also responded that it will revise LRA Section A.2.1.20 to "five years." The applicant will revise LRA Appendix B.1.18 to remove the exception to five years. On this basis, the project team found the applicant's response acceptable. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Sections A.2.1.20 and B.1.18 as described above.

3.0.3.2.12.4 Enhancements

None.

3.0.3.2.12.5 Operating Experience

The applicant stated in the PNPS LRA that the Metal-Enclosed Bus Inspection Program at PNPS is a new program for which there is no operating experience.

GALL AMP XI.E4 indicates that operating experience has shown that degradation of MEB within the scope of XI.E4 may exist. The project team requested the applicant to provide industry and plant-specific operating experience associated with this program. In its response, the applicant stated that the Metal-Enclosed Bus Inspection Program is a new program. Plant and industry operating experience will be considered when developing this program. Industry operating experience that forms the basis for the program is described in the operating experience element of the GALL Report program description. PNPS plant-specific operating experience is consistent with the operating experience in the GALL Report program description.

The PNPS program is based on the program description in the GALL Report, which in turn is based on relevant industry operating experience. As such, operating experience provides assurance that effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the CLB for the PEO. The team found the applicant's response acceptable because the applicant has reviewed the plant-specific operating experience against the industry experience identified in the GALL Report. As additional operating experience is obtained, lessons learned can be used to adjust the program elements.

Operating experience at PNPS is controlled by PNPS Procedure No. EN-OP-100, "Operating Experience Program." The program includes the following components: (1) operating experience – information received from various industry sources that describes events, issues,

and equipment failures that may represent opportunities to apply lessons learned to avoid negative consequences or to re-create positive experience as applicable; (2) internal operating experience – operating experience that originates as a CR or request from plant personnel which warrants consideration for possible Entergy-wide distribution(internal operating experience can originate from any Entergy plant or headquarters); and impact evaluation – analysis of an operating experience event or problem that requires additional information and research to determine impact or potential impact as it relates to plant condition and/or configuration. Impact evaluations are typically documented with a CR. CR action items and corrective actions are used to confirm program effectiveness and to modify the program as needed.

The project team also reviewed the basis document LRPD-05 to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Metal-Enclosed Bus Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.12.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Metal-Enclosed Bus Inspection Program in PNPS LRA Appendix A, Section A.2.1.20, which states that under the Metal-Enclosed Bus Inspection Program, internal portions of the nonsegregated phase bus which connects the 4.16 kV switchgear (A3 through A6) are inspected for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion. Bus insulation is inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. Internal bus supports are inspected for structural integrity and signs of cracks. Since bolted connections are covered with heat shrink tape or insulating boots per the manufacturer's recommendations, a sample of accessible bolted connections is visually inspected for insulation material surface anomalies. Enclosure assemblies are visually inspected for evidence of loss of material, and where applicable, enclosure assembly elastomers are visually inspected and manually flexed to manage cracking and change in material properties. These inspections are performed at least once every 10 years.

As described above, the applicant will revise the inspection frequency described in the UFSAR Supplement Appendix A.2.1.20 to "5 years." The project team reviewed the proposed revised UFSAR Supplement for PNPS AMP B.1.18 and determined that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d). In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Appendix A.2.1.20 to change the inspection frequency to at least once every 5 years. Also in this letter, the applicant provided a list of commitments. Commitment No. 14 states that the applicant will implement the Metal-Enclosed Bus Inspection Program as described in LRA Section B.1.18 by June 8, 2012.

3.0.3.2.12.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to manage the aging effects for which it is credited.

The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.13 OIL ANALYSIS PROGRAM (PNPS AMP B.1.22)

In PNPS LRA Appendix B, Section B.1.22, the applicant stated that PNPS AMP B.1.22, "Oil Analysis Program," is an existing plant program that is consistent with GALL AMP XI.M39, "Lubricating Oil Analysis," with an exception and enhancements.

3.0.3.2.13.1 Program Description

The applicant stated in the PNPS LRA that this program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results.

3.0.3.2.13.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.22 is consistent with GALL AMP XI.M39, with an exception and enhancements.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.22, including AMPER, LRPD-02, Revision 1, Section 4.16, "Oil Analysis Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M39. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.22 and associated bases documents to determine consistency with GALL AMP XI.M39.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Section 4.16, "Oil Analysis Program," *Entergy Nuclear Management Manual*, Revision 0, EN-DC-310, "Predictive Maintenance Program," CR-PNP-2003-02670, "During Lube Oil Analysis Evaluation for RHR Pump B (P-203B) the Viscosity Was Noted to Be Slightly Outside of the Acceptable Range," CR-PNP-2005-00116, "Lube Oil Testing of the A Diesel X-107A Has Indicated a Step Change in the Wear Particle Count," CR-PNP-2005-00618, "Lube Oil Testing of the B Diesel X-107B Has Indicated a Step Change in the Wear Particle Count."

The project team reviewed those portions of the Oil Analysis Program for which the applicant claims consistency with GALL AMP XI.M39 and found that they are consistent with the GALL

Report AMP. Furthermore, the project team concluded that the applicant's Oil Analysis Program provides assurance that the effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Oil Analysis Program acceptable because it conforms to the recommended GALL AMP XI.M22, "Lubricating Oil Analysis," with an exception and enhancements as described below.

3.0.3.2.13.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Element: 3: Parameters Monitored/Inspected
Exception: Flash point is not determined for sampled oil.

The GALL Report identified the following recommendation for the "parameters monitored/inspected" program element associated with the exception taken:

> For components with periodic oil changes in accordance with manufacturer's recommendations, a particle count and check for water are performed to detect evidence of abnormal wear rates, contamination by moisture, or excessive corrosion. For components that do not have regular oil changes, viscosity, neutralization number, and flash point are also determined to verify the oil is suitable for continued use. In addition, analytical ferrography and elemental analysis are performed to identify wear particles.

The applicant stated in the PNPS LRA that analyses of filter residue or particle count, viscosity, total acid/base (neutralization number), water content, and metals content provide sufficient information to verify the oil is suitable for continued use.

During the audit and review, the project team asked the applicant to provide justification for not monitoring the flash point of oil that is not regularly changed. In its response to this request, the applicant stated that flash point is not determined for sample oil because analysis of filter residue or particle count, viscosity, total acid/base (neutralization number), water content, and metals content provide sufficient information to verify the oil does not contain water or contaminants that would permit the onset of aging effects. Also, the applicant stated that the percent fuel dilution in diesel engine oils is monitored, which is a more accurate method than flash point for identifying fuel leak and oil dilution. Subsequently, the project team asked the applicant to provide the method, including any standards, used to determine fuel dilution and the acceptance criterion for oil dilution in diesel engine oils.

In its response to this request, the applicant provided a copy of PNPS Procedure No. 3.M.3-61.3, "Emergency Diesel Generator Quarterly Preventive Maintenance," showing that quarterly lube oil samples are sent to a laboratory. The provided laboratory test results show that percent dilution is measured in accordance with ASTM standards. Acceptance criterion is less than 3 percent by weight and based on ALCO diesel engine owners group chemistry guidelines. The following will be added to LRA Section B.1.22 exception note. PNPS measures the percent fuel

dilution in diesel engine oils, which is a more accurate method than flash point for identifying fuel leaks and oil dilution. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated in Appendix B, Audit Item 213, that LRA Section B.1.22 exception note is revised to state that PNPS measures the percent fuel dilution in diesel engine oils, which is a more accurate method than flash point for identifying fuel leak and oil dilution and acceptance criterion is less than 3% weight based on ALCO diesel engine owners group chemistry guidelines.

On this basis, the project team found this exception acceptable.

3.0.3.2.13.4 Enhancements

The applicant stated in the PNPS LRA that the enhancements in meeting the GALL Report program elements are as follows:

Enhancement 1

Elements:	1: Scope of Program
Enhancement:	The Oil Analysis Program will be enhanced to periodically change CRD pump lubricating oil. A particle count and check for water will be performed on the drained oil to detect evidence of abnormal wear rates, contamination by moisture, or excessive corrosion.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the enhancement:

> **Scope of Program**: On a periodic basis, this program samples lubricating oil from plant components subject to aging management review.

The applicant stated in the PNPS LRA that this enhancement will be initiated before the PEO. The implementation of this enhancement by the applicant will verify that the oil environment of the CRD pump will not be conducive to loss of material, thus providing loss of material will be adequately managed.

On this basis, the project team found this enhancement acceptable because when enhancements are implemented, PNPS AMP B.1.22, "Oil Analysis Program," will be consistent with GALL AMP XI.M39 and provide the effects of aging will be adequately managed.

Enhancement 2

Element:	3: Parameters Monitored/Inspected
Enhancement:	Procedures for security diesel and RWCU pump oil changes will be enhanced to obtain oil samples from the drained oil. Procedures for lubricating oil analysis will be enhanced to specify that a particle count and check for water are performed on oil samples from the fire water pump diesel, security diesel, and RWCU pumps.

The GALL Report identified the following recommendation for the "parameters monitored/inspected" program element associated with the enhancement:

> **Parameters Monitored/Inspected:** For components with periodic oil changes in accordance with manufacturer's recommendations, a particle count and check for water are performed to detect evidence of abnormal wear rates, contamination by moisture, or excessive corrosion. For components that do not have regular oil changes, viscosity, neutralization number, and flash point are also determined to verify the oil is suitable for continued use. In addition, analytical ferrography and elemental analysis are performed to identify wear particles.

The applicant stated in the PNPS LRA that this enhancement will be initiated before the PEO. The implementation of this enhancement by the applicant will verify that the oil environment of the fire water pump diesel, security diesel, and RWCU pumps will not be conducive to loss of material, thus providing loss of material will be adequately managed.

On this basis, the project team found this enhancement acceptable since when enhancement is implemented, PNPS AMP B.1.22, "Oil Analysis Program," will be consistent with GALL AMP XI.M39 and will provide the effects of aging will be adequately managed.

3.0.3.2.13.5 Operating Experience

The applicant stated in the PNPS LRA that lube oil analysis for residual heat removal (RHR) pump B in July 2003 showed viscosity slightly outside of the acceptable range. No other problems were noted with the oil. A retest confirmed the viscosity condition. The oil was changed at the next system window. Continuous confirmation of oil quality and timely corrective actions provide evidence that the program is effective in managing aging effects for lube oil components.

Lube oil testing of the A diesel generator in December 2004 and of the B diesel generator in January 2005 indicated a step change in the wear particle count. The increase in iron and aluminum was very minor, and levels remained well below those at which corrective action is necessary. The laboratory analysis indicated that the increases may be the result of new analysis equipment that has a higher resolution. Quarterly trending will continue for wear products, and appropriate action will be taken if required. Continuous confirmation of oil quality and timely corrective actions provide evidence that the program is effective in managing aging effects for lube oil components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the Oil Analysis Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Oil Analysis Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.13.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Oil Analysis Program in PNPS LRA Appendix A, Section A.2.1.24, which states that the Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Program activities include sampling and analysis of lubricating oil for detrimental contaminants, water, and particulates.

Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results.

During the audit and review, the project team noted that the applicant's description of the PNPS AMP B.1.22 program in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancements described in LRA Appendix B.1.22. The project team asked the applicant to include a description of the enhancements to Oil Analysis Program in the UFSAR Supplement in LRA Appendix A as recommended by SRP-LR Section 3.X.2.4. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number(s) associated with the enhancement(s) for that program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that license renewal Commitment Nos. 18 and 19 specify enhancements to this program.

On this basis, the project team found this enhancement to be acceptable because when the enhancement is implemented, PNPS AMP B.1.22, "Oil Analysis Program," will be consistent with GALL AMP XI.M39 and will provide the effects of aging will be adequately managed.

3.0.3.2.13.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to manage the aging effects for which it is credited. Also, the project team has reviewed the enhancements and determined that the implementation of the enhancements before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.14 REACTOR HEAD CLOSURE STUDS PROGRAM (PNPS AMP B.1.25)

In PNPS LRA Appendix B, Section B.1.25, the applicant stated that PNPS AMP B.1.25, "Reactor Head Closure Studs Program," is an existing plant program that is consistent with GALL AMP XI.M3, "Reactor Head Closure Studs," with an exception.

3.0.3.2.14.1 Program Description

The applicant stated in the PNPS LRA that this program includes ISI in conformance with the requirements of ASME Code Section XI, Subsection IWB, and preventive measures (e.g., rust inhibitors, stable lubricants, and appropriate materials) to mitigate cracking and loss of material of reactor head closure studs, nuts, washers, and bushings.

3.0.3.2.14.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.25 is consistent with GALL AMP XI.M3, with an exception.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.25, including AMPER, LRPD-02, Revision 1, Section 4.18, "Reactor Head Closure Studs Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M3. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.25 and associated bases documents to determine consistency with GALL AMP XI.M3.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.20, "Reactor Head Closure Studs Program," ASME Code Section XI, 2001 Edition with 2002 and 2003 Addenda, Table IWB-2500-1; and ASME Code Section XI, 1995 Edition with 1996 Addenda, Table IWB-2500-1.

The project team reviewed those portions of the Reactor Head Closure Studs Program for which the applicant claims consistency with GALL AMP XI.M3 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Reactor Head Closure Studs Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Reactor Head Closure Studs Program acceptable because it conforms to the recommended GALL AMP XI.M3, "Reactor Head Closure Studs," with the exception as described below.

3.0.3.2.14.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Exception

Element: 4: Detection of Aging Effects

Exception: When reactor head closure studs are removed for examination, either a surface or a volumetric examination is allowed.

The GALL Report identified the following recommendation for the "Detection of Aging Effects" program element associated with the exception taken:

> The extent and schedule of the inspection and test techniques prescribed by the program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component. Inspection can reveal cracking, loss of material due to corrosion or wear, and leakage of coolant.
>
> The program uses visual, surface, and volumetric examinations in accordance with the general requirements of Subsection IWA-2000. Surface examination uses magnetic particle, liquid penetration, or eddy current examinations to indicate the presence of surface discontinuities and flaws. Volumetric examination uses radiographic or ultrasonic examinations to indicate the presence of discontinuities or flaws throughout the volume of material. Visual VT-2 examination detects evidence of leakage from pressure-retaining components, as required during the system pressure test.
>
> Components are examined and tested as specified in Table IWB-2500-1. Examination category B-G-1 for pressure-retaining bolting greater than 2 in. diameter in reactor vessels specifies volumetric examination of studs in place, from the top of the nut to the bottom of the flange hole, and surface and volumetric examination of studs when removed. Also specified are volumetric examination of flange threads and visual VT-1 examination of surfaces of nuts, washers, and bushings. Examination category B-P for all pressure-retaining components specifies visual VT-2 examination of all pressure-retaining boundary components during the system leakage test and the system hydrostatic test.

The applicant stated in the PNPS LRA that cracking initiates on the outside surfaces of bolts and studs. Therefore, a qualified surface examination meeting the acceptance standards of ASME Code Section XI, Subsection IWB-3515, provides at least the sensitivity for flaw detection that an end-shot ultrasonic examination provides on bolts and studs. Thus, when reactor head closure studs are removed for examination, either a surface or volumetric examination is allowed.

During the audit and review, the project team asked the applicant whether the surface examination of the reactor head closure studs that are removed is performed with the studs in a tensioned or untensioned condition. The project team also asked the applicant whether PNPS has performed any radial ultrasonic scans of its RV closure studs. In response to these requests, the applicant provided the following statements:

> Since refueling outage 15 (RFO15) (2005), PNPS has adopted the 1998 edition with 2000 addenda of ASME Section XI, which requires either a surface exam or a volumetric exam of RPV studs that are removed. PNPS elected to perform a

volumetric examination of these four studs in RFO15 in the tensioned condition prior to their removal. No indications were detected in the four removed studs in 2005. The four studs adjacent to the fuel transfer chute are removed at each refueling outage; these are the only studs that have been removed from the PNPS vessel.

PNPS currently performs ultrasonic examination of RPV studs from the top surface of the stud. In the past, PNPS had performed this examination using a specially fabricated stud radial ultrasonic testing (UT) probe inserted into the stud's heater hole located on the stud's central axis. The technique currently in use, utilizing the flat surface at the top of the stud, is considered superior in detection of flaws in RPV studs when compared to UT exams performed from the heater hole.

RPV studs at PNPS are examined utilizing a straight beam UT technique. This method has been demonstrated and qualified by the Performance Demonstration Initiative (PDI) at the Electric Power Research Institute (EPRI) Nondestructive Examination (NDE) Center. Examiners utilizing this qualified technique are also qualified by the PDI to perform this examination. This straight beam examination has been demonstrated by PDI to be capable of detecting a flaw of critical size. All 56 RPV studs at PNPS are examined once per interval using this technique.

The project team reviewed the ASME Code Section XI requirements for Examination Category B-G-1, "pressure retaining bolting," in the 1995 Code Edition, which was referenced in Revision 0 of the GALL Report and in the 2001 Code Edition, which is referenced in Revision 1 of the GALL Report. The project team noted that Code examination requirements were changed from the earlier Code edition to the more recent Code edition so that the 2001 Code edition with 2002 and 2003 Addenda, on which the current revision of the GALL Report is based, no longer requires both surface and volumetric examination of RV closure studs when removed. On the basis that the applicant's requirement to perform either surface or volumetric examination of RV closure studs (when removed) is consistent with the ASME Section XI Code edition and addenda referenced in the GALL Report, Revision 1, the project team found the exception identified by the applicant to be acceptable. On this basis, the project team found this exception acceptable.

3.0.3.2.14.4 <u>Enhancements</u>

None.

3.0.3.2.14.5 <u>Operating Experience</u>

The applicant stated in the PNPS LRA that volumetric examination of 18 reactor head closure studs and visual examination of 18 nuts and 18 washers during RFO 15 (April 2005) resulted in no new recordable indications. Absence of new recordable indications provides evidence that the program is effective for managing loss of material and cracking of the reactor head closure studs, nuts, washers, and bushings.

During the audit and review, the project team asked the applicant what fraction of the total number of reactor head closure studs is represented by the 18 studs examined during RFO 15. The project team also asked whether all reactor head closure studs, nuts, and washers are examined during each 10-year ISI interval and whether the currently installed studs, nuts, and washers are original equipment that has been in use since startup of the plant. In response to this request, the applicant provided the following information:

> There are 56 reactor head studs, so a sample of 18 is one-third of the studs (19, 19, 18). All studs, nuts and washers are examined during every 10-year ISI interval. The reactor head studs, nuts, and washers currently installed at PNPS are original equipment.

Based on the applicant's response, the project team determined that the operating experience with the applicant's Reactor Head Closure Studs Program provides evidence that the program has provided acceptable management of aging effects during the current licensed operating period and is expected to provide acceptable management of aging effects during the PEO.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience, as documented in the PNPS License Renewal Project Operating Experience Review Report for the Reactor Head Closure Studs Program, and did not find any evidence of PNPS equipment degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Reactor Head Closure Studs Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.14.6 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the Reactor Head Closure Studs Program in PNPS LRA Appendix A, Section A.2.1.27, which states that the Reactor Head Closure Studs Program includes ISI in conformance with the requirements of ASME Code Section XI, Subsection IWB, and preventive measures (e.g., rust inhibitors, stable lubricants, and appropriate materials) to mitigate cracking and loss of material of reactor head closure studs, nuts, washers, and bushings.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.25, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.14.7 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.15 REACTOR VESSEL SURVEILLANCE PROGRAM (PNPS AMP B.1.26)

This program was reviewed by NRR-DE staff.

3.0.3.2.16 SERVICE WATER INTEGRITY PROGRAM (PNPS AMP B.1.28)

In PNPS LRA Appendix B, Section B.1.28, the applicant stated that PNPS AMP B.1.28, "Service Water Integrity Program," is an existing plant program that is consistent with GALL AMP XI.M20, "Open-Cycle Cooling Water System," with exceptions.

3.0.3.2.16.1 Program Description

The applicant stated in the PNPS LRA that this program relies on implementation of the recommendations of NRC GL 89-13 to ensure that the effects of aging on the SSW system are managed for the PEO. The program includes surveillance and control techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the SSW system or SCs serviced by the SSW system.

3.0.3.2.16.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.28 is consistent with GALL AMP XI.M20, with exceptions.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.28, including LRPD-02, Revision 1, "Evaluation of Aging Management Programs," Section 4.2, "Service Water Integrity Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M20. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.28 and associated bases documents to determine consistency with GALL AMP XI.M20.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.2, "Service Water Integrity Program," NRC GL 89-13, "Service Water System Problems Affecting Safety Related Equipment," July 18, 1989; NRC GL 89-13, Supplement 1, "Service Water System Problems Affecting Safety Related Equipment," April 4, 1990; M591, Revision E7; PNPS 1, "Specification for SSW & Reactor Building Closed Cooling Water (RBCCW) Safety-Related Piping & Heat Exchanger Inspection,

Maintenance & Test Requirements in Response to Generic Letter 89-13"; NOP02E1, Revision 01, "Service Water Inspections, Maintenance and Testing in Response to Generic Letter 89-13."

The project team reviewed those portions of the Service Water Integrity Program for which the applicant claims consistency with GALL AMP XI.M20 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Service Water Integrity Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Service Water Integrity Program acceptable because it conforms to the recommended GALL AMP XI.M20, "Service Water Integrity," with exceptions as described below.

3.0.3.2.16.3 Exceptions to the GALL Report

Exception 1

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Element:	2: Preventive Actions
Exception:	NUREG-1801 states that system components are lined or coated. Components are lined or coated only where necessary to protect the underlying metal surfaces.

The GALL Report identified the following recommendation for the "preventive actions" program element associated with the exception taken:

> The system components are constructed of appropriate materials and lined or coated to protect the underlying metal surfaces from being exposed to aggressive cooling water environments. Implementation of NRC GL 89-13 includes a condition and performance monitoring program; control or preventive measures, such as chemical treatment, whenever the potential for biological fouling species exists; or flushing of infrequently used systems. Treatment with chemicals mitigates microbiologically influenced corrosion (MIC) and buildup of macroscopic biological fouling species, such as blue mussels, oysters, or clams. Periodic flushing of the system removes accumulations of biofouling agents, corrosion products, and silt.

The applicant stated in the PNPS LRA that NUREG-1801 states that system components are constructed of appropriate materials and lined or coated to protect the underlying metal surfaces from being exposed to aggressive cooling water environments. Not all PNPS system components are lined or coated. Components are lined or coated only where necessary to protect the underlying metal surfaces.

During the audit and review, the project team asked the applicant to identify those applications in which components are not coated or lined and the materials of construction. In response to this request, the applicant stated that the SSW supply piping is constructed of titanium, a material

which has shown excellent corrosion resistance in this environment. The other components in the SSW supply are small-bore piping for vents and drains, pump and valve bodies, and heat exchanger tubes. All of these components are constructed of copper alloys that have demonstrated good corrosion resistance in this environment. Also, operating experiences show that loss of material is managed by the Service Water Integrity Program such that corrective action is taken before loss of intended functions of components. On this basis, the project team found this exception acceptable.

Exception 2

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

> Element: 5: Monitoring and Trending
> Exception: NUREG-1801 states that testing and inspections are performed annually and during RFOs. The PNPS program requires tests and inspections during each RFO.

The GALL Report identified the following recommendation for the "monitoring and trending" program element associated with the exception taken:

> Inspection scope, method (e.g., visual or nondestructive examination [NDE]), and testing frequencies are in accordance with the utility commitments under NRC GL 89-13. Testing and inspections are done annually and during refueling outages. Inspections or nondestructive testing will determine the extent of biofouling, the condition of the surface coating, the magnitude of localized pitting, and the amount of MIC, if applicable. Heat transfer testing results are documented in plant test procedures and are trended and reviewed by the appropriate group.

The applicant stated in the PNPS LRA that the NUREG-1801 program entails testing and inspections performed annually and during RFOs. The PNPS program requires tests and inspections during each RFO, but not annually. Since aging effects are typically manifested over several years, the difference in inspection and testing frequency is insignificant.

During the audit and review, the project team evaluated the PNPS inspection interval and agreed that adverse conditions caused by the aging effects in the service water systems manifest over several years. Also, operating experience demonstrates that a 2-year interval has not led to adverse operating conditions of the service water system. Therefore, the difference between a 1-year and 2-year inspection and testing frequency is insignificant. On this basis, the project team found this exception acceptable.

3.0.3.2.16.4 Enhancements

None.

3.0.3.2.16.5 Operating Experience

The applicant stated in the PNPS LRA that results of heat transfer capability testing of the RBCCW heat exchangers from 2001 through 2004 show that the heat exchangers are capable of removing the required amount of heat. Confirmation of adequate thermal performance provides evidence that the program is effective for managing fouling of SSW cooled heat exchangers.

Results of SSW visual inspections, eddy current testing, UT, and radiography testing from 1998 through 2004 revealed areas of erosion and areas of corrosion on internal and external surfaces. SSW butterfly valves, pump discharge check valves, air removal valves, and pipe spools have been replaced with components made of corrosion resistant materials. Also, RBCCW heat exchanger channel assemblies have been replaced and tubes have been sleeved to address erosion and corrosion. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material for SSW system components.

Visual inspections of SSW piping revealed degradation of the lining in original SSW carbon steel rubber-lined piping. Pipe lining is intended to protect pipe internal surfaces from erosion and corrosion. Therefore, SSW piping has been replaced with carbon steel pipe with cured-in-place rubber lining, relined with a ceramic epoxy compound, or replaced with titanium pipe. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material for SSW system components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the Service Water Integrity Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Service Water Integrity Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.16.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Service Water Integrity Program in PNPS LRA Appendix A, Section A.2.1.30, which states that the Service Water Integrity Program relies on implementation of the recommendations of NRC GL 89-13 to ensure that the effects of aging on the SSW system are managed for the PEO. The program includes component inspections for erosion, corrosion, and blockage and performance monitoring to verify the heat transfer capability of the safety-related heat exchangers cooled by SSW. Chemical treatment using biocides and chlorine and periodic cleaning and flushing of redundant or infrequently used loops are the methods used to control or prevent fouling within the heat exchangers and loss of material in SSW components.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.28, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.16.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team reviewed the exceptions and the associated justifications and determined that the AMP, with the exceptions, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.17 STRUCTURES MONITORING – STRUCTURES MONITORING PROGRAM (PNPS AMP B.1.29.2)

In PNPS LRA Appendix B, Section B.1.29.2, the applicant stated that PNPS AMP B.1.29.2, "Structures Monitoring – Structures Monitoring Program," is an existing plant program that is consistent with GALL AMP XI.S6, "Structures Monitoring Program," with enhancements.

3.0.3.2.17.1 Program Description

The applicant stated in the PNPS LRA that structures monitoring in accordance with 10 CFR 50.65 (the Maintenance Rule) is addressed in RG 1.160 and NUMARC 93-01. These two documents provide guidance for development of licensee-specific programs to monitor the condition of structures and structural components within the scope of the Maintenance Rule, such that there is no loss of structure or structural component intended function. Since protective coatings are not relied on to manage the effects of aging for structures included in the Structures Monitoring Program, the program does not address protective coating monitoring and maintenance.

3.0.3.2.17.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.29.2 is consistent with GALL AMP XI.S6, with enhancements. The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.29.2, including AMPER, LRPD-02, Revision 1, Section 4.21, "Structures Monitoring Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.S6. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.29.2 and associated bases documents to determine consistency with GALL AMP XI.S6.

The project team also reviewed PNPS Procedure Nos. MRSSC58, Revision 1, "Building & Structures System 56" ; NE8.02, Revision 3, "Structure Inspection and Condition Monitoring."

The project team reviewed those portions of the Structures Monitoring Program for which the applicant claims consistency with GALL AMP XI.S6 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Structures Monitoring Program provides assurance that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO. The project team found the applicant's Structures Monitoring Program acceptable because it conforms to the recommended GALL AMP XI.S6, "Structures Monitoring Program," with enhancements as described below.

3.0.3.2.17.3 Exceptions to the GALL Report

None.

3.0.3.2.17.4 Enhancements

The applicant stated in the PNPS LRA that the enhancements in meeting the GALL Report program elements are as follows:

Enhancement 1

Element:	1: Scope of Program
Enhancement:	The Structures Monitoring Program procedure will be enhanced to clarify that the discharge structure, security diesel generator building, trenches, valve pits, manholes, duct banks, underground fuel oil tank foundations, manway seals and gaskets, hatch seals and gaskets, underwater concrete in the intake structure, and crane rails and girders are included in the program.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the enhancement:

> The applicant specifies the structure/aging effect combinations that are managed by its Structures Monitoring Program.

The applicant stated in the PNPS LRA that the Structures Monitoring Program at PNPS is comparable to the program described in the GALL Report, Section XI.S6, "Structures Monitoring Program." The Structures Monitoring Program will be enhanced to clarify that the discharge structure, security diesel generator building, trenches, valve pits, manholes, duct banks, underground fuel oil tank foundations, manway seals and gaskets, hatch seal and gaskets, underwater concrete in the intake structure, and crane rails and girders are included in the program. The structures, structural components, and their AERMs under the scope of the Structures Monitoring Program are included in LRA Tables 3.5.2-1 through 3.5.2-6. Visual inspections of accessible plant structures are performed at 3-year intervals, and inspections of normally inaccessible (insulated or high-radiation zone) areas are performed at 10-year intervals. Visual inspections of buried plant structures are performed when opportunistic excavation occurs. However, more frequent inspections may be performed based on past inspection results, industry experience, or exposure to a significant event (e.g., tornado, earthquake, fire, or chemical spill).

On this basis, the project team found this enhancement acceptable because when enhancements are implemented, PNPS AMP B.1.29.2, "Structures Monitoring – Structures Monitoring Program," will be consistent with GALL AMP XI.S6 and will provide the effects of aging will be adequately managed.

Enhancement 2

Element:	4: Detection of Aging Effects
Enhancement:	Guidance for performing structural examinations of elastomers (seals, gaskets, seismic joint filler, and roof elastomers) to identify cracking and change in material properties will be added to the Structures Monitoring Program procedure.

The GALL Report identified the following recommendation for the "discussion of aging effects" program element associated with the enhancement:

> For each structure/aging effect combination, the inspection methods, inspection schedule, and inspector qualifications are selected to ensure that aging degradation will be detected and quantified before there is loss of intended functions. Inspection methods, inspection schedule, and inspector qualifications are to be commensurate with industry codes, standards and guidelines, and are to also consider industry and plant-specific operating experience. Although not required, ACI 349.3R-96 and ANSI/ASCE 11-90 provide an acceptable basis for addressing detection of aging effects. The plant-specific structure monitoring program is to contain sufficient detail on detection to conclude that this program attribute is satisfied.

The applicant stated in the PNPS LRA that cracks, gaps, and corrosion will be monitored as stated in LRPD-02 and Attachment 4, "Structures Monitoring Program General Criteria." For concrete, the Structures Monitoring Program manages loss of material, cracking, and change in material properties, as identified in LRA Tables 3.5.2-1 through 3.5.2-6. The acceptance criteria are the absence of the following: cracks, excessive rust bleeding, staining or discoloration, abrasion, erosion, cavitation, spalling, scaling, leaching, excessive settlement, corrosion of reinforcing, and degraded waterproof membranes. For steel, the Structures Monitoring Program manages the loss of material, as identified in LRA Tables 3.5.2-1 through 3.5.2-6. The acceptance criteria are the absence of the following: pitting, beam/column deflection, cracks, flaking coatings, excessive rust, loose/missing bolts, peeling paint, and wide spread corrosion. For elastomers, the aging effects managed are cracking and change in material properties. The acceptance criteria include the absence of cracks and gaps.

On this basis, the project team found this enhancement acceptable because when enhancements are implemented, PNPS AMP B.1.29.2, "Structures Monitoring – Structures Monitoring Program," will be consistent with GALL AMP XI.S6 and will provide the effects of aging will be adequately managed.

The project team asked the applicant whether it intends to inspect inaccessible areas that may be exposed by excavation for any reason, whether the environment is aggressive or not, and

also whether it intends to inspect inaccessible areas if degradation is observed in accessible areas which are exposed to the same environment. In its response, the applicant stated that PNPS site procedure will be enhanced to require opportunistic inspections of inaccessible concrete areas when they become accessible. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant added this enhancement to Commitment No. 25, which includes Enhancement 1 above. The project team found this acceptable since opportunistic inspections will be performed.

In its response, the applicant also stated that expanding inspection to other areas where significant concrete degradation is observed in the accessible areas will continue to be part of its corrective action program as identified in LRA Appendix B.0.3. The project team found this response to be acceptable since the corrective action program will address expansion of scope when significant degradation is observed.

3.0.3.2.17.5 Operating Experience

The applicant stated in the PNPS LRA that inspections of structural steel, concrete exposed to fluid, and structural elastomers from 1998 through 2004 revealed signs of degradation such as cracks, gaps, corrosion (rust), and flaking coatings. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects for structural components.

Structural inspection of pipe supports and cable trays in November 2004 revealed numerous minor signs of degradation which were repaired. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects for structural components.

A self-assessment in July 2005 revealed no issues or findings that could impact effectiveness of the program.

> The applicant also stated in the industry operating experience at Dresden/Quad Cities (BWR units have a history of problems with containment penetration bellows):
>
> There are no PNPS site-specific operating experiences similar to that of Dresden/Quad Cities. The normal environment for the PNPS drywell is dry, and there has been no indication of contamination of the bellows during construction at PNPS. In addition, containment bellows for PNPS are not exposed to a corrosive environment. As such SCC is not applicable to PNPS stainless steel bellows.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Structures Monitoring Program

will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.17.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Structures Monitoring Program in PNPS LRA Appendix A, Section A.2.1.32, which states that the Structures Monitoring Program is in accordance with 10 CFR 50.65 (the Maintenance Rule) as addressed in RG 1.160 and NUMARC 93-01. Periodic inspections are used to monitor the condition of structures and structural components to ensure there is no loss of structure or structural component intended function.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Section A.2.1.32, “Structures Monitoring – Structures Monitoring Program,” is revised to add “License renewal commitments 25 and 26 specify enhancements to this program.”

The project team reviewed the UFSAR Supplement and the amendment for PNPS AMP B.1.29.2, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.17.7 Conclusion

On the basis of its review and audit of the applicant’s program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. Also, the project team reviewed the enhancements and determined that the implementation of the enhancements before the PEO would result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.18 STRUCTURES MONITORING – WATER CONTROL STRUCTURES MONITORING PROGRAM (PNPS AMP B.1.29.3)

In PNPS LRA Appendix B, Section B.1.29.3, the applicant stated that PNPS AMP B.1.29.3, “Structures Monitoring – Water Control Structures Monitoring Program,” is an existing plant program that is consistent with GALL AMP XI.S7, RG 1.127, “Inspection of Water-Control Structures Associated with Nuclear Power Plants," with an enhancement.

3.0.3.2.18.1 Program Description

The applicant stated in the PNPS LRA that the program includes visual inspections to manage loss of material and loss of form for water control structures (breakwaters, jetties, and revetments). The water control structures are of rubble mound construction with the outer layer protected by heavy capstone. Parameters monitored include settlement (vertical displacement) and rock displacement. These parameters are consistent with those described in RG 1.127.

3.0.3.2.18.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.29.3 is consistent with GALL AMP XI.S7, with an enhancement.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.29.3, including AMPER, LRPD-02, Revision 1, Section 4.21.3, "Water Control Structures Monitoring Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.S7. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.29.3 and associated bases documents to determine consistency with GALL AMP XI.S7.

The project team also reviewed PNPS Procedure No. 3.M.5-3, Revision 0, "Main Breakwater Monitoring and Repair Procedure."

The project team reviewed those portions of the Water Control Structures Monitoring Program for which the applicant claims consistency with GALL AMP XI.S7 and found that the PNPS program is comparable to the program described in the GALL Report, Section XI.S7, RG 1.127, "Inspection of Water Control Structures Associated with Nuclear Power Plants." The program includes visual inspections to manage loss of material and loss of form for water control structures (breakwaters, jetties, and revetments). The water control structures are of rubble mound construction with the outer layer protected by heavy capstone. Parameters monitored include settlement (vertical displacement) and rock displacement. These parameters are consistent with those described in RG 1.127. There are no underwater supports identified within scope of this program. Visual inspections are performed on water control structures at least every 5 years and following major storms (AMPER, LRPD-02, Section 4.21.3.4(b)). For that, they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Water Control Structures Monitoring Program provides assurance that the aging effects will be adequately managed so that the intended functions will be maintained during the PEO. The project team found the applicant's Water Control Structures Monitoring Program acceptable because it conforms to the recommended GALL AMP XI.S7, RG 1.127, "Inspection of Water Control Structures Associated with Nuclear Power Plants," with the enhancement as described below.

3.0.3.2.18.3 Exceptions to the GALL Report

None.

3.0.3.2.18.4 Enhancements

The applicant stated in the PNPS LRA that the enhancement in meeting the GALL Report program elements is as follows:

Enhancement

Element:	1: Scope of Program
Enhancement:	Program scope will be enhanced to include the east breakwater, jetties and onshore revetments in addition to the main breakwater.

The GALL Report identified the following recommendation for the "scope of program" program element associated with the enhancement:

> RG 1.127 applies to water-control structures associated with emergency cooling water systems or flood protection of nuclear power plants. The water-control structures included in the RG 1.127 program are concrete structures; embankment structures; spillway structures and outlet works; reservoirs; cooling water channels and canals, and intake and discharge structures; and safety and performance instrumentation.

The applicant stated in the PNPS LRA that the Water Control Structures Monitoring Program at PNPS is comparable to the program described in the GALL Report, Section XI.S7, RG 1.127, "Inspection of Water Control Structures Associated with Nuclear Power Plants." The program includes visual inspections to manage loss of material and loss of form for water control structures (breakwaters, jetties, and revetments). The water control structures are of rubble mound construction with the outer layer protected by heavy capstone. The parameters monitored include settlement and are consistent with those described in RG 1.127. There are no underwater supports identified within the scope of this program. However, the program scope will be enhanced to include the east breakwater, jetties, and onshore revetments in addition to the main breakwater (Commitment No. 27).

On this basis, the project team found this enhancement acceptable because when the enhancement is implemented, PNPS AMP B.1.29.3, "Structures Monitoring – Water Control Structures Monitoring Program," will be consistent with GALL AMP XI.S7 and will provide the effects of aging will be adequately managed.

3.0.3.2.18.5 Operating Experience

The applicant stated in the PNPS LRA that preliminary results of the 2004 inspection of the main breakwater indicated that one area of the breakwater had rock displacement resulting in the complete dislodging of the rocks on the shore side of the main breakwater. Since the discontinuity extended beyond the facade but did not involve the full height or width of the water control structure, an evaluation was performed to determine if repair was required to restore the designed stability of the structure. Results of the evaluation show that the designed stability of the structure was not impacted; however, a work request was issued to repair the structure due to the possibility of future storms extending the damaged areas and restricting personnel from easily walking on the structure. The applicant has completed this work. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material and loss of form for water control structures.

The project team reviewed the CR-PNP-2004-03933 (December 13, 2004) dislodged at point "L" station "5," shore side; CR-PNP-2005-00093 (January 10, 2005) dislodged at point "L" station "5," channel side (adjacent to CR-PNP-2004-03933 but smaller in size); CR-PNP-2005-00450 (January 23, 2005) at multiple areas (smaller in size compared to the previous two); and CR-PNP-2005-03018. PNPS Maintenance Request No. 04118760 for repairs on CR-PNP-2004-0393, 2005-00093, 2005-00450, and 2005-03018 had been completed and closed.

The Water Control Structures Monitoring Program has been effective at managing aging effects and provides assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the CLB for the PEO.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

The project team recognized that the corrective action program, which captures internal and external plant operating experience issues, will ensure that operating experience is reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging are adequately managed.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Water Control Structures Monitoring Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.18.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Water Control Structures Monitoring Program in PNPS LRA Appendix A, Section A.2.1.33, which states that the Water Control Structures Monitoring Program includes visual inspections to manage loss of material and loss of form for water control structures (breakwaters, jetties, and revetments). The water control structures are of rubble mound construction with the outer layer protected by heavy capstone. Parameters monitored include settlement (vertical displacement) and rock displacement. These parameters are consistent with those described in RG 1.127.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Section A.2.1.32, "Structures Monitoring – Structures Monitoring Program," is revised to add "License renewal commitment 27 to specify enhancement to this program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.2.3, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.18.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. Also, the project team reviewed the enhancement and determined that the implementation of the enhancement before the PEO will result in the existing AMP being consistent with the GALL Report AMP to which it was compared. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.19 WATER CHEMISTRY CONTROL – CLOSED COOLING WATER PROGRAM (PNPS AMP B.1.32.3)

In PNPS LRA Appendix B, Section B.1.32.3, the applicant stated that PNPS AMP B.1.32.3, "Water Chemistry Control – Closed Cooling Water Program," is an existing plant program that is consistent with GALL AMP XI.M21, "Closed-Cycle Cooling Water System," with an exception.

3.0.3.2.19.1 Program Description

The applicant stated in the PNPS LRA that this program includes preventive measures that manage loss of material, cracking, and fouling for components in closed cooling water (CCW) systems (RBCCW, turbine building closed cooling water (TBCCW), EDG cooling water, SBO diesel cooling water, security diesel generator cooling water, and plant heating). These chemistry activities provide for monitoring and controlling CCW chemistry using PNPS procedures and processes based on EPRI guidance for CCW chemistry.

3.0.3.2.19.2 Consistency with the GALL Report

In the PNPS LRA, the applicant stated that PNPS AMP B.1.32.3 is consistent with GALL AMP XI.M21, with an exception.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.32.3, including AMPER, LRPD-02, Revision 1, Section 4.23.3, "Water Chemistry Control Closed Cooling Water Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M21. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.32.3 and associated bases documents to determine consistency with GALL AMP XI.M21.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.29, "Water Chemistry Control – Closed Cooling Water Program," PNPS Procedure No. 7.8.1, Revision 40, "Chemistry Sample and Analysis Program Procedure," and PNPS Procedure No. 7.8.7, Revision 1, "Recording and Trending of Chemistry Data Procedure."

In the program description, the GALL Report recommends testing and inspection to monitor the effects of corrosion and SCC on the intended function of the component. The applicant does not

include performance testing as part of this program. The applicant stated that EPRI Report TR-107396 does not recommend that equipment performance and functional testing be part of a water chemistry control program. Rather, EPRI Report TR-107396 states in Section 5.7 (Section 8.4 in EPRI Report 1007820) that performance monitoring is typically part of an engineering program, which would not be part of water chemistry. Usually, this performance and functional testing is part of the Maintenance Rule for active components. Thus, the testing as recommended is performed – just not as part of the Water Chemistry Program – and is therefore found acceptable.

The project team noted that the exception taken for Element 4, "Detection of Aging Effects," concerning the performance and functional testing should also have been applied to Element 3, "Parameters Monitored/Inspected," for the same reason that it applies to Element 4. The project team asked the applicant to justify why this exception does not apply to Element 3. In its response, the applicant stated that the exception in LRA Section B.1.32.3, which was applied to the "detection of aging effects" program element, is equally applicable to the "parameters monitored/trended" program element. The exception was discussed under Element 4 since it is more directly related to detection of aging effects. However, LRA Section B.1.32.3 will be amended to indicate that the exception is applicable to both the "parameters monitored/trended" and "detection of aging effects" program elements. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Section B.1.32.3 is revised to indicate that the exception is applicable to both Attribute 3, "Parameters Monitored/Trended," and Attribute 4, "Detection of Aging Effects." The exception is addressed in Section 3.0.3.2.19.3 of this audit and review report.

The GALL Report recommends that for "susceptible locations," an OTI verification program may be appropriate. The project team asked the applicant if it intended to implement a One-Time Inspection Program for this water chemistry control program and, if so, why this was not included in the UFSAR Supplement Appendix A for this program. In its response, the applicant stated that the One-Time Inspection Program described in LRA Section B.1.23 does include inspections to verify the effectiveness of the water chemistry control AMPs by confirming that unacceptable cracking, loss of material, and fouling is not occurring. Discussions in LRA Section 3, Table 1, provide the link between the One-Time Inspection Program and water chemistry control program for susceptible components. However, for clarity, LRA Appendix A descriptions for the Water Chemistry Control – Closed Cooling Water Program will be amended to provide a link to the One-Time Inspection Program activities to confirm the effectiveness of these programs. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the following sentence: "The One-Time Inspection Program will confirm the effectiveness of the program." Based on changes to the Appendix A writeup, the applicant's response was found to be acceptable.

The project team reviewed those portions of the Water Chemistry Control – Closed Cooling Water Program for which the applicant claims consistency with GALL AMP XI.M21 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Water Chemistry Control – Closed Cooling Water Program provides

assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Water Chemistry Control – Closed Cooling Water Program acceptable because it conforms to the recommended GALL AMP XI.M21, "Closed-Cycle Cooling Water System," with the exception as described below.

3.0.3.2.19.3 Exceptions to the GALL Report

The applicant stated in the PNPS LRA that the exception to the GALL Report program elements is as follows:

Exception

Element: 4: Detection of Aging Effects
Exception: The PNPS Water Chemistry Control – Closed Cooling Water Program does not include performance and functional testing.

The GALL Report identified the following recommendation for the "detection of aging effects" program element associated with the exception taken:

> Control of water chemistry does not preclude corrosion or SCC at locations of stagnant flow conditions or crevices. Degradation of a component due to corrosion or SCC would result in degradation of system or component performance. The extent and schedule of inspections and testing should assure detection of corrosion or SCC before the loss of the intended function of the component. Performance and functional testing ensures acceptable functioning of the CCCW system or components serviced by the CCCW system. For systems and components in continuous operation, performance adequacy should be verified by monitoring component performance through data trends for evaluation of heat transfer capability, system branch flow changes, and chemistry data trends. Components not normally in operation are periodically tested to ensure operability.

The applicant stated in the PNPS LRA that while NUREG-1801, Section XI.M21, "Closed-Cycle Cooling Water System" endorses EPRI Report TR-107396 for performance and functional testing guidance, EPRI Report TR-107396 does not recommend that equipment performance and functional testing be part of a water chemistry control program. This appears appropriate since monitoring pump performance parameters are of little value in managing effects of aging on long-lived, passive CCW system components. Rather, EPRI Report TR-107396 states in Section 5.7 (Section 8.4 in EPRI report 1007820) that performance monitoring is typically part of an engineering program, which would not be part of water chemistry. In most cases, functional and performance testing verifies that component active functions can be accomplished and, as such, would be included as part of the Maintenance Rule (10 CFR 50.65). Passive intended functions of pumps, heat exchangers, and other components will be adequately managed by the CCW chemistry program through monitoring and control of water chemistry parameters.

The project team reviewed EPRI Report TR-107396 and agreed with the applicant that it does not recommend that performance and functional testing be part of the water chemistry control program. This testing could be performed as part of another program. Usually, the Maintenance Rule dictates the requirements of the performance and functional testing. However, in the last sentence of the applicant's justification, PNPS stated that the passive intended functions were adequately managed by the CCW chemistry control program through monitoring and control of water chemistry. The project team asked the applicant whether the One-Time Inspection Program was also used to verify the effectiveness of the chemistry program and, if so, whether it should be addressed as part of the exception justification. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Section B.1.32.3, Exception Note 1, is revised as follows:

> Passive intended functions of pumps, heat exchangers, and other components will be adequately managed by the Closed Cooling Water Chemistry and One-Time Inspection Programs through monitoring and control of water chemistry parameters and verification of the absence of aging effects.

On this basis, the project team found the applicant's response acceptable and found the exception acceptable.

3.0.3.2.19.4 Enhancements

None.

3.0.3.2.19.5 Operating Experience

The applicant stated in the PNPS LRA that during the period from 1998 through 2004, several CRs were initiated due to adverse trends in parameters (nitrite and tolytriazole) monitored by the Water Chemistry Control – Closed Cooling Water Program. Corrective actions were taken within the corrective action program to preclude reaching unacceptable values. No increases, long- or short-term, were observed in iron or copper levels. Continuous confirmation of water quality and corrective action before reaching control limits provide evidence that the program is effective in managing aging effects for applicable components.

During the period from 1998 through 2004, two CRs were initiated due to parameters monitored by the Water Chemistry Control – Closed Cooling Water Program that were outside of administrative limits but still within EPRI acceptance criteria. Corrective actions were taken within the corrective action program to preclude violating EPRI acceptance criteria. Continuous confirmation of water quality and corrective action before reaching control limits provide evidence that the program is effective in managing aging effects for applicable components.

During the period from 1998 through 2004, a few incidents occurred in which station heating system parameters monitored by the Water Chemistry Control – Closed Cooling Water Program were outside of EPRI Action Level 1 acceptance criteria. Monitoring frequency was increased and the parameter was returned to within the prescribed normal operating range as soon as possible (well within the 90 days permitted by Action Level 1). Continuous confirmation of water

quality and timely corrective action provide evidence that the program is effective in managing aging effects for applicable components.

QA audits in 2000 and 2002 revealed no issues or findings that could impact effectiveness of the program.

A self-assessment in October 2003 noted that chemistry specifications and methods of control were not clearly established for NSR diesel jacket coolant systems. This assessment and a QA audit in early 2004 revealed that corrective actions for CRs addressing CCW analyses had not been completed in a timely manner. Specifically, CRs initiated in early 2003 identified that for RBCCW, TBCCW, and plant heating, some chemical analyses were not being performed in the frequencies defined in procedures due to faulty analysis equipment. In June 2004, corrective actions had not been completed. Corrective actions were taken by the end of 2004 to reinstate all analyses and confirm water quality for the RBCCW, TBCCW, and plant heating systems. Completion of corrective actions and confirmation of water quality provide evidence that the program is effective in managing aging effects for applicable components.

When the revised EPRI CCW guidelines were first implemented in January 2005, new jacket coolant chemistry parameters did not meet recommendations for the EDG, SBO, and security diesels. The parameters that did not meet recommendations are indicators that the glycol and corrosion inhibitor products in the jacket cooling water systems are degrading and becoming less effective. Evaluation determined that there were no immediate concerns of corrosion or cooling ability breakdown for the diesels as other parameters routinely analyzed were in specification and had no adverse trend to indicate an immediate need for action. Work requests were issued to change the SBO and security diesel cooling water during the next maintenance window. Evaluation determined that EDG jacket coolant changeout was not warranted. Continuous confirmation of water quality and timely corrective action provide evidence that the program is effective in managing aging effects for applicable components.

A self-assessment of the Water Chemistry Control – Closed Cooling Water Program was performed in August 2005 to assess how well the program was implementing the revised EPRI CCW guidelines. The assessment concluded that open issues remain regarding the tolytriazole achievable limit for the security diesel and reserve alkalinity achievable limit for the EDGs and SBO diesel. The applicant will complete this work in the future.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.29, "Water Chemistry Control – Closed Cooling Water Program." Several instances where the limit levels were exceeded are identified, with appropriate actions taken. The program is effective in managing aging effects.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Water Chemistry Control – Closed Cooling Water Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.19.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Water Chemistry Control – Closed Cooling Water Program in PNPS LRA Appendix A, Section A.2.1.38, which states that the Water Chemistry Control – Closed Cooling Water Program includes preventive measures that manage loss of material, cracking, and fouling for components in CCW systems (RBCCW, TBCCW, EDG cooling water, SBO diesel cooling water, security diesel generator cooling water, and plant heating). These chemistry activities provide for monitoring and controlling CCW chemistry using PNPS procedures and processes based on EPRI guidance for CCW chemistry.

As stated above in Section 3.0.3.2.19.2, in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the following sentence: "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.32.3, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.19.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.20 BOLTING INTEGRITY PROGRAM (PNPS AMP B.1.33)

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant submitted Appendix B, Section B.1.33, and stated that PNPS AMP B.1.33, "Bolting Integrity Program," is a new plant program that is consistent with GALL AMP XI.M18, "Bolting Integrity," with an enhancement.

3.0.3.2.20.1 Program Description

The applicant stated in the PNPS LRA Amendment 5 that this program relies on recommendations for a comprehensive bolting integrity program as delineated in NUREG-1339 and industry recommendations as delineated in the EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for comprehensive bolting maintenance as delineated in EPRI TR-104213 for pressure-retaining bolting and structural bolting.

3.0.3.2.20.2 Consistency with the GALL Report

The Bolting Integrity Program at PNPS is consistent with the program described in the GALL Report, Section XI.M18, "Bolting Integrity," with an enhancement.

The project team interviewed the applicant's technical staff and reviewed, in whole or in part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.33, including AMPER, "Bolting Integrity Program," which provides an assessment of the AMP elements' consistency with GALL AMP XI.M18. Specifically, the project team reviewed the program elements (see Section 3.0.2.1 of this audit and review report) contained in PNPS AMP B.1.33 and associated bases documents to determine consistency with GALL AMP XI.M18.

The applicant stated that this program covers bolting within the scope of license renewal, including (1) safety-related bolting, (2) bolting for nuclear steam supply system (NSSS) component supports, (3) bolting for other pressure-retaining components including NSR bolting, and (4) structural bolting (actual measured yield strength is less than or equal to 150 ksi). The aging management of reactor head closure studs is addressed by GALL AMP XI.M3 and is not included in this program. The staff's recommendations and guidelines for comprehensive bolting integrity programs that encompass all safety-related bolting are delineated in NUREG-1339, which includes the criteria established in the 1995 Edition through the 1996 Addenda of ASME Code Section XI. The industry's technical basis for the program for safety-related bolting and guidelines for material selection and testing, bolting preload control, ISI, plant operation and maintenance, and evaluation of the structural integrity of bolted joints are outlined in EPRI NP-5769, with the exceptions noted in NUREG-1339. For other bolting, this information is set forth in EPRI TR-104213.

The applicant stated that the Bolting Integrity Program applies to bolting and torquing practices of safety-related and NSR bolting for pressure-retaining components, NSSS component supports, and structural joints. The program addresses all bolting regardless of size. Guidance for the program is contained in NUREG 1339, which refers to EPRI NP-5769 and EPRI NP-5067 for technical bases. For other (structural) bolting, the guidelines of EPRI TR-104213 are followed.

The project team reviewed those portions of the Bolting Integrity Program for which the applicant claims consistency with GALL AMP XI.M18 and found that they are consistent with the GALL Report AMP. Furthermore, the project team concluded that the applicant's Bolting Integrity Program provides assurance that effects of aging will be managed so that components crediting this program can perform their intended function consistent with the CLB during the PEO. The project team found the applicant's Bolting Integrity Program acceptable because it conforms to the recommended GALL AMP XI.M18, "Bolting Integrity," with the enhancements as described below.

3.0.3.2.20.3 Exceptions to the GALL Report

None.

3.0.3.2.20.4 Enhancements to the GALL Report

The applicant stated, in the PNPS LRA, that the enhancements in meeting the GALL Report preventive actions elements are as follows:

Enhancement

Element:	2: Preventive Actions
Enhancement:	Enhance procedures to verify gasket compression if applicable following assembly. Enhance procedures to clarify that actual yield strength is used in selecting materials for low susceptibility to SCC and to clarify the prohibition on the use of lubricants containing MoS_2 for bolting at PNPS.

The GALL Report identified the following recommendation for the "Preventive Actions" program element associated with the enhancement:

> Selection of bolting material and the use of lubricants and sealants is in accordance with the guidelines of EPRI NP-5769, and the additional recommendations of NUREG-1339, to prevent or mitigate degradation and failure of safety-related bolting (see element 10, below). NUREG-1339 takes exception to certain items in EPRI NP-5769, and recommends additional measures with regard to them. Bolting replacement activities include proper torquing of the bolts and checking for uniformity of the gasket compression after assembly. Maintenance practices require the application of an appropriate preload, based on EPRI documents.

The project team finds that these enhancements are acceptable. The enhancements are to procedures to ensure that the recommendations in the referenced documents are properly implemented.

3.0.3.2.20.5 Operating Experience

The applicant stated that operating experience reviews did not identify cracking or loss of preload as AERMs for pressure boundary bolting. Although cracking and loss of preload are not AERMs for the PEO, plant procedures implement the recommendations of NUREG-1339, "Resolution to Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," for pressure boundary bolting in the scope of license renewal. Plant procedures address material and lubricant selection, design standards, and good bolting maintenance practices in accordance with EPRI 5067, "Good Bolting Practices."

PNPS commits (Commitment No. 32) to implement the Bolting Integrity Program in accordance with the LRA amendment.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Bolting Integrity Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.2.20.6 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Bolting Integrity Program, Appendix A, Section A.2.1.39, which states that the Bolting Integrity Program relies on recommendations for a comprehensive bolting integrity program as delineated in NUREG-1339 and industry recommendations as delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for comprehensive bolting maintenance as delineated in EPRI TR-104213 for pressure-retaining bolting and structural bolting.

License Renewal Commitment No. 32 specifies enhancement to this program.

The project team reviewed the UFSAR Supplement for PNPS AMP B.1.2, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program as identified in the SRP-LR FSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.2.20.7 Conclusion

On the basis of its review and audit of the applicant's program, the project team found that those program elements for which the applicant claims consistency with the GALL Report are consistent with the GALL Report. In addition, the project team has reviewed the exception and the associated justifications and determined that the AMP, with the exception, is adequate to manage the aging effects for which it is credited. The project team also reviewed the UFSAR Supplement for this AMP and found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 PNPS AMPs That Are Not Consistent with or Not Addressed in the GALL Report

3.0.3.3.1 HEAT EXCHANGER MONITORING PROGRAM (PNPS AMP B.1.15)

In PNPS LRA Appendix B, Section B.1.15, the applicant described PNPS AMP B.1.15, "Heat Exchanger Monitoring Program."

The applicant stated that PNPS AMP B.1.15 is a new plant-specific program. The Heat Exchanger Monitoring Program will inspect heat exchangers for degradation. If degradation is found, then an evaluation will be performed to evaluate its effects on the heat exchanger's design functions, including its ability to withstand a seismic event.

Representative tubes within the sample population of heat exchangers will be eddy current tested at a frequency determined by internal and external operating experience to ensure that effects of aging are identified before loss of intended function. Along with each eddy current

test, visual inspections will be performed on accessible heat exchanger heads, covers, and tube sheets to monitor surface condition for indications of loss of material. The sample population of heat exchangers includes the RHR heat exchangers, core spray pump motor thrust bearing lube oil coolers, high-pressure coolant injection (HPCI) gland seal condenser, HPCI turbine lube oil cooler, RCIC lube oil cooler, recirculation pump motor generator (MG) set fluid coupling oil and bearing coolers, CRD pump oil coolers, recirculation pump motor lube oil coolers, cleanup recirculation pump lube oil coolers and stuffing box cooler, and EDG lube oil coolers.

The program will be initiated before the PEO.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.15, including AMPER, LRPD-02, Revision 1, Section 4.9, "Heat Exchanger Monitoring Program," and interviewed the applicant's technical staff.

3.0.3.3.1.1 Review of the PNPS AMP B.1.15 Against the Program Elements

The project team reviewed PNPS AMP B.1.15 against the AMP elements found in SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.1.1.1 Scope of Program

The "scope of program" program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the SCs addressed with this program.

The applicant stated in PNPS AMP B.1.15, for the "scope of program" program element, that this program will manage aging effects on selected heat exchangers in various systems as identified in AMRs.

The project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. On this basis, the project team found that the applicant's proposed program scope is acceptable.

3.0.3.3.1.1.2 Preventive Actions

The "preventive actions" program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.15, for the "preventive actions" program element, that this program is an inspection program and no actions are taken as part of this program to prevent degradation.

The project team determined that the "preventive actions" program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. This is an inspection program and no actions are

taken as part of this program to prevent degradation. Item 2 of the SRP, "Preventive Action," is not applicable because the Heat Exchanger Monitoring Program is an inspection program. Preventive actions of this program are consistent with SRP-LR. On this basis, the project team found the applicant's "preventive actions" to be acceptable.

3.0.3.3.1.1.3 Parameters Monitored/Inspected

The "parameters monitored/inspected" program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

> The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).
>
> For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.
>
> For performance monitoring programs, a link should be established between degradation of the particular structure's or component's intended function(s) and the parameter being monitored.
>
> For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.15, for the "parameters monitored/inspected" program element, that, where practical, eddy current inspections of shell-and-tube heat exchanger tubes will be performed to determine tube wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets where accessible to monitor surface condition for indications of loss of material.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. Heat exchanger tubes will be subjected to eddy current inspection to determine wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets for loss of material. Inspection techniques linked to specific degradation are identified. The parameters monitored/inspected in this program are consistent with the SRP-LR. On this basis, the project team found the applicant's description of the "parameters monitored/inspected" is acceptable.

3.0.3.3.1.1.4 Detection of Aging Effects

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

- Provide information that links the parameters to be monitored or inspected to the aging effects being managed.
- Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).

- Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.

- Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on aspects of the SCs such as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, and aging effects.

The applicant stated in PNPS AMP B.1.15, for the "detection of aging effects" program element, that loss of material is the aging effect managed by this program. Representative tubes within the sample population of heat exchangers will be eddy current tested at a frequency determined by internal and external operating experience to ensure that effects of aging are identified before loss of intended function. Visual inspections of accessible heat exchangers will be performed on the same frequency as eddy current inspections.

An appropriate sample population of heat exchangers will be determined based on operating experience before inspections. Inspection can reveal loss of material that could result in degradation of the heat exchangers. Fouling is not addressed by this program.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR. Representative tubes within a sample population of heat exchangers will be eddy current tested at a frequency determined by operating experience. Visual inspections of accessible heat exchangers will be performed at the same frequency as the eddy current inspections. Sample population will be based on operating experience before the inspections. Parameters to be inspected (wall thickness and evidence of corrosion) are appropriate to assure the heat exchangers will be adequately maintained for license renewal under all CLB design conditions. However, the project team noticed that there were no provisions to detect localized corrosion such as MIC and crevice corrosion. As a result, the applicant was requested to identify what method(s) will be used to detect localized corrosion and to determine areas to be inspected and frequency of inspections for localized corrosion.

In its response, the applicant stated that this is a new program and the details have not yet been developed. In accordance with LRPD- 02, Sections 3.2.B.3 and 3.2.B.4, where practical, eddy current inspections of shell-and-tube heat exchanger tubes will be performed to determine tube wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets where accessible to monitor surface conditions for indications of loss of material, such as areas where localized corrosion could occur (i.e., stagnant/low flow areas). A potential approach for determining the inspection frequency would be that once the initial inspections are completed, the results would be used to determine the frequency to ensure that effects of aging are identified before loss of intended function. Inspection frequency will depend on the specific component operating parameters (process fluid, cooling medium, pressures, materials), maintenance history, licensing commitments, NEI Loss Control Standards, and operating experience. The project team determined that the applicant's response to this request was acceptable because this approach to establishing inspection locations for localized corrosion will provide the effects of aging will be adequately managed.

During the audit and review process, the project team determined that more detail was needed to evaluate the adequacy of the inspection sample size and frequency. The project team asked the applicant to provide additional details describing the methods that will be used to establish the inspection sample size and frequency. In its response, the applicant stated that a review of the specific component's mechanical design, environments, operating conditions, and flow paths combined with its maintenance history and internal and external operating experience will be used to determine the inspection sample size and frequency. The sample size will most likely include peripheral tubes and areas within a particular heat exchanger that are more susceptible to wear, corrosion, or damage (i.e., adjacent to inlet/outlet nozzles and changes in flow direction) and will consider industry best practices and EPRI recommendations. Once the initial inspections are completed, the results will be used to determine the inspection frequency to ensure that effects of aging are identified before loss of intended function. Visual inspections of accessible heat exchangers will be performed on the same frequency as eddy current inspections. The project team determined that the applicant's response to this request was acceptable because this approach to establishing inspection sample size and frequency will provide assurance that the effects of aging will be adequately managed.

The project team also noticed that the Heat Exchanger Monitoring Program does not describe when, where, and how program data are collected. Therefore, the project team requested the applicant to provide detail on data collection. In its response, the applicant stated that this is a new program and the details of data collection are not available. However, inspections will be performed either online or during refueling outages (depending on the particular component). The data will be collected and analyzed, and required actions will be taken at that time. The data will also be utilized for longer term trending and for developing future action plans and will be maintained in accordance with site QA program requirements. The project team determined that the applicant's response to this request was acceptable because this approach to establishing data collection will provide assurance that the effects of aging will be adequately managed.

On this basis, the project team found that the applicant's description of the "detection of aging effects" is acceptable.

3.0.3.3.1.1.5 Monitoring and Trending

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.15, for the "monitoring and trending" program element, that results will be evaluated against established acceptance criteria and an assessment will be

made on the applicable degradation mechanism, degradation rate, and allowable degradation level. This information will be used to develop future inspection scope and to modify inspection frequency, if appropriate. Wall thickness will be trended and projected to the next inspection. Corrective actions will be taken if projections indicate that the acceptance criteria may not be met at the next inspection.

The project team determined that for visual inspection, this program element satisfies the criteria defined in Appendix A.1.2.3.5 of the SRP-LR. The PNPS Heat Exchanger Monitoring Program states that the inspection results will be evaluated against established criteria. During the audit and review process, the project team determined that monitoring and trending is not described in enough detail to allow an assessment of the predictability of the extent of degradation. As a result, the applicant was requested to provide details describing the methods to assess remaining component life for loss of material using inspection results such that timely mitigative action can be made.

In its response, the applicant stated that because this is a new program, exact details are not yet available. Wall thickness will be trended and projected to the next inspection. Corrective actions will be taken if projections indicate that the acceptance criteria may not be met at the next inspection (LRPD-02 Section 3.2.B.6). Trend information along with operating experience will be utilized to determine the remaining component life. The project team determined that the applicant's response to this request was acceptable because this approach to establishing remaining component life will provide the effects of aging will be adequately managed.

On this basis, the project team found the applicant's description of the "monitoring and trending" is acceptable.

3.0.3.3.1.1.6 Acceptance Criteria

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

- The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

- The program should include a methodology for analyzing the results against applicable acceptance criteria.

- Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the requirements of the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.15, for the "acceptance criteria" program element, that the minimum acceptable tube wall thickness for each heat exchanger to be eddy current inspected will be established based on a component-specific engineering evaluation. Wall thickness will be acceptable if it is greater than the minimum wall thickness for the component.

To meet the acceptance criterion for visual inspections, heat exchanger heads, covers, and tube sheets must show no evidence of degradation that could lead to loss of function. If degradation that could lead to loss of intended function is detected, a CR will be written and the issue resolved in accordance with the site corrective action program.

The project team reviewed this program element to determine whether or not it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. The PNPS Heat Exchanger Monitoring Program states that minimum wall thickness will be established based on a component-specific engineering evaluation. However, no numerical values or processes to establish acceptance criteria were provided. As a result, the project team asked the applicant to provide more details on how acceptance criteria will be established.

In its response, the applicant stated that the minimum acceptable tube wall thickness for each heat exchanger to be eddy current inspected will be established based on a component-specific engineering evaluation based on Code requirements, EPRI guidelines, and internal calculations. Wall thickness will be acceptable if it is greater than the minimum wall thickness for the component. The acceptance criterion for visual inspections of heat exchanger heads, covers, and tube sheets will be no evidence of degradation that could lead to loss of function. If degradation is detected that, if not corrected, would lead to loss of intended function, a CR will be written and the issue resolved in accordance with the site corrective action program. The project team determined that the applicant's response to this request was acceptable because this approach to establishing acceptance criteria will provide the effects of aging will be adequately managed.

On this basis, the project team found the applicant's description of the "acceptance criteria" is acceptable.

3.0.3.3.1.1.7 Corrective Actions

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.1.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.1.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.1.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

- Operating experience should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.

- An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated in the PNPS LRA for the "operating experience" program element that the Heat Exchanger Monitoring Program at PNPS is a new program for which there is no operating experience. However, operating experience with respect to heat exchanger degradation is available as a result of adherence to NRC GL 89-13. Therefore, the project team asked the applicant to provide heat exchanger wall thinning and other degradation operating experience resulting from adherence to NRC GL 89-13.

In its response, the applicant stated that NRC GL 89-13 requires inspection of one RBCCW heat exchanger each refuel outage. Service water side inspections have resulted in some minimal tube plugging and weld or belzona repair to washed out areas on the pass partition plate or tube sheet. Past inspections have also identified degraded gasket seating surfaces and tube inlet sleeve erosion that have required repairs. The copper nickel tube degradation is typically due to internal erosion caused by material wedged in the tube and is random in location. There has also been external tube damage in the area impacted by the shell-side inlet flow due to vibration. This particular operating experience is included in the Service Water Integrity Program, Section B.1.28, since it is a heat exchanger in the scope of the Service Water Integrity Program and the operating experience confirms the effectiveness of the program. In accordance with NEI 95-10, the review of operating experience is used to either confirm the effectiveness of an existing program or to identify new site-specific aging effects. For new programs such as the Heat Exchanger Monitoring Program, PNPS AMP B.1.15, applying this as operating experience is not required. The project team determined that the applicant's response to this request was acceptable.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Heat Exchanger Monitoring Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.3.1.2 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplement for the Heat Exchanger Monitoring Program in PNPS LRA Appendix A, Section A.2.1.16, which states that the Heat Exchanger Monitoring Program inspects heat exchangers for degradation. If degradation is found, then an evaluation is performed to evaluate its effects on the heat exchanger's design functions, including its ability to withstand a seismic event.

Representative tubes within the population of heat exchangers are eddy current tested at a frequency determined by internal and external operating experience to ensure that effects of aging are identified before loss of intended function. Along with each eddy current test, visual inspections are performed on accessible heat exchanger heads, covers, and tube sheets to monitor surface conditions for indications of loss of material. The population of heat exchangers includes the RHR heat exchangers, core spray pump motor thrust bearing lube oil coolers, HPCI gland seal condenser, HPCI turbine lube oil cooler, RCIC lube oil cooler, recirculation pump MG set fluid coupling oil and bearing coolers, CRD pump oil coolers, recirculation pump motor lube oil coolers, cleanup recirculation pump lube oil coolers and stuffing box cooler, and EDG lube oil coolers.

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.1.3 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.2 INSERVICE INSPECTION – CONTAINMENT INSERVICE INSPECTION (CII) PROGRAM (PNPS AMP B.1.16.1)

In PNPS LRA Appendix B, Section B.1.16.1, the applicant described PNPS AMP B.1.16.1, "Inservice Inspection – Containment Inservice Inspection (CII) Program."

The applicant stated that PNPS AMP B.1.16.1 is an existing plant-specific program. The Containment Inservice Inspection Program is a plant-specific program encompassing the requirements for the inspection of class MC pressure-retaining components (primary containment) and their integral attachments in accordance with the requirements of 10 CFR 50.55a(b)(2) and ASME Code Section XI, 1998 Edition with 2000 Addenda, Inspection Program B.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.16.1, including AMPER, Revision 1, Section 4.14.2, "Containment Inservice Inspection (CII) Program." and interviewed the applicant's technical staff.

3.0.3.3.2.1 Review of the PNPS AMP B.1.16.1 Against the Program Elements

The project team reviewed PNPS AMP B.1.16.1 against the AMP elements found in the SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.2.1.1 Scope of Program

The “scope of program” program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the specific SCs addressed with this program.

The applicant stated in PNPS AMP B.1.16.1, for the “scope of program“ program element, that this program, under ASME Code Section XI, Subsection IWE, manages loss of material for the primary containment and its integral attachments. The primary containment is a GE Mark I pressure suppression containment system. The system consists of a drywell (housing the RV and reactor coolant recirculation loops), a pressure suppression chamber (housing a water pool), and the connecting vent system between the drywell and the water pool, isolation valves, and containment cooling systems. The code of construction for the containment structure is the ASME Code Section III, 1965 Edition and the latest addenda as of June 9, 1969, including Code Cases 1330-1 and 1177-5.

The project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. On this basis, the project team found the applicant’s proposed program scope to be acceptable.

3.0.3.3.2.1.2 Preventive Actions

The “preventive actions” program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.16.1, for the “preventive actions“ program element, that this program is a monitoring program that does not include preventive actions.

The project team determined that the “preventive actions” program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. The project team found that the applicant’s Containment Inservice Inspection program is only an inspection program and the inspections performed under this program will only monitor the condition of the primary containment and its integral attachments and will not perform any preventive or mitigating action for aging effects/mechanisms. On this basis, the project team found the applicant’s preventive actions to be acceptable.

3.0.3.3.2.1.3 Parameters Monitored/Inspected

The “parameters monitored/inspected” program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

- The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).

- For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.

- For performance monitoring programs, a link should be established between degradation of the particular structure or component intended function(s) and the parameter being monitored.

- For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.16.1, for the "parameters monitored/inspected" program element, that primary containment and its attachments are inspected for evidence of cracks, wear, and corrosion.

The project team determined that the "parameters monitored/inspected" program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. On this basis, the project team found that the applicant's description of the "parameters monitored/inspected" is acceptable.

3.0.3.3.2.1.4 Detection of Aging Effects

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

- Provide information that links the parameters to be monitored or inspected to the aging effects being managed.

- Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).

- Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.

- Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects.

The applicant stated in PNPS AMP B.1.16.1, for the "detection of aging effects" program element, that the Containment Inservice Inspection Program manages loss of material for the primary containment and its integral attachments.

The primary inspection method for the primary containment and its integral attachments is visual examination. Visual examinations are performed either directly or remotely, with sufficient illumination and resolution suitable for the local environment, to assess general conditions that may affect either the integrity of the containment structure or leak tightness of the pressure-retaining component. The program includes augmented ultrasonic exams to measure wall thickness of the containment structure.

For steel, the Containment Inservice Inspection Program manages loss of material and cracking for ASME Code class MC pressure-retaining steel components and their integral attachments. This aging effect is managed by visual inspections required by ASME Code Section XI, Subsection IWE.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR. PNPS's drywell interior surfaces are examined for degradation every refueling outage as required by Technical Specification 4.7.A.2.d. Additionally, drywell interior surfaces are examined every other outage in accordance with the PNPS IWE Program. Drywell structures are examined in accordance with ASME Code Section XI, 1998 Edition with 2000 Addenda, Subsection IWE requirements for class MC and metallic liners of class CC components of light-water cooled plants. Since IWE requirements were mandated in 1996, no areas have been identified that exceeded Code acceptance criteria on the drywell interior surfaces during these inspections. On this basis, the project team found that the applicant's description of the "detection of aging effects" is acceptable.

3.0.3.3.2.1.5 Monitoring and Trending

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.16.1, for the "monitoring and trending" program element, that results are compared, as appropriate, to baseline data and other previous test results. If indications are accepted for continued use by analytical evaluation, the areas containing such flaws are monitored during successive inspection periods.

The project team determined that for visual inspection, this program element satisfies the criteria defined in Appendix A.1.2.3.5 of the SRP-LR. With the exception of inaccessible areas, all surfaces are monitored by virtue of the examination requirements on a scheduled basis. The monitoring and trending of the drywell shell liner plate are in addition to the current PNPS ASME Code Section XI, Subsection IWE procedural requirements. These inspections will provide there is no loss of intended function of the drywell shell. On this basis, the project team found that the applicant's description of the "monitoring and trending" is acceptable.

3.0.3.3.2.1.6 Acceptance Criteria

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

- The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

- The program should include a methodology for analyzing the results against applicable acceptance criteria.

- Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.16.1, for the "acceptance criteria" program element, that results are compared, as appropriate, to baseline data, other previous test results, and acceptance criteria of the ASME Code Section XI, Subsection IWE, for evaluation of any evidence of degradation.

The project team reviewed this program element to determine whether or not it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. In a letter dated May 11, 2006 (ADAMS Accession Number ML061380549), the applicant stated the following:

> PNPS inspects the liner drains for the water reservoirs on the refuel floor (e.g., spent fuel pool, dryer/separator pool, and reactor cavity) for leakage. Leakage into the liner drain could be a precursor for water leaks, which could wet the drywell shell exterior surface. These drains are examined for leakage after filling the refueling cavity. …The code requires owners to identify locations they believe are suspect or potential problem areas for augmented inspection. After a review of PNPS drywell construction methods, PNPS identified various locations for augmented examination. The presence of ethafoam rings left in place at certain elevations of the drywell caused a concern that they could trap and hold leakage from the bellows or fuel pool and cause corrosion of the shell outer surface. For this reason, augmented UT examinations in the upper drywell at elevation 72 feet and 83 feet (four locations at each elevation) were performed in vertical trips to ensure the region of interest was examined. The examinations performed in 1999 and 2001 revealed no degradation of the drywell shell thickness in the upper drywell. UT thickness examinations will continue to be performed under PNPS IWE Program at two locations in the upper drywell immediately adjacent to the fuel pool due to the potential for leakage from the fuel pool liner. The drywell shell to floor joint is inspected under the PNPS IWE Program.

On this basis, the project team found that the applicant's description of the "acceptance criteria" is acceptable.

3.0.3.3.2.1.7 <u>Corrective Actions</u>

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.2.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.2.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.2.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

- Operating experience should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.

- The applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated, in the PNPS LRA, for the "Operating Experience" program element, that RFO14 (April 2003) ultrasonic thickness examination of the torus shell, several measurements were below the nominal wall thickness of 0.629". Since the measurements were all greater than the minimum allowable thickness of 0.563", no further action was taken. CII examinations will continue to monitor thickness of the torus shell. Identification of degradation and corrective action prior to loss of intended function provide evidence that the program is effective for managing aging effects.

Results of the CII general visual walkdown of primary containment during RFO 14 (April 2003) were compared with those from the previous inspection. The only new indication was in the CRD penetration area, where there was some surface corrosion but it was not significant and was structurally acceptable. No significant corrosion was found in other areas. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects.

CII inspections during RFO 15 (April 2005) did not reveal evidence of loss of material. Absence of degradation provides evidence that the program is effective for managing aging effects.

The Oyster Creek Generating Station experienced drywell corrosion due to salt-water intrusion. To ensure the same problem did not exist at PNPS, augmented IWE UT inspections were performed.

A QA audit and an NRC inspection in spring 2005 revealed no issues or findings that could impact the effectiveness of the program.

Augmented IWE visual examinations of selected portions of the drywell to torus vent system in 1999 revealed localized pitting due to degradation of the coating aggravated by standing water in the downcomer vent bowls (vent bowl drains had been cut and capped in a previous modification for seismic considerations). The scope of the examinations was expanded to include all eight vents. All pitting was evaluated and found to be acceptable. The surfaces were prepped and recoated with a qualified coating to prevent recurrence of the corrosion.

The applicant stated that the PNPS monitors torus wall thickness via the inclusion of augmented UT thickness examinations in the PNPS IWE Program. These thickness examinations are performed at eight locations distributed around the torus. Half of the inspections are performed at the torus vapor/water interface of the torus shell while the other half are performed at a location approximately halfway between the waterline and the lowest point on the torus shell. Torus shell thickness examinations are performed during each 40-month period (i.e., every other outage) while the plant is online. Comparison of UT results from 1999 and 2003 reveal no measurable change in wall thickness. These examinations will continue to be performed by qualified NDE technicians who are Code-certified to at least level II in UT measurement.

The applicant also stated that the findings from the IWE general visual walkdown performed during RFO 14 are evaluated and dispositioned in CR-PNP-2003-01618. Newly reported corrosion around the CRD penetrations at the 270-degree azimuth at approximately 35 feet elevation in the drywell was rechecked visually by the IWE responsible/design engineer and found acceptable. This was characterized as surface corrosion that was not considered significant by the responsible/design engineer. Since the determination was made that the corrosion was acceptable, no root cause analysis was performed and no corrective or preventive actions were required. Acceptance criteria for the general visual walkdown are detailed in PNPS Procedure No. 2.1.8.7 and Entergy Engineering Standard ENN-EP-S-001, Section 5. Conditions listed as requiring evaluation include, in part, peeling, flaking, blistering, cracking, checking, absence of coating, and rust bleedout on the containment coating.

The Code requires owners to identify locations they believe are suspect or potential problem areas for augmented inspection. After a review of PNPS drywell construction methods, PNPS identified various locations for augmented examination. The presence of ethafoam rings left in place at certain elevations of the drywell caused a concern that they could trap and hold leakage from the bellows or fuel pool and cause corrosion of the shell outer surface. For this reason, augmented UT examinations in the upper drywell at elevations of 72 feet and 83 feet (four locations at each elevation) were performed in vertical strips to ensure the region of interest was examined. The examinations performed in 1999 and 2001 revealed no degradation of the drywell shell thickness in the upper drywell. UT thickness examinations will continue to be performed under the PNPS IWE Program at two locations in the upper drywell immediately adjacent to the fuel pool due to the potential for leakage from the fuel pool liner. The drywell shell to floor joint is inspected under the PNPS IWE Program.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Containment Inservice Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.3.2.2 UFSAR Supplement

The applicant provided its UFSAR Supplement for the Containment Inservice Inspection Program in PNPS LRA Appendix A, Section A.2.1.17, which states that the Heat Exchanger Monitoring Program outlines the requirements for the inspection of class MC pressure-retaining components (primary containment) and their integral attachments in accordance with the requirements of 10 CFR 50.55a(b)(2) and ASME Code Section XI, 1998 Edition with 2000 Addenda, Inspection Program B.

The primary inspection method for the primary containment and its integral attachments is visual examination. Visual examinations are performed either directly or remotely with illumination and resolution suitable for the local environment to assess general conditions that may affect either the integrity of the containment structure or leak tightness of the pressure-retaining component. The program includes augmented ultrasonic exams to measure wall thickness of the containment drywell structure.

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.2.3 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.3 INSERVICE INSPECTION – INSERVICE INSPECTION (ISI) PROGRAM (PNPS AMP B.1.16.2)

In PNPS LRA Appendix B, Section B.1.16.2, the applicant described PNPS AMP B.1.16.2, "Inservice Inspection – Inservice Inspection (ISI) Program."

The applicant stated that PNPS AMP B.1.16.2 is an existing plant-specific program encompassing ASME Code Section XI, Subsections IWA, IWB, IWC, IWD, and IWF requirements. The applicant stated that the Inservice Inspection Program is based on ASME Inspection Program B (IWA-2432), which has 10-year inspection intervals, and that every 10 years, the program is updated to the latest ASME Section XI Code edition and addendum approved by the NRC in 10 CFR 50.55a. The applicant stated that on July 1, 2005, PNPS

entered the fourth ISI interval. The applicant stated that the ASME Code edition and addenda used for the fourth interval is the 1998 edition with 2000 addenda and the current program ensures that the structural integrity of class 1, 2, and 3 systems and associated supports is maintained at the level required by 10 CFR 50.55a.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.16.2, including AMPER, LRPD-02, Revision 1, Section 4.14.1, "Inservice Inspection (ISI) Program," and interviewed the applicant's technical staff.

The project team also reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.15, "Inservice Inspection (ISI) Program"; PNPS-RPT-05-001, Revision 0, "Fourth 10-Year ISI Program Plan" (ML051920157); ASME Code Section XI, 2001 Edition with 2002 and 2003 Addenda; and ASME Code Section XI, 1998 Edition with 2000 Addenda.

3.0.3.3.3.1 Review of the PNPS AMP B.1.16.2 Against the Program Elements

The project team reviewed PNPS AMP B.1.16.2 against the AMP elements found in the SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.3.1.1 Scope of Program

The "scope of program" program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the specific SCs addressed with this program.

The applicant stated in PNPS AMP B.1.16.2, for the "scope of program" program element, that this program manages cracking, loss of material, and reduction of fracture toughness of RCS piping, components, and supports. The program implements applicable requirements of ASME Code Section XI, Subsections IWA, IWB, IWC, IWD, and IWF, and other requirements specified in 10 CFR 50.55a with approved NRC alternatives and relief requests. Every 10 years, the Inservice Inspection Program is updated to the latest ASME Section XI Code edition and addendum approved by the NRC in 10 CFR 50.55a.

The applicant stated that ASME Code Section XI inspection requirements for RV internals (Subsection IWB, Categories B-N-1 and B-N-2) are not in the Inservice Inspection Program, but are included in the BWR Vessel Internals Program. For more information on the BWR Vessel Internals Program, see Section 3.0.3.2.7 of this audit and review report.

During the audit and review, the project team noted that the applicant's "scope of program" description includes a reference to "relief requests." The project team noted that ASME Section XI relief requests are not approved as part of the license renewal process and asked the applicant to clarify its mention of relief requests in the "scope of program" description. In a conference call on September 25, 2006, the applicant agreed to revise the first paragraph of the "scope of program" description for PNPS AMP B.1.16.2 to read as follows:

> The ISI Program manages cracking, loss of material, and reduction of fracture toughness of reactor coolant system piping, components, and supports. The program implements applicable requirements of ASME Section XI, Subsections IWA, IWB, IWC, IWD and IWF and other requirements specified in 10 CFR 50.55a with approved NRC alternatives. Every 10 years the ISI Program is updated to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50.55a.

The project team noted that the applicant's response deleted the the mention of relief requests from the "scope of program" description for PNPS AMP B.1.16.2. The applicant agreed to implement this change in the annual update. However, this is an open item, and based on the review of the annual update, the resolution of this item will be performed in SER Section 3.0.3.3.3. This is open item 3.0.3.3.3.1.1-1.

The project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. They conform to the scope of ISI as set forth in ASME Section XI, Subsections IWA, IWB, IWC, IWD, and IWF and approved by the staff according to 10 CFR 50.55a. On this basis, the project team found that the applicant's proposed program scope is acceptable.

3.0.3.3.3.1.2 Preventive Actions

The "preventive actions" program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.16.2, for the "preventive actions" program element, that this program is a condition monitoring program that does not include preventive actions.

The project team determined that the "preventive actions" program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. On this basis, the project team found that the applicant's description of the "preventive actions" program element is acceptable.

3.0.3.3.3.1.3 Parameters Monitored/Inspected

The "parameters monitored/inspected" program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

- The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).
- For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.

- For performance monitoring programs, a link should be established between degradation of the particular structure or component intended function(s) and the parameter being monitored.

- For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.16.2, for the "parameters monitored/inspected" program element, that the program uses NDE techniques to detect and characterize flaws. The applicant stated that volumetric examinations such as radiographic, ultrasonic, or eddy current examinations are used to locate surface and subsurface flaws. Surface examinations, such as magnetic particle or dye PT, are used to locate surface flaws.

The applicant stated that three levels of visual examinations are specified. VT-1 visual examination is conducted to assess the condition of the surface of the part being examined, looking for cracks and symptoms of wear, corrosion, erosion, or physical damage. It can be done with either direct visual observation or with remote examination using various optical and video devices. The applicant stated that VT-2 visual examination is conducted specifically to locate evidence of leakage from pressure-retaining components (period pressure tests). While the system is under pressure for a leakage test, visual examinations are conducted to detect direct or indirect indication of leakage. The applicant stated that VT-3 visual examination is conducted to determine the general mechanical and structural condition of components and supports and to detect discontinuities and imperfections.

The project team determined that the "parameters monitored/inspected" program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. They are consistent with the requirements of applicable subsections of Section XI of the ASME code. Although the 1998 Edition (with year 2000 Addenda) is in effect for the current (fourth) 10-year ISI interval, the program addresses the need to increase or expand examination scope as required to satisfy the requirements of 10 CFR 50.55a. In addition, the program addresses the need to revisit the specific version of the ASME Code in subsequent intervals and to reevaluate exemptions to be requested. On this basis, the project team found that the applicant's description of the "parameters monitored/inspected" program element is acceptable.

3.0.3.3.3.1.4 <u>Detection of Aging Effects</u>

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

> Provide information that links the parameters to be monitored or inspected to the aging effects being managed.
>
> Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).
>
> Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.

> Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects.

The applicant stated in PNPS AMP B.1.16.2, for the "detection of aging effects" program element, that the Inservice Inspection Program manages cracking and loss of material, as applicable, for carbon steel, low-alloy steel, and SS/nickel-based-alloy subcomponents of the RPV using NDE techniques specified in ASME Code Section XI, Subsections IWB, IWC, and IWD examination categories.

The applicant stated that the Inservice Inspection Program manages cracking, loss of material, and reduction of fracture toughness, as applicable, of RCS components using NDE techniques specified in ASME Code Section XI, Subsections IWB, IWC, and IWD examination categories.

The applicant stated that the Inservice Inspection Program manages loss of material for ASME Class MC and Class 1, 2, and 3 piping and component supports and their anchorages by visual examination of components using NDE techniques specified in ASME Code Section XI, Subsection IWF examination categories.

The applicant also stated that no AERMs are identified for Lubrite® sliding supports. However, the applicant stated that the Inservice Inspection Program will confirm the absence of aging effects for the PEO.

The project team determined that the "detection of aging effects" program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR for the detection of aging effects. The applicant's Inservice Inspection Program has been reviewed and accepted by the staff in accordance with 10 CFR 50.55a. On this basis, the project team found that the applicant's description of the "detection of aging effects" program element is acceptable.

3.0.3.3.3.1.5 <u>Monitoring and Trending</u>

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.16.2, for the "monitoring and trending" program element, that results are compared as appropriate to baseline data and other previous test results and that if indications are accepted for continued use by analytical evaluation, the areas containing such flaws are monitored during successive inspection periods.

The applicant stated that ISI results are recorded every operating cycle and provided to the NRC after each RFO via owner's activity reports prepared by the Inservice Inspection Program coordinator. The applicant also stated that these detailed reports include scope of inspection and significant inspection results.

The project team noted that the "monitoring and trending" program element for the plant-specific Inservice Inspection Program in the PNPS LRA provided only a very broad description of a monitoring and trending process, with no explicit reference to ASME Code Section XI requirements, and that the description did not appear to conform with the level of detail described for this program element in Appendix A.1.2.3.5 of the SRP-LR. The project team asked the applicant to provide a description of the parameter(s) or indicator(s) being trended and of the methodology for analyzing the inspection or test results. In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the "monitoring and trending" program element in LRA Section B.1.16.2 to include the following information:

> Results are compared, as appropriate, to baseline date and other previous test results. Indications are evaluated in accordance with ASME Section XI. If the component is qualified as acceptable for continued service, the area containing the indication is reexamined during subsequent inspection periods. Examinations that reveal indications that exceed the acceptance standards are extended to include additional examinations in accordance with ASME Section XI.

The project team determined that the "monitoring and trending" program element, as amended, includes sufficient additional details and appropriate references to ASME Code Section XI to conform with the requirements for this program element as described in Appendix A.1.2.3.5 of the SRP-LR. The project team also determined that, as amended, the description of this program element for the PNPS site-specific Inservice Inspection Program is consistent with the GALL Report's descriptions of the program element. On the basis that the "monitoring and trending" program element in the applicant's plant-specific Inservice Inspection Program is consistent with the "monitoring and trending" program element as described in the GALL Report for programs encompassed by the applicant's program, the project team found this element of the applicant's plant-specific program to be acceptable.

The project team determined that the "monitoring and trending" program element satisfies the criteria defined in Appendix A.1.2.3.5 of the SRP-LR. The implementing procedures and selected records of prior inspections were examined to confirm that the requirement of this program element are satisfied. On this basis, the project team found that the applicant's description of the "monitoring and trending" program element is acceptable.

3.0.3.3.3.1.6 <u>Acceptance Criteria</u>

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

> The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated,

should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

The program should include a methodology for analyzing the results against applicable acceptance criteria.

Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.16.2, for the "acceptance criteria" program element, that a preservice, or baseline, inspection of program components was performed before startup to assure freedom from defects greater than Code-allowable. The applicant stated that these baseline data also provide a basis for evaluating subsequent ISI results. The applicant stated that since plant startup, additional inspection criteria for Class 2 and 3 components have been imposed by 10 CFR 50.55a, for which baseline and inservice data has also been obtained and that results of ISIs are compared, as appropriate, to baseline data, other previous test results, and acceptance criteria of the ASME Code Section XI, 1998 Edition, 2000 Addenda, for evaluation of any evidence of degradation.

The project team reviewed this program element to determine whether it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. The implementing procedure and selected records of prior inspections were examined to confirm that the requirements of this program element are satisfied. On this basis, the project team found that the applicant's description of the "acceptance criteria" program element is acceptable.

3.0.3.3.3.1.7 Corrective Actions

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.3.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.3.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.3.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

- Operating experienceshould provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.

- An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated in the PNPS LRA for the "operating experience" program element that IGSCC was discovered during RFO 06 in the thermal sleeve at nine of the 10 recirculation supply nozzles. GE has performed an evaluation to demonstrate no further crack growth with HWC protection.

A scheduled ISI surface examination in 1997 detected an indication adjacent to a welded pipe support lug. The lug was removed and the indication was repaired by welding. A scheduled ISI visual examination in 1999 detected a snubber with restricted movement and a cold piston setting out of tolerance. The restriction was reworked and the cold piston setting was accepted by evaluation. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects.

One hundred and forty-two scheduled ISI (ASME Code Section XI, Subsections IWB, IWC, IWD, and IWF) examinations were performed online (between RFO 13 and RFO 14) and during RFO 14 (April 2003). Results show that one spring hanger support in the residual heat-removal system required rework because ISI visual inspection determined that bolting was loose. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects.

One hundred and ninety-four scheduled ISI (ASME Code Section XI, Subsections IWB, IWC, IWD, and IWF) examinations were performed online (between RFO 14 and RFO 15) and during RFO 15 (April 2005). Results show that cracked welds on four steam dryer tie-bars were repaired, loose bolting on a hanger was reworked, a UT exam indication on an SLC system weld was repaired, and a number of RPV safe-end welds were accepted by evaluation because they had wall thickness less than the screening criteria but not less than design minimums. Identification of degradation and corrective action before loss of intended function provide evidence that the program is effective for managing aging effects.

A QA audit and an NRC inspection in spring 2005 revealed no issues or findings that could impact effectiveness of the program.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the plant-specific Inservice Inspection Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Inservice Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

Based on its review of operating experience described for the applicant's plant-specific Inservice Inspection Program, the project team determined that the "operating experience" program element satisfies the criteria defined in Appendix A.1.2.3.10 of the SRP-LR. On this basis, the project team found that the applicant's description of the "operating experience" program element is acceptable.

3.0.3.3.3.2 UFSAR Supplement

The applicant provided its UFSAR Supplements for the Inservice Inspection Program in PNPS LRA Appendix A, Section A.2.1.18, which states that the Inservice Inspection Program is based on ASME Inspection Program B (Section XI, IWA-2432), which has 10-year inspection intervals. Every 10 years, the program is updated to the latest ASME Section XI Code edition and addendum approved in 10 CFR 50.55a. On July 1, 2005, PNPS entered the fourth ISI interval. The Code edition and addenda used for the fourth interval is the 1998 Edition with 2000 Addenda.

The program consists of periodic volumetric, surface, and visual examination of components and their supports for assessment, signs of degradation, flaw evaluation, and corrective actions.

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.3.3 Conclusion

The project team reviewed PNPS AMP B.1.16.2 against the AMP elements found in SRP-LR, Appendix A.1, Section A.1.2.3 and SRP-LR Table A.1-1.

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.4 INSTRUMENT AIR QUALITY PROGRAM (PNPS AMP B.1.17)

In PNPS LRA Appendix B, Section B.1.17, the applicant described PNPS AMP B.1.17, "Instrument Air Quality Program."

The applicant stated that PNPS AMP B.1.17 is an existing plant-specific program. The Instrument Air Quality Program is a plant-specific program which ensures that instrument air (IA) supplied to components is maintained free of water and significant contaminants, thereby preserving an environment that is not conducive to loss of material. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked to verify the IA quality is maintained.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.17, including AMPER, LRPD-02, Revision 1, Section 4.15, "Instrument Air Quality Program," which provides an assessment of the AMP elements, and interviewed the applicant's technical staff.

3.0.3.3.4.1 Review of the PNPS AMP B.1.17 Against the Program Elements

The project team reviewed PNPS AMP B.1.17 against the AMP elements found in SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.4.1.1 Scope of Program

The "scope of program" program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the specific SCs addressed with this program.

The applicant stated in PNPS AMP B.1.17, for the "scope of program" program element, that this program applies to components within the scope of license renewal and subject to AMR that are supplied with IA, for which pressure boundary integrity is required for the component to perform its intended function. During the audit and review, the project team requested that the applicant provide the specific components that are subject to the Instrument Air Quality Program. In its response, the applicant stated that tubing and valve bodies are managed in the SGT system and piping, tanks, tubing, and valve bodies are managed in the IA system. The project team determined that the applicant's response to this request was acceptable because specific components were identified.

The applicant stated that the Instrument Air Quality Program will be enhanced to include a sample point in the SGT and torus vacuum breaker IA subsystem in addition to the IA header sample points. The applicant stated in the PNPS LRA that this enhancement will be initiated before the PEO. The implementation of this enhancement by the applicant will verify that the environment of the SGT and torus vacuum breaker IA subsystem will not be conducive to loss of material, thus providing loss of material will be adequately managed.

The project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. On this basis, the project team found that the applicant's proposed program scope is acceptable.

3.0.3.3.4.1.2 Preventive Actions

The "preventive actions" program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.17, for the "preventive actions" program element, that system air quality is monitored and maintained within specified limits to ensure that IA supplied to components is maintained free of water and significant contaminants, thereby preventing loss of material.

The project team determined that the "preventive actions" program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. Air quality is maintained within specified limits for water content and contamination to prevent loss of material. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked at least every 18 months to verify IA quality is maintained as indicated in PNPS Evaluation of Aging Management Programs, AMP B.1.17/AMPER 4.15, "Instrument Air Quality Program," and PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.15, pages 173 through 175. Parameters to be monitored that are linked to specific degradation are identified. Parameters monitored/inspected in this program are consistent with SRP-LR. On this basis, the project team found that the applicant's "preventive actions" program element is acceptable.

3.0.3.3.4.1.3 Parameters Monitored/Inspected

The "parameters monitored/inspected" program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

- The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).
- For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.
- For performance monitoring programs, a link should be established between degradation of the particular structure or component intended function(s) and the parameter being monitored.
- For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.17, for the "parameters monitored/inspected" program element, that dewpoint, particulate contamination, and hydrocarbon concentration (oil mist) are periodically checked to verify that IA quality is maintained.

The project team determined that the "parameters monitored/inspected" program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked at least every 18 months to verify that IA quality is maintained as indicated in PNPS AMP B.1.17/AMPER 4.15: Instrument Air Quality Program, Evaluation of Aging Management Programs, LRPD-02, Revision 1, Section 4.15, pages 173 through 175 . Parameters to be monitored that are linked to specific degradation are identified. Parameters monitored/inspected in this program are consistent with SRP-LR. On this basis, the project team found that the applicant's description of the "parameters monitored/inspected" program element is acceptable.

3.0.3.3.4.1.4 Detection of Aging Effects

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

- Provide information that links the parameters to be monitored or inspected to the aging effects being managed.
- Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).
- Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.
- Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects.

The applicant stated in PNPS AMP B.1.17, for the "detection of aging effects" program element, that dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked to verify that IA quality is maintained, thereby preventing loss of material. At least every 18 months, dewpoint, particulate contamination, and hydrocarbon concentration are monitored at several locations in the IA system.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked to verify that IA quality is maintained, thereby preventing loss of material. At least every 18 months, dewpoint particulate contamination and hydrocarbon concentration are monitored at several locations in the IA system. Inspection sample and frequency will ensure that the effects of aging are identified before the loss of intended function as indicated in B.1.17/AMPER 4.15: Instrument Air Quality Program, Evaluation of Aging Management Programs, LRPD-02, Revision 1, Section 4.15, pages 173 of 286 through 175 of 286, Pilgrim Nuclear Power Station License Renewal Project. On this basis, the project team found that the applicant's description of the "detection of aging effects" program element is acceptable.

3.0.3.3.4.1.5 Monitoring and Trending

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.17, for the "monitoring and trending" program element, that results of sample analyses are maintained in the chemistry log. A CR is issued if data indicate deteriorating IA quality. During the audit and review, the project team requested the applicant to provide details describing the methods that determine deteriorating air quality. The applicant provided to the project team PNPS Procedure 7.1.69, "System Air Quality Sampling," during the site audit for review. This procedure provides for trending of IA quality. On this basis, the project team found that the applicant's description of the "monitoring and trending" program element is acceptable.

3.0.3.3.4.1.6 Acceptance Criteria

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

- The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

- The program should include a methodology for analyzing the results against applicable acceptance criteria.

- Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.17, for the "acceptance criteria" program element, that the dewpoint is less than or equal to -20°F and oil mist and particulate are less than 1.2 mg/m^3.

The project team evaluated this program element to determine whether or not it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. The PNPS Instrument Air Quality Program acceptance criteria are dewpoint less than or equal to -20°F and oil mist and particulate less than 1.2 mg/m^3; therefore, numerical values of acceptance criteria are provided by this program. The LRA did not provide the basis of the acceptance criteria, and therefore, during the audit and

review, the project team requested the applicant to provide this basis. In its response, the applicant stated that the bases of the acceptance criteria are American National Standards Institute (ANSI)/Instrumentation, Systems, and Automation Society (ISA) 7.3, which are cited in PNPS Procedure 7.1.69, "System Air Quality Sampling." On this basis, the project team found that the applicant's description of the "acceptance criteria" program element is acceptable.

3.0.3.3.4.1.7 Corrective Actions

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.4.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.4.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.4.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

> Operating experience provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.
>
> An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated in the PNPS LRA, for the "operating experience" program element, that in 1999, an IA dryer dewpoint reading was greater than the acceptance criterion of less than or equal to -20°F. A faulty solenoid valve was replaced and dewpoint was confirmed to be less than or equal to -20°F. Monitoring of IA quality and subsequent corrective actions provide evidence that the program is effective in managing loss of material and cracking of IA system components.

For a period of time (October 2001 through March 2005), dewpoint, particulate contamination, and hydrocarbon concentration (oil mist) were not sampled in the IA system. Procedures were corrected in March 2005 to require dewpoint, particulate contamination, and hydrocarbon concentration (oil mist) sampling at several locations in the IA system. Sample results for the service air system, which supplies the IA system, show that dewpoint, oil mist, and particulates were within acceptance criteria. IA header moisture checks during the same period found little or no moisture. Therefore, IA quality is assumed to have been maintained and will be

maintained from now on by sampling in accordance with the Instrument Air Quality Program. Continuous confirmation of IA quality and subsequent corrective actions provide evidence that the program is effective in managing loss of material and cracking of IA system components.

The PNPS Instrument Air Quality Program operating experience includes corrective actions that respond to degradation and enhancements to the program to assure timely monitoring of IA contamination and moisture content. New sampling points were added to procedures as a result of operating experience. The Instrument Air Quality Program will be enhanced to include a sample point in the SGT and torus vacuum breaker IA subsystem in addition to the IA header sample points. This enhancement is Item No. 13 on the applicant's list of commitments for license renewal and will be completed before the PEO.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Section 4.15, "Instrument Air Quality Program," and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Instrument Air Quality Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.3.4.2 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplements for the Instrument Air Quality Program in PNPS LRA Appendix A, Section A.2.1.19, which states that the Instrument Air Quality Program ensures that IA supplied to components is maintained free of water and significant contaminants, thereby preserving an environment that is not conducive to loss of material. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked to verify that the IA quality is maintained.

During the audit and review, the project team noted that the applicant's description of AMP B.1.17 in the UFSAR Supplement in LRA Appendix A did not include, as a commitment, the enhancements described in LRA Appendix B.1.17. The project team asked the applicant to include a description of the enhancements to PNPS's AMP B.1.17 in the UFSAR Supplement in LRA Appendix A as recommended by NUREG-1800, Section 3.X.2.4. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number(s) associated with the enhancement(s) for that program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that License Renewal Commitment No. 13 specifies the enhancement to this program.

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.4.3 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.5 PERIODIC SURVEILLANCE AND PREVENTIVE MAINTENANCE PROGRAM (PNPS AMP B.1.24)

In PNPS LRA Appendix B, Section B.1.24, the applicant described PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The applicant stated that PNPS AMP B.1.24 is an existing plant-specific program. The Periodic Surveillance and Preventive Maintenance Program includes periodic inspections and tests that manage aging effects not managed by other AMPs. The preventive maintenance (PM) and surveillance testing activities are generally implemented through repetitive tasks or routine monitoring of plant operations. Credit for program activities has been taken in the AMR of the following systems and structures:

reactor building	Perform visual or other NDE to manage loss of material for the reactor building crane, rails, and girders and refueling platform carbon steel components.
process facilities	Visually inspect the main stack components to manage loss of material for carbon steel and cracking, spalling, or loss of material for concrete.
standby liquid control	Use UT or other NDE techniques to verify system remaining wall thickness to manage loss of material from internal surfaces of the carbon steel discharge accumulators.
automatic depressurization	Use visual or other NDE techniques to inspect system torus to manage loss of material for carbon steel piping in the waterline region of the torus.
high-pressure coolant	Use visual or other NDE techniques to inspect a representative sample of the internals of gland seal

	condenser blower (P-223) and suction piping to manage loss of material.
reactor core isolation	Use visual or other NDE techniques to inspect a representative sample of RCIC steam supply and exhaust piping downstream of the strainers and steam traps to manage loss of material.
standby gas treatment	Perform a visual inspection of accessible system expansion joints for cracks. Also perform manual flexing (manipulation) of the expansion joints to determine if they have become brittle. These inspections will verify the absence of significant change in material properties.
	Use visual or other NDE techniques to inspect internal surfaces of the valve bodies and piping in the demister drains to manage loss of material.
	Use visual or other NDE techniques to inspect a representative sample of the internal and external surfaces of the drain lines from each reactor building auxiliary bay passing into the water trough in the torus room to manage loss of material.
reactor building closed	Use visual or other NDE techniques to inspect cooling water system cleanup recirculation pump P-204B stuffing box cooler to manage loss of material due to wear.
	Use visual or other NDE techniques to inspect a representative sample of the in scope RBCCW copper alloy cooling coils to manage loss of material.
EDG	Use visual or other NDE techniques to inspect a representative sample of EDG intake air, air start, and exhaust components to manage loss of material and fouling.
	Visually inspect A/B EDG jacket water radiators to manage loss of material and fouling for heat exchanger tubes.
SBO diesel	Use visual or other NDE techniques to inspect a representative sample of SBO diesel intake air, air start, and exhaust components to manage loss of material, cracking, and fouling.
	Visually inspect SBO jacket water radiator to manage loss of material and fouling.

	Perform SBO diesel surveillance test to manage fouling for heat exchanger tubes.
heating, ventilation, and air	Use visual or other NDE techniques to inspect the air side of the copper alloy tubes of heat exchangers volts alternating current (VAC) 201A/B, VAC-202A/B, and VAC-204A/B/C/D to manage loss of material and fouling. Visually inspect and manually flex VSF-103A/B, VAC-202A/B, VAC-204A/B/C/D, and EDG engine-driven fan duct flexible connections to manage cracking and change in material properties.
security diesel	Perform security diesel generator surveillance test (loaded) to manage fouling for heat exchanger tubes. Use visual or other NDE techniques to inspect a representative sample of security diesel oil cooler, aftercooler, and radiator tubes to manage loss of material. Use visual or other NDE techniques to inspect a representative sample of security diesel intake air and exhaust components to manage cracking and loss of material on internal surfaces.
condensate storage system	Use visual or other NDE techniques to inspect a representative sample of the internal and external surfaces of the condensate storage tanks to manage loss of material.
NSR systems	Use visual or other NDE techniques to inspect affecting safety-related representative water, potable and sanitary water, systems radioactive waste, sanitary soiled waste and vent, plumbing and drains and screen wash system components to manage internal loss of material. Visually inspect and manually flex a representative sample of the flex/expansion joints in the circulating water; heating, ventilation, and air conditioning (HVAC)/chilled water; and radioactive waste systems to manage cracking and change in material properties.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.24, including AMPER, LRPD-02, Revision 1, Section 4.17, “Periodic Surveillance and Preventive Maintenance Program,” and interviewed the applicant’s technical staff.

3.0.3.3.5.1 Review of the PNPS AMP B.1.24 Against the Program Elements

The project team reviewed PNPS AMP B.1.24 against the AMP elements found in SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.5.1.1 Scope of Program

The "scope of program" program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the specific SCs addressed with this program.

The applicant stated in PNPS AMP B.1.24, for the "scope of program" program element, that this program, with regard to license renewal, includes those tasks credited with managing aging effects identified in AMRs.

The project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. On this basis, the project team found that the applicant's proposed program scope is acceptable.

3.0.3.3.5.1.2 Preventive Actions

The "preventive actions" program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.24, for the "preventive actions" program element, that inspection and testing activities used to identify component aging effects do not prevent aging effects. However, activities are intended to prevent failures of components that might be caused by aging effects.

The project team determined that the "preventive actions" program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. Visual or other NDE techniques are used to identify component aging – primarily fouling and loss of material – to prevent failures of structures, systems, and components within the scope of the PNPS Periodic Surveillance and Preventive Maintenance Program. Preventive actions of this program are consistent with SRP-LR. On this basis, the project team found that the applicant's "preventive actions" program element is acceptable.

3.0.3.3.5.1.3 Parameters Monitored/Inspected

The "parameters monitored/inspected" program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

- The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).

- For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.

- For performance monitoring programs, a link should be established between degradation of the particular structure or component intended function(s) and the parameter being monitored.

- For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.24, for the "parameters monitored/inspected" program element, that this program provides instructions for monitoring structures, systems, and components to detect degradation. Inspection and testing activities monitor various parameters, including system flow, system pressure, surface condition, loss of material, presence of corrosion products, and signs of cracking.

The project team determined that the "parameters monitored/inspected" program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. This program provides instructions for monitoring structures, systems, and components to detect degradation. Inspection and testing activities monitor various parameters, including system flow, system pressure, surface condition, loss of material, presence of corrosion products, and signs of cracking. Parameters to be monitored are linked to specific degradation. Parameters monitored/inspected in this program are consistent with SRP-LR. On this basis, the project team found that the applicant's description of the "parameters monitored/inspected" program element is acceptable.

3.0.3.3.5.1.4 <u>Detection of Aging Effects</u>

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

- Provide information that links the parameters to be monitored or inspected to the aging effects being managed.

- Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).
- Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.

- Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects.

The applicant stated in PNPS AMP B.1.24, for the "detection of aging effects" program element, that PM activities and periodic surveillances provide for periodic component inspections and

testing to detect aging effects. Inspection intervals are established such that they provide timely detection of degradation. Inspection intervals are dependent on component material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations. Each inspection or test occurs at least once every 10 years.

The extent and schedule of inspections and testing assure detection of component degradation before loss of intended functions. Established techniques such as visual inspections are used.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR. PM activities and periodic surveillances provide for periodic component inspections and testing to detect aging effects. Inspection intervals are established such that they provide timely detection of degradation. Inspection intervals are dependent on component material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations. Each inspection or test occurs at least once every 10 years and, in most cases, every 5 years. The project team reviewed the operating experience and concluded that there was no significant deterioration observed which justifies the inspection intervals found in AMPER, LRPD-02, Revision 1, Attachment 3, "Periodic Surveillance and Preventive Maintenance Activities." This table provides the procedure and/or PM activity that specifies the parameters to be inspected, the inspection interval, and the acceptance criterion of degradation (such as loss of material, cracking, and fouling) for each component covered by the PNPS Periodic Surveillance and Preventive Maintenance Program. Detection of aging effects is sufficient to preclude loss of SC intended function.

The project team noted in AMPER, LRPD-02, Revision 1, Attachment 3, "Periodic Surveillance and Preventive Maintenance Activities," that enhancements to existing procedures or development of new procedures will be necessary to implement the inspections of this program. Therefore, the applicant committed to an enhancement to the Periodic Surveillance and Preventive Maintenance Program in the LRA.

Before the PEO, program activity implementing documents will be enhanced as necessary to assure that the effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the CLB for the PEO.

The project team noted that the details for the enhancements to existing procedures or development of new procedures are contained in AMPER, LRPD-02, Revision 1, Attachment 3, "Periodic Surveillance and Preventive Maintenance Activities."

The PNPS Periodic Surveillance and Preventive Maintenance Program describes when, where, and how program data are collected and provides justification that technique and frequency are adequate to detect aging effects before loss of SC intended function. However, the project team noticed that there were no codes or standards cited in the program. As a result, the project team asked the applicant to provide any codes and standards used for detection of aging effects. In its response, the applicant stated that many of the maintenance activities include visual or other NDEs of SSCs. These examinations are performed in accordance with approved procedures that are consistent with ASME Code Section XI and 10 CFR Part 50, Appendix B. The project team determined that the applicant's response to this request was acceptable because appropriate codes are identified in accordance with the SRP-LR.

This element of the PNPS Periodic Surveillance and Preventive Maintenance Program is consistent with SRP-LR. On this basis, the project team found that the applicant's description of the "detection of aging effects" program element is acceptable.

3.0.3.3.5.1.5 Monitoring and Trending

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.24, for the "monitoring and trending" program element, that PM and surveillance testing activities provide for monitoring and trending of aging degradation. Inspection and testing intervals are established such that they provide for timely detection of component degradation. Inspection and testing intervals are dependent on component material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations.

The project team determined that for visual inspection, this program element satisfies the criteria defined in Appendix A.1.2.3.5 of the SRP-LR. Although the PNPS Periodic Surveillance and Preventive Maintenance Program states the above attributes for monitoring and trending, the project team determined that the LRA was not detailed enough to make an assessment of this program element. As a result, the project team requested the applicant to provide trending methods used in this program. In its response, the applicant stated that inspection and testing intervals are established such that they provide for timely detection of SSCs degradation. Inspection and testing intervals are dependent on the material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations. Trending of degraded components occurs within the corrective action program. The project team determined that the applicant's response to this request was acceptable because this approach of establishing degradation trends was adequate to detect aging effects in SSCs before loss of intended function.

On this basis, the project team found that the applicant's description of the "monitoring and trending" program element is acceptable.

3.0.3.3.5.1.6 Acceptance Criteria

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

- The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

- The program should include a methodology for analyzing the results against applicable acceptance criteria.

- Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.24, for the "acceptance criteria" program element, that the Periodic Surveillance and Preventive Maintenance Program acceptance criteria are defined in specific inspection and testing procedures. The procedures confirm component integrity by verifying the absence of aging effects or by comparing applicable parameters to limits based on applicable intended functions established by plant design basis.

The project team reviewed this program element to determine whether or not it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. The project team determined that the PNPS Periodic Surveillance and Preventive Maintenance Program acceptance criteria are defined in specific inspection and testing procedures. This element of the PNPS Periodic Surveillance and Preventive Maintenance Program is consistent with this item of the SRP-LR. On this basis, the project team found that the applicant's description of the "acceptance criteria" program element is acceptable.

3.0.3.3.5.1.7 Corrective Actions

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.5.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.5.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.5.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

- Operating experience should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.
- An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated in the PNPS LRA, for the "operating experience" program element, that inspection of the reactor building crane in 2000 and of the refueling platform in March 2003 found no significant corrosion or wear. Absence of significant corrosion and wear provides evidence that the program is effective for managing loss of material for the reactor building crane, rails, and girders and refueling platform carbon steel components.

Visual inspection of the main stack and guy wires in June 2004 revealed no significant corrosion of steel SCs. Similarly, inspection of the concrete anchor blocks revealed no cracking, spalling, or other loss of material. Absence of steel corrosion and concrete cracking, spalling, and loss of material provides evidence that the program is effective for managing aging effects for components of the main stack.

In 1999, visual inspection of the drywell spray header revealed no significant corrosion. Absence of significant corrosion provides evidence that the program is effective for managing loss of material for the drywell spray header.

In 1999, the below-water regions of all 16 torus bays as well as the drywell to torus vent areas with water accumulation were inspected. The condition of other submerged SCs was also reported. Results revealed no significant corrosion on submerged SCs within the torus. Absence of significant corrosion provides evidence that the program is effective for managing loss of material for carbon steel safety relief valve (SRV) tailpipes in the waterline region of the torus.

During visual inspection of SGT system exhaust fans in 2000 and 2001, the expansion joints which connect the fans to ductwork were disconnected from the fans to facilitate fan inspection. Inspection of the expansion joints after this evolution revealed no cracking. Absence of cracking provides evidence that the program is effective for managing cracking and change in material properties for the expansion joints.

No significant corrosion or wear was found on the reactor recirculation system (RRS) MG sets area cooling coils during an inspection in 2000. Absence of significant corrosion or wear provides evidence that the program is effective for managing loss of material for RBCCW copper alloy cooling coils.

During a 2002 run of the A EDG, soot buildup was noticed on the turbo charger. Although no obvious leakage was noted, soot buildup may indicate existence of a small exhaust leak. Thermography was performed during the next diesel run to determine if and where leakage was occurring, but no leakage was found. Identification of possible degradation and corrective action before loss of intended function provide evidence that the program is effective for managing loss of material for EDG exhaust components.

Inspections of EDG air intake and jacket water radiator components in 1999 and 2004 revealed no significant corrosion, wear, or fouling. Also, no significant corrosion was found on air start components or exhaust components during the inspections. Absence of aging effects provides evidence that the program is effective for managing aging effects for EDG components.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. In addition, the project team reviewed PNPS operating experience as documented in the PNPS License Renewal Project Operating Experience Review Report for the Periodic Surveillance and Preventive Maintenance Program and did not find any evidence of PNPS component degradation or failures that are outside the envelope of industry experience.

On the basis of its review of the operating experience and discussions with the applicant's technical staff, the project team concluded that the applicant's Periodic Surveillance and Preventive Maintenance Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.3.5.2 UFSAR Supplement

The applicant provided its UFSAR Supplements for the Periodic Surveillance and Preventive Maintenance Program in PNPS LRA Appendix A, Section A.2.1.26, which states that the Periodic Surveillance and Preventive Maintenance Program includes periodic inspections and tests that manage aging effects not managed by other AMPs. The PM and surveillance testing activities are generally implemented through repetitive tasks or routine monitoring of plant operations.

Temperatures are monitored during periodic EDG, SBO diesel, and security diesel surveillance tests to verify that associated heat exchangers are capable of removing the required amount of heat, thereby managing fouling of the heat exchanger tubes.

Periodic inspections using visual or other NDE techniques verify that the following components are capable of performing their intended function:

- reactor building crane, rails, and girders
- refueling platform carbon steel components
- main stack components
- SLC system discharge accumulators
- carbon steel piping in the waterline region of the torus
- HPCI gland seal condenser blower and suction piping
- RCIC steam supply and exhaust piping downstream of the strainers and steam traps
- SGT system expansion joints, demister drain valves, and demister drain piping
- drain lines from each reactor building auxiliary bay passing into the water trough in the torus
- cleanup recirculation pump P-204B stuffing box cooler
- RBCCW copper alloy cooling coils
- EDG, SBO diesel, and security diesel intake air, air start, and exhaust components

- EDG, SBO diesel, and security diesel jacket water radiators
- security diesel oil cooler and aftercooler
- area coolers VAC-210A/B, VAC-202A/B, and VAC-204A/B/C/D
- VSF-103A/B, VAC-202A/B, VAC-204A/B/C/D, and EDG engine-driven fan duct flexible connections
- condensate storage tanks
- circulating water, potable and sanitary water, radioactive waste, sanitary soiled waste and vent, plumbing and drains, and screen wash system components
- flex/expansion joints in the circulating water, HVAC/chilled water, and radioactive waste systems

During the audit and review, the project team noted that the applicant's description of PNPS AMP B.1.24 in UFSAR Supplement in LRA Appendix A, did not include, as a commitment, the enhancement described in LRA Appendix B.1.24. The project team asked the applicant to include a description of the enhancement to PNPS AMP B.1.24 in the UFSAR Supplement in LRA Appendix A as recommended by NUREG-1800, Section 3.X.2.4. In response to this request, the applicant stated that the program description in Appendix A will be revised to identify the commitment number associated with the enhancement for that program as described in LRA Appendix B. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that License Renewal Commitment No. 21 specifies an enhancement to this program.

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.5.3 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.6 WATER CHEMISTRY CONTROL – AUXILIARY SYSTEMS PROGRAM (PNPS AMP B.1.32.1)

In PNPS LRA Appendix B, Section B.1.32.1, the applicant described PNPS AMP B.1.32.1, "Water Chemistry Control – Auxiliary Systems Program."

The applicant stated that PNPS AMP B.1.32.1 is an existing plant-specific program. The purpose of the Water Chemistry Control – Auxiliary Systems Program is to manage loss of material for components exposed to treated water. Program activities include sampling and analysis of the stator cooling water system to minimize component exposure to aggressive environments.

The project team reviewed, in whole or part, the documents listed in Attachment 5 to this audit and review report for PNPS AMP B.1.32.1, including AMPER, LRPD-02, Revision 1, Section 4.23.1, "Water Chemistry Control – Auxiliary System Program," and interviewed the applicant's technical staff.

3.0.3.3.6.1 Review of the PNPS AMP B.1.32.1 Against the Program Elements

The project team reviewed PNPS AMP B.1.32.1 against the program elements found in SRP-LR Appendix A.1, Section A.1.2.3, and SRP-LR Table A.1-1. The project team followed the review process as described in the PNPS audit and review plan.

3.0.3.3.6.1.1 Scope of Program

The "scope of program" program element in Appendix A.1.2.3.1 of the SRP-LR requires that the program scope include the specific SCs addressed with this program.

The applicant stated in PNPS AMP B.1.32.1, for the "scope of program" program element, that program activities include sampling and analysis of the stator cooling water system to minimize component exposure to aggressive environments.

City water is taken from the town of Plymouth water main and distributed throughout the potable and sanitary water system at town water pressure. City water is monitored and treated by the town of Plymouth to meet the regulations of the Commonwealth of Massachusetts.

Since the applicant identified the stator cooling water system components to which this program is applied, the project team determined that the specific components for which the program manages aging effects are identified by the applicant, which satisfies the criterion as defined in Appendix A.1.2.3.1 of the SRP-LR. On this basis, the project team found that the applicant's proposed program scope is acceptable.

3.0.3.3.6.1.2 Preventive Actions

The "preventive actions" program element in Appendix A.1.2.3.2 of the SRP-LR are that (1) the activities for prevention and mitigation programs should be described, and (2) for condition or performance monitoring programs that do not rely on preventive actions, preventive actions need not be provided.

The applicant stated in PNPS AMP B.1.32.1, for the "preventive actions" program element, that the program includes monitoring and control of stator cooling water to minimize exposure to aggressive environments.

City water used in the potable and sanitary water system is monitored and treated by the town of Plymouth to meet the regulations of the Commonwealth of Massachusetts.

The project team determined that the "preventive actions" program element satisfies the criteria defined in Appendix A.1.2.3.2 of the SRP-LR. Because the applicant has identified the preventive action performed by the town of Plymouth to monitor the cooling water, the project

team found that the applicant's description of the "preventive actions" program element is acceptable.

3.0.3.3.6.1.3 Parameters Monitored/Inspected

The "parameters monitored/inspected" program element in Appendix A.1.2.3.3 of the SRP-LR can be summarized as follows:

> The parameters to be monitored or inspected should be identified and linked to the degradation of the particular SC intended function(s).
>
> For condition monitoring programs, the parameter monitored or inspected should detect the presence and extent of aging effects.
>
> For performance monitoring programs, a link should be established between degradation of the particular structure or component intended function(s) and the parameter being monitored.
>
> For prevention and mitigation programs, the parameter monitored should be the specific parameter being controlled to achieve prevention or mitigation of aging effects.

The applicant stated in PNPS AMP B.1.32.1, for the "parameters monitored/inspected" program element, that in accordance with industry recommendations, stator cooling water parameters monitored are conductivity, corrosion products, and dissolved oxygen. City water used in the potable and sanitary water system is monitored and treated by the town of Plymouth to meet the regulations of the Commonwealth of Massachusetts.

The project team determined that the "parameters monitored/inspected" program element satisfies the criteria defined in Appendix A.1.2.3.3 of the SRP-LR. Because the applicant has identified the parameters monitored, the project team found that the applicant's description of the "parameters monitored/inspected" program element is acceptable.

3.0.3.3.6.1.4 Detection of Aging Effects

The "detection of aging effects" program element in Appendix A.1.2.3.4 of the SRP-LR can be summarized as follows:

- Provide information that links the parameters to be monitored or inspected to the aging effects being managed.
- Describe when, where, and how program data are collected (i.e., all aspects of activities to collect data as part of the program).
- Link the method or technique and frequency, if applicable, to plant-specific or industrywide operating experience.

- Provide the basis for the inspection population and sample size when sampling is used to inspect a group of SCs. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects.

The applicant stated in PNPS AMP B.1.32.1, for the "detection of aging effects" program element, that the program manages loss of material for stator cooling water system and potable and sanitary water system components.

The One-Time Inspection Program describes inspections planned to verify the effectiveness of water chemistry control programs to ensure that significant degradation is not occurring and component intended function is maintained during the PEO.

The project team noted that frequency of sampling water chemistry was not identified. The project team asked the applicant to provide the frequencies. In its response, the applicant stated that stator cooling water conductivity is monitored continuously using three conductivity elements with remote readouts and alarms. Dissolved oxygen is measured using a portable oxygen meter with a continuous local display. The oxygen meter is read weekly and the value is recorded. If the oxygen meter is out of service, a weekly grab sample is obtained and a chemical analysis is performed. Monthly copper analyses are performed to monitor for corrosion.

1. Three installed plant conductivity elements (P&ID M275) are read out remotely and are alarmed for operations. In addition, one portable conductivity meter is kept in sample panel C-3006, and it only has a local readout. Normally, the portable meter satisfies the PNPS Procedure No. 7.8.1 grab sample requirement. However, PNPS is considering removing the portable meter from the sample panel and just using the installed conductivity elements. With three conductivity elements, there is more than enough monitoring.

2. The only oxygen meter is portable and located in sample panel C-3006. The meter has a continuous local readout display, but it has no readout or alarms. It is read weekly and the value is recorded. If the oxygen meter is out of service, a weekly grab sample is obtained and a chemical analysis is performed.

3. PNPS does not perform corrosion products analyses; only copper analyses are performed.

Since the applicant has identified the frequencies, the project team found the applicant's response to be acceptable.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.4 of the SRP-LR. Based on the above response and considering that OTI will be performed to verify effectiveness of this chemistry program, the project team found that the applicant's description of the "detection of aging effects" program element is acceptable.

3.0.3.3.6.1.5 <u>Monitoring and Trending</u>

The "monitoring and trending" program element in Appendix A.1.2.3.5 of the SRP-LR can be summarized as follows:

- Monitoring and trending activities should be described, and they should provide predictability of the extent of degradation and thus effect timely corrective or mitigative actions.

- This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The applicant stated in PNPS AMP B.1.32.1, for the "monitoring and trending" program element, that values from analyses are archived for long-term trending and review.

The project team reviewed PNPS Procedure No. 7.8.7, "Reading and Trending of Chemistry Data," and concluded that appropriate trending is being performed.

The project team determined that this program element satisfies the criteria defined in Appendix A.1.2.3.5 of the SRP-LR. On this basis, the project team found that the applicant's description of the "monitoring and trending" program element is acceptable.

3.0.3.3.6.1.6 Acceptance Criteria

The "acceptance criteria" program element in Appendix A.1.2.3.6 of the SRP-LR can be summarized as follows:

- The acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the SC intended function(s) are maintained under all CLB design conditions during the PEO.

- The program should include a methodology for analyzing the results against applicable acceptance criteria.

- Qualitative inspections should be performed to the same predetermined criteria as quantitative inspections by personnel in accordance with the ASME Code and through approved site-specific programs.

The applicant stated in PNPS AMP B.1.32.1, for the "acceptance criteria" program element, that in accordance with industry recommendations, acceptance criteria for the stator cooling water system are as follows:

- conductivity less than 0.3 S/cm
- dissolved oxygen greater than 2.0 ppm / less than 8.0 ppm
- corrosion products no detectable activity

However, the project team noted that the units for conductivity were incorrect. Also, as stated in Section 3.0.3.3.6.1.4 above, PNPS does not perform corrosion products analyses. Instead, copper analyses are performed. The project team asked the applicant to clarify the units and the statement on corrosion products. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that it was an error created by a software conversion error. Element 6 of LRA Section B.1.32.1 will be amended to correct the units of conductivity to µS/cm and delete the acceptance criteria for corrosion products. Corrosion product (copper) sampling is used to determine the type of copper oxide layer formed. Thus, it is a diagnostic parameter without an acceptance criteria.

The project team reviewed PNPS Procedure No. 7.8.1, Revision 40, "Chemistry Sample and Analysis Program Procedure," and determined that the response was acceptable.

The project team reviewed this program element to determine whether or not it satisfies the criteria defined in Appendix A.1.2.3.6 of the SRP-LR. Since specific values are identified, the project team found that the applicant's description of the "acceptance criteria" is acceptable.

3.0.3.3.6.1.7 Corrective Actions

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.6.1.8 Confirmation Process

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.6.1.9 Administrative Controls

The adequacy of the applicant's 10 CFR Part 50, Appendix B Program associated with this program element is addressed in Section 3.0.4 of this audit and review report.

3.0.3.3.6.1.10 Operating Experience

The "operating experience" program element criteria in Appendix A.1.2.3.10 of the SRP-LR can be summarized as follows:

- Operating experience should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the PEO.
- An applicant may have to commit to providing operating experience in the future for new programs to confirm their effectiveness.

The applicant stated in the PNPS LRA, for the "operating experience" program element, that in spring 2001, a small leak of hydrogen into the stator coolant that caused displacement of oxygen was identified and repaired. Continuous confirmation of stator cooling water quality and timely

corrective actions provide evidence that the program is effective in managing loss of material for stator cooling water system components.

Stator cooling water sample results between October 2001 and January 2002 revealed oxygen concentrations below the acceptance criterion of 2 ppm. Feed and bleed operations were used to introduce atmospheric oxygen into the cooling water to correct the oxygen level. Oxygen levels did not go below 0.76 ppm, and copper concentrations remained normal with no adverse trend. Continuous confirmation of stator cooling water quality and timely corrective actions provide evidence that the program is effective in managing loss of material for stator cooling water system components.

Stator cooling water sample results for the period January 1, 2004 through September 7, 2005 revealed only two instances of a parameter outside the acceptance criteria. On July 1, 2004, measured dissolved oxygen was 1.84 ppm. The acceptance criterion for dissolved oxygen is greater than 2.0 ppm and less than 8.0 ppm. Subsequent readings were within the acceptance criterion and corrective action was not required. On April 7, 2005, measured dissolved oxygen was 0.90 ppm. In this instance, it was determined that the oxygen probe had failed. Grab sample analysis resulted in a dissolved oxygen reading within acceptance criteria. Continuous confirmation of stator cooling water quality provides evidence that the program is effective in managing loss of material for stator cooling water system components.

QA audits in 2000, 2002, and 2004 revealed no issues or findings that could impact effectiveness of the program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.27, “Water Chemistry Control – Auxiliary Systems Program.” Several instances where the limit levels were exceeded were identified, with appropriate actions taken. The program is effective in managing aging effects. The project team reviewed CR-PNP-2001-09096 regarding dissolved oxygen levels in stator cooling water decreasing below acceptable levels. The project team reviewed the CR and determined that appropriate corrective actions as required by this program were performed and the necessary corrective actions were completed.

The project team reviewed the operating experience provided in the PNPS LRA and interviewed the applicant’s technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience.

On the basis of its review of the operating experience and discussions with the applicant’s technical staff, the project team concluded that the applicant’s Water Chemistry Control – Auxiliary Systems Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited.

3.0.3.3.6.2 <u>UFSAR Supplement</u>

The applicant provided its UFSAR Supplements for the Water Chemistry Control – Auxiliary Systems Program in PNPS LRA Appendix A, Section A.2.1.36, which states that the purpose of

the Water Chemistry Control – Auxiliary Systems Program is to manage loss of material for components exposed to treated water.

Program activities include sampling and analysis of the stator cooling water system to minimize component exposure to aggressive environments.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team reviewed the UFSAR Supplement, found that it was consistent with the GALL Report, and determined that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR Supplement table and as required by 10 CFR 54.21(d).

3.0.3.3.6.3 Conclusion

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

On the basis of its review of the UFSAR Supplement for this program, the project team also found that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 QA Program Attributes Integral to AMPs

Pursuant to 10 CFR 54.21(a)(3), a license renewal applicant is required to demonstrate that the effects of aging on SCs subject to an AMR will be adequately managed so that their intended functions will be maintained consistent with the CLB for the PEO. SRP-LR, Branch Technical Position RLSB-1, "Aging Management Review – Generic," describes 10 attributes of an acceptable AMP. Three of these 10 attributes are associated with the QA 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.

SRP-LR, Branch Technical Position IQMB-1, "Quality Assurance for Aging Management Programs," noted that those aspects of the AMP that affect the quality of safety-related SCs are subject to the QA requirements of 10 CFR Part 50, Appendix B. Additionally, for non-safety related (NSR) SCs subject to an AMR, the existing 10 CFR Part 50, Appendix B, QA program may be used by the applicant to address the elements of corrective action, the confirmation process, and administrative controls. Branch Technical Position IQMB-1 provides the following guidance with regard to the QA attributes of AMPs:

> Safety-related SCs are subject to 10 CFR Part 50, Appendix B, requirements, which are adequate to address all quality-related aspects of an AMP consistent with the CLB of the facility for the period of extended operation.

For NSR SCs 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 SCs to address corrective actions, the confirmation process, and administrative controls for aging management during the PEO. In this case, the applicant should document such a commitment in the FSAR Supplement in accordance with 10 CFR 54.21(d).

3.0.4.1 Summary of Technical Information in Application

LRA Section 3.0, "Aging Management Review Results," provides an AMR summary for each unique structure, component, or commodity group determined to require aging management during the PEO. This summary includes identification of AERMs and AMPs utilized to manage these aging effects. LRA Appendix A, "Updated Final Safety Analysis Report Supplement," and LRA Appendix B, "Aging Management Programs," demonstrate 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 three types of programs: existing programs, programs that contain exceptions or enhancements, and new programs.

In LRA Section A2.1, "Aging Management Programs and Activities," the applicant stated that PNPS QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The Entergy quality assurance program applies to safety-related SCs. Corrective actions and administrative (document) control for both safety-related and NSR SCs are accomplished per the existing PNPS corrective action program and document control program and are applicable to all AMPs and activities that will be required during the PEO. The confirmation process is part of the corrective action program and includes reviews to assure that proposed actions, tracking and reporting of open corrective actions, and review of corrective action effectiveness are adequate. Any followup inspection required by the confirmation process is documented in accordance with the corrective action program.

Generally, the three elements are applicable as follows:

Corrective Actions

PNPS QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. Conditions adverse to quality, such as failures, malfunctions, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of significant conditions adverse to quality, measures are implemented to ensure that the cause of the nonconformance is determined and that corrective action is taken to preclude recurrence. In addition, the root cause of the significant condition adverse to quality and the corrective action implemented are documented and reported to appropriate levels of management.

Confirmation Process

PNPS QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. The Entergy quality assurance program applies to PNPS safety-related SCs. Corrective actions and administrative (document) control for both safety-related and NSR SCs are accomplished per the existing PNPS corrective action program and document control program. The confirmation process is part of the corrective action program and includes the following:

- reviews to assure that proposed actions are adequate,
- tracking and reporting of open corrective actions, and
- review of corrective action effectiveness.

Any followup inspection required by the confirmation process is documented in accordance with the corrective action program. The corrective action program constitutes the confirmation process for AMPs and activities. The PNPS confirmation process is consistent with NUREG-1801.

Administrative Controls

PNPS QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. The Entergy quality assurance program applies to PNPS safety-related SCs. Administrative (document) control for both safety-related and NSR SCs is accomplished per the existing document control program. The PNPS administrative controls are consistent with NUREG-1801.

3.0.4.2 Project Team Evaluation

The project team reviewed the applicant's AMPs described in PNPS LRA Appendix A, "FSAR Supplement," specifically Appendix A2.1, "Aging Management Programs and Activities"; and Appendix B, "Aging Management Programs," specifically Appendix B0.3, "PNPS Corrective Actions, Confirmation Process and Administrative Controls.". 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 QA attributes of AMPs.

PNPS has chosen to follow the current procedure for handling NSR SCs subject to an AMR. It uses the same procedures for corrective actions, the confirmation process, and administrative controls for SR and NSR SCs, but does not include NSR SCs in its 10 CFR 50, Appendix B Program.

The project team reviewed the applicant's corrective action, confirmation process, and administrative controls procedure and found them to be acceptable. The corrective action procedure is reviewed on a routine basis by the regional inspection teams and has been found to be acceptable during past inspections.

3.0.4.3 Conclusion

The project team concluded that the QA attributes of the applicant's AMPs are consistent with 10 CFR 54.21(a)(3). Specifically, the applicant described the quality attributes of the programs and activities for managing the effects of aging for both SR and NSR SSCs within the scope of license renewal and stated that the 10 CFR Part 50, Appendix B, QA program addresses the elements of corrective action, confirmation process, and administrative control. Therefore, the applicant's QA description for its AMPs is acceptable.

3.1 PNPS LRA Section 3.1 - Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

This section of the audit and review report documents the project team's review and evaluation of PNPS AMR results for the aging management of the RV, internals, and RCS component and component groups associated with the following systems: (1) RV, (2) RV internals, and (3) RCPB.

3.1.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.1, the applicant provided the results of its AMRs for the RV, internals, and RCS components and component groups.

In PNPS LRA Table 3.1.1, "Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of NUREG-1801," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the RV, internals, and RCS components and component groups. The applicant also identified for each component type in the PNPS LRA Table 3.1.1 those components that are consistent with the GALL Report, those for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In the PNPS LRA Tables 3.1.2-1 through 3.1.2-3, the applicant provided a summary of the AMR results for component types associated with (1) RV, (2) RV internals, and (3) RCPB. Specifically, the information for each component type included intended function, material, environment, AERM, AMPs, the GALL Report Volume 2 item, cross-reference to the PNPS LRA Table 3.1.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporated applicable operating experience in the determination of AERMs. These reviews included evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.1.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.1 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the RV, internals, and RCS components that are within the scope of license renewal and subject to an AMR will be adequately managed.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.1.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further evaluations were in accordance with the acceptance criteria in SRP-LR. The project team's audit evaluation is documented in Section 3.1.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.1.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the RV, internals, and RCS components.

Table 3.1-1 of this audit and review report provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in LRA Section 3.1 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.1-1 Project Team's Evaluation for LRA Section 3.1 – Reactor Vessel, Internals, and Reactor Coolant System Components in the GALL Report

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-1	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA – metal fatigue	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.1.
3.1.1-2	Steel; SS; steel with nickel-alloy or SS cladding; nickel-alloy RV components: flanges; nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads, and welds	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	TLAA – metal fatigue	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.1.
3.1.1-3	Steel; SS; steel with nickel-alloy or SS cladding; nickel-alloy RCPB piping, piping components, and piping elements exposed to reactor coolant	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	TLAA – metal fatigue	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.1.
3.1.1-4	Steel pump and valve closure bolting	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) check Code limits for allowable cycles (less than 7,000 cycles) of thermal stress range	TLAA – metal fatigue	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.1.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-5	SS and nickel-alloy RV internals components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA – metal fatigue	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.1.
3.1.1-11	Steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR (B.1.32.2), and Inservice Inspection (B.1.16.2)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.2.1.
3.1.1-13	Steel and SS isolation condenser components exposed to reactor coolant	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2), or Water Chemistry – BWR (B.1.32.2) and Inservice Inspection (B.1.16.2)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.2.2.
3.1.1-14	SS, nickel-alloy, and steel with nickel-alloy or SS cladding RV flanges, nozzles, penetrations, safe ends, vessel shells, heads, and welds	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2), or Water Chemistry – BWR (B.1.32.2) and Inservice Inspection (B.1.16.2)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.2.1.
3.1.1-15	SS; steel with nickel-alloy or SS cladding; and nickel-alloy RCPB components exposed to reactor coolant (Item 3.1.1-15)	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2), or Water Chemistry – BWR (B.1.32.2) and Inservice Inspection (B.1.16.2)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.2.3.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-17	Steel (with or without SS cladding) RV beltline shell, nozzles, and welds	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	TLAA – neutron fluence	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.3.1.
3.1.1-18	Steel (with or without SS cladding) RV beltline shell, nozzles, and welds; safety injection nozzles	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor Vessel Surveillance	Reactor Vessel Surveillance (B.1.26)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.3.2.
3.1.1-19	SS and nickel-alloy top head enclosure vessel flange leak detection line	Cracking due to SCC and IGSCC	A plant-specific AMP is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	One-Time Inspection (B.1.23)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.4.1.
3.1.1-20	SS isolation condenser components exposed to reactor coolant	Cracking due to SCC and IGSCC	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and plant-specific verification program	None	Not applicable to PNPS because there is no isolation condenser. See audit report Section 3.1.2.2.4.2.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-25	SS jet pump sensing line	Cracking due to cyclic loading	A plant-specific AMP is to be evaluated.	None for the portion of the jet pump sensing lines inside the RPV. Water Chemistry – BWR (B.1.32.2) and One-Time Inspection (B.1.23) for the portion of the jet pump sensing lines outside the RPV.	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.8.1.
3.1.1-26	Steel and SS isolation condenser components exposed to reactor coolant	Cracking due to cyclic loading	Inservice Inspection (IWB, IWC, and IWD) and plant-specific verification program	None	Not applicable to PNPS because there is no isolation condenser. See audit report Section 3.1.2.2.8.2.
3.1.1-29	SS steam dryers exposed to reactor coolant	Cracking due to flow-induced vibration	A plant-specific AMP is to be evaluated	BWR Vessel Internals (B.1.8)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.1.2.2.11.
3.1.1-38	Steel (with or without SS cladding) CRD return line nozzles exposed to reactor coolant	Cracking due to cyclic loading	BWR CRD Return Line Nozzle	BWR CRD Line Nozzle (B.1.3)	Consistent with the GALL Report.
3.1.1-39	Steel (with or without SS cladding) feedwater nozzles exposed to reactor coolant	Cracking due to cyclic loading	BWR Feedwater Nozzle	BWR Feedwater Nozzle (B.1.4)	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-40	SS and nickel-alloy penetrations for CRD stub tubes instrumentation, jet pump instrument, standby liquid control, flux monitor, and drain line exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	BWR Penetrations and Water Chemistry	BWR Penetrations (B.1.5) and Water Chemistry – BWR (B.1.32.2) or BWR Vessel Internals (B.1.8) and Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report. See audit report Section 3.1.2.1.1 for further discussion.
3.1.1-41	SS and nickel-alloy piping, piping components, and piping elements greater than or equal to 4 NPS; nozzle safe ends and associated welds	Cracking due to SCC and IGSCC	BWR Stress Corrosion Cracking and Water Chemistry	BWR Stress Corrosion Cracking (B.1.6) and Water Chemistry – BWR (B.1.32.2); or Inservice Inspection (B.1.16.2) and Water Chemistry – BWR (B.1.32.2); or Water Chemistry – BWR (B.1.32.2), Inservice Inspection (B.1.16.2), and BWR Stress Corrosion Cracking (B.1.6); or Water Chemistry - BWR (B.1.32.2), and One-Time Inspection (B.1.23)	Consistent with the GALL Report. See audit report Section 3.1.2.1.2 for further discussion.
3.1.1-42	SS and nickel-alloy vessel shell attachment welds exposed to reactor coolant	Cracking due to SCC and IGSCC	BWR Vessel ID Attachment Welds and Water Chemistry	BWR Vessel ID Attachment Welds (B.1.7) and Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-43	SS fuel supports and CRD assemblies CRD housing exposed to reactor coolant	Cracking due to SCC and IGSCC	BWR Vessel Internals and Water Chemistry	BWR Vessel Internals (B.1.8) and Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report.
3.1.1-44	SS and nickel-alloy core shroud, core plate, core plate bolts, support structure, top guide, core spray lines, spargers, jet pump assemblies, CRD housing, nuclear instrumentation guide tubes	Cracking due to SCC, IGSCC, IASCC	BWR Vessel Internals and Water Chemistry	BWR Vessel Internals (B.1.8) and Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report.
3.1.1-45.	Steel piping, piping components, and piping elements exposed to reactor coolant	Wall thinning due to FAC	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion Program (B.1.14)	Consistent with the GALL Report.
3.1.1-46	Nickel-alloy core shroud and core plate access hole cover (mechanical covers)	Cracking due to SCC, IGSCC, IASCC	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	None	Not applicable. See audit report Section 3.1.2.3.
3.1.1-47	SS and nickel-alloy RV internals exposed to reactor coolant	Loss of material due to pitting and crevice corrosion	Inservice Inspection (IWB, IWC, and IWD), and Water Chemistry	Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report. See audit report Section 3.1.2.1.3 for further discussion.
3.1.1-48	Steel and SS Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to SCC, IGSCC (for SS only), and thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and One-Time Inspection of ASME Code Class 1 small-bore piping	Inservice Inspection (B.1.16.2) and Water Chemistry – BWR (B.1.32.2) or Water Chemistry – BWR (B.1.32.2) and One-Time Inspection (B.1.23)	Consistent with the GALL Report. See audit report Section 3.1.2.1.4 for further discussion.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-49	Nickel-alloy core shroud and core plate access hole cover (welded covers)	Cracking due to SCC, IGSCC, IASCC	Inservice Inspection (IWB, IWC, and IWD), Water Chemistry, and, for BWRs with a crevice in the access hole covers, augmented inspection using UT or other demonstrated acceptable inspection of the access hole cover welds	Inservice Inspection (B.1.16.2) and Water Chemistry – BWR (B.1.32.2)	Consistent with the GALL Report. See audit report Section 3.1.2.1.5 for further discussion.
3.1.1-50	High-strength low-alloy steel top head closure studs and nuts exposed to air with reactor coolant leakage	Cracking due to SCC and IGSCC	Reactor Head Closure Studs	Reactor Head Closure Studs (B.1.25) or Inservice Inspection (B.1.16.2)	Consistent with the GALL Report. See audit report Section 3.1.2.1.6 for further discussion.
3.1.1-51	CASS jet pump assembly castings; orificed fuel support	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	Thermal Aging Embrittle-ment of CASS (B.1.31)	Consistent with the GALL Report.
3.1.1-52	Steel and SS RCPB pump and valve closure bolting, manway and holding bolting, flange bolting, and closure bolting in high-pressure and high-temperature systems	Cracking due to SCC, loss of material due to wear, loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	Inservice Inspection (B.1.16.2)	Consistent with the GALL Report. See audit report Section 3.1.2.1.7 for further discussion.
3.1.1-53	Steel piping, piping components, and piping elements exposed to CCW	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.1.2.3.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-54	Copper alloy piping, piping components, and piping elements exposed to CCW	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.1.2.3.
3.1.1-55	CASS Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant > 482°F	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, ISI requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings	Inservice Inspection (B.1.16.2) or One-Time Inspection (B.1.23)	Consistent with the GALL Report. See audit report Section 3.1.2.1.8 for further discussion.
3.1.1-56	Copper alloy > 15% zinc piping, piping components, and piping elements exposed to CCW	Loss of material due to selective leaching	Selective Leaching of Materials	None	Not applicable. See audit report Section 3.1.2.3.
3.1.1-57	CASS Class 1 piping, piping component, and piping elements and CRD pressure housings exposed to reactor coolant > 482°F	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	One-Time Inspection (B.1.23)	Consistent with the GALL Report. See audit report Section 3.1.2.1.9 for further discussion.
3.1.1-85	Nickel alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external)	None	None	None	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect, Aging Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.1.1-86	SS piping, piping components, and piping elements exposed to air-indoor uncontrolled (external); air with borated water leakage; concrete; gas	None	None	None	Consistent with the GALL Report.
3.1.1-87	Steel piping, piping components, and piping elements in concrete	None	None	None	Not applicable. See audit report Section 3.1.2.3.

3.1.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Section 3.1.2.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the aging effects related to the RV, RV internals, and RCPB components:

- BWR CRD Return Line Nozzle Program (B.1.3)
- BWR Feedwater Nozzle Program (B.1.4)
- BWR Penetrations Program (B.1.5)
- BWR Stress Corrosion Cracking Program (B.1.6)
- BWR Vessel ID Attachment Welds Program (B.1.7)
- BWR Vessel Internals Program (B.1.8)
- Flow-Accelerated Corrosion Program (B.1.14)
- Inservice Inspection Program (B.1.16.2)
- One-Time Inspection Program (B.1.23)
- Reactor Head Closure Studs Program (B.1.25)
- Reactor Vessel Surveillance Program (B.1.26)
- System Walkdown Program (B.1.30)
- Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program (B.1.31)
- Water Chemistry Control – BWR Program (B.1.32.2)
- Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)

Project Team Evaluation

In PNPS LRA Tables 3.1.2-1 through 3.1.2-3, the applicant provides a summary of AMRs for the RV, RV internals, and RCPB components and identifies which AMRs it considers to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claims consistency with the GALL Report, and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components contained in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provides a note for each AMR line item in Tables 3.1.2-1 through 3.1.2-3. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with Notes A through E, which indicated the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, aging effect, and AMP. In addition, the AMP is consistent with the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and AMP. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report. The project team verified that the identified exceptions to the GALL AMPs had been reviewed and accepted by the staff. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item is different from but consistent with the GALL Report for material, environment, and AMP. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report. However, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component that was under review. The staff audited these line items to verify consistency with the GALL Report. The staff also determined that the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and AMP, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the identified AMP would manage the aging effect consistent with the AMP identified by the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff conducted an audit and review of the information provided in the LRA, as documented in its PNPS audit and review report. The staff did not repeat its review of the matters described in the GALL Report. However, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

For aging management evaluations that the applicant stated are consistent with the GALL Report and for which further evaluation is not recommended, the staff conducted its audit of the LRA to determine if the applicant's reference to the GALL Report is acceptable.

The staff reviewed the PNPS LRA to confirm that the applicant (1) provided a brief description of the system, components, materials, and environment; (2) stated that the applicable aging effects had been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the RV, RV internals, and RCPB components subject to an AMR.

3.1.2.1.1 Cracking Due to SCC, IGSCC, Cyclic Loading

In the discussion section of Table 3.1.1, Item 3.1.1-40 of the PNPS LRA, the applicant stated that cracking in SS and nickel-alloy nozzles and penetrations in the RV is managed by the Water Chemistry Control – BWR and either the BWR Penetrations or BWR Vessel Internals Programs. During the audit and review, the project team noted that for two AMR results lines that point to Table 3.1.1, Item 3.1.1-40, the applicant included a reference to Note E. The lines that refer to Note E summarize AMR results for the CRD stub tubes and the incore housings.

The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Reports recommends the BWR Penetrations AMP, the applicant proposed using the BWR Vessel Internals AMP. For the components associated with these lines, the project team asked the applicant why PNPS included these components in the BWR Vessel Internals Program rather than in the BWR Penetrations Program as recommended by the GALL Report.

In response to this question, the applicant stated that the PNPS BWR Penetrations Program is consistent with the GALL Report, Section XI.M8, BWR Penetrations, which covers only the standby liquid control/core plate differential pressure nozzles, and the instrument penetrations as discussed in BWRVIP-27 and BWRVIP-49, respectively. The applicant stated that PNPS includes the CRD stub tubes and instrument housings in the BWR Vessel Internals Program because they are covered by BWRVIP-47, "Lower Plenum," which is included in GALL Report, Section XI.M9, "BWR Vessel Internals." The applicant stated that this is slightly inconsistent with GALL Report, Section IV, but PNPS felt it was better to be consistent with the programs in Section XI of the GALL Report, rather than with one line item in Section IV of the GALL Report. The applicant also stated that at PNPS both the BWR Penetrations Program and the BWR Vessel Internals Program are implemented by the same plant procedure.

The project team reviewed the applicant's response together with the applicable GALL Report AMPs and the related BWRVIP documents. The project team determined that the GALL Report does not refer to BWRVIP-47 in its description of the BWR Penetrations AMP; however,

the GALL Report does include BWRVIP-47 in its description of the BWR Vessel Internals Program. On this basis, the project team found the applicant's use of Water Chemistry Control – BWR and BWR Vessel Internals Programs for aging management of the CRD stub tubes and incore instrument housings to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.2 Cracking Due to SCC and IGSCC

In the discussion section of Table 3.1.1, Item 3.1.1-41, of the PNPS LRA, the applicant stated that at PNPS cracking in SS, nickel-alloy, and steel clad with SS components in reactor coolant is managed by several programs. The applicant stated that consistent with the GALL Report for some components of the RV and RCPB, the BWR Stress Corrosion Cracking and Water Chemistry Control – BWR Programs, further supplemented by the Inservice Inspection Program for some components, manage cracking; and that for other components, to which the BWR Stress Corrosion Cracking Program is not applicable, cracking is managed by the Water Chemistry Control – BWR and Inservice Inspection or One-Time Inspection Programs. During the audit and review, the project team noted that for five AMR results lines that point to Table 3.1.1, Item 3.1.1-41, the applicant included a reference to Note E. Four lines that refer to Note E summarize AMR results for which the AMPs are the Water Chemistry Control – BWR and the Inservice Inspection Programs. One line that refers to Note E summarizes AMR results for which the AMPs are the Water Chemistry Control – BWR and the One-Time Inspection Programs.

The project team reviewed the AMR results lines referenced to Note E, where the AMPs are the Water Chemistry Control – BWR and the Inservice Inspection Programs and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report. During the audit and review, the project team noted that the only components identified in these lines are either vessel nozzles made of low-alloy steel with SS cladding or safe ends for vessel penetration nozzles that are included in the PNPS BWR Penetrations Program. In response to a project team request that the applicant provide more details about assignment of components to PNPS programs, the applicant stated that PNPS chose to include these components in the Inservice Inspection Program, rather than the BWR Stress Corrosion Cracking Program, for implementation purposes and that the implementing procedure, when enhanced as described in the LRA's discussion of the BWR Stress Corrosion Cracking Program, will include appropriate references to the BWR Stress Corrosion Cracking Program basis documents. The project team determined that including these components in the PNPS Inservice Inspection Program provides aging management equivalent to their being explicitly included in the PNPS BWR Stress Corrosion Cracking Program. Based on this determination, the project team found the applicant's use of Note E appropriate and found these AMR results lines to be acceptable.

The project team reviewed the AMR results line referenced to Note E, where the AMPs are the Water Chemistry Control – BWR and the One-Time Inspection Programs and determined that

the material, environment, and aging effect are consistent with the corresponding line of the GALL Report. The project team noted that the only component identified in this line is the MS line flow restrictor, made of CASS in an environment of treated water at greater than 482°F. By review of ASME Code Section XI, Table IWB-2500-1, and the applicant's implementing procedures for ISI, the project team determined that the MS line flow restrictors are not required to be included in the PNPS Inservice Inspection Program because they are inside the MS lines and are not part of the RCPB. As such, the MS line flow restrictors are not routinely inspected as part of the Inservice Inspection Program, and partial disassembly of the MS lines will be required to provide access for their inspection. The project team noted that the GALL Report recommends Water Chemistry, augmented by One-Time Inspection to confirm Water Chemistry effectiveness, as appropriate AMPs to manage the aging effects of other components with materials, environments and aging effects similar to those of the MS line flow restrictors. On this basis, the project team found the applicant's use of Note E appropriate and found these AMR results lines acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM as recommended by the GALL Report.

3.1.2.1.3 Loss of Material Due to Pitting and Crevice Corrosion

In the discussion section of Table 3.1.1, Item 3.1.1-47, of the PNPS LRA, the applicant stated that at PNPS loss of material in SS and nickel-alloy components of the RV internals is managed by the Water Chemistry Control – BWR Program and that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program to manage loss of material. The applicant stated that the Inservice Inspection Program is not applicable to most RV internals components since they are not part of the pressure boundary and that management of loss of material using the Water Chemistry Control – BWR Program augmented by the One-Time Inspection Program is consistent with other items of LRA Table 3.1.1, including Items 3.1.1-14 and 3.1.1-15. During the audit and review, the project team noted that for all of the AMR results lines that point to Table 3.1.1, Item 3.1.1-47, the applicant included a reference to Note E. The project team noted that the components described by the AMR results lines are BWR internal components that are not part of the RCPB in an environment of hot treated water (reactor coolant) and that the AMP was identified as Water Chemistry Control – BWR.

During the audit and review, the project team noted that the LRA's discussion for Table 3.1.1, Item 3.1.1-47, stated that the One-Time Inspection Program will be used to verify the effectiveness of the Water Chemistry Control – BWR Program. The project team asked the applicant to explain why, for management of loss of material in these components, PNPS does not list the Inservice Inspection Program as recommended in the corresponding line of the GALL Report.

In response to this question, the applicant stated that PNPS does perform VT-3 examinations of the vessel interior as required by ASME Section XI, Table IWB-2500-1 (Examination Category B-N-1, interior of reactor vessel). The applicant also stated that these examinations at PNPS

do not include the majority of the BWR internal components, and that, therefore, crediting ISI for managing loss of material of the internals in general is inappropriate. The applicant stated that ASME Examination Category B-N-3 (removable core support structures) is not applicable to PNPS, which does not have removable core support structures. The applicant further stated that the AMR results lines that roll up to Table 3.1.1, Item 3.1.1-47 (GALL Report, Table IV, Item IV.A1-8) are for loss of material due to pitting and crevice corrosion and that the GALL Report repeatedly credits the Water Chemistry Control – BWR Program augmented by the One-Time Inspection Program to manage loss of material due to pitting and crevice corrosion. The applicant stated that this program combination is adequate to manage the aging effect in that the loss of material due to pitting and crevice corrosion for the reactor internals in no different than the loss of material due to pitting and crevice corrosion for other SS components exposed to reactor coolant. The applicant stated that the effectiveness of the Water Chemistry Control - BWR Program is confirmed by the One-Time Inspection Program and that the PNPS One-Time Inspection Program will incorporate the results of other inspections that are performed, including ISI inspections done per ASME Code Section XI, Table IWB-2500-1, and other opportunistic inspections.

The project team reviewed the applicant's response together with ASME Code Section XI, Table IWB-2500-1, Examination Category B-N-1, B-N-2, and B-N-3 requirements. On the basis that the Inservice Inspection examinations are performed per the requirements of ASME Section XI, IWB-2500-1, and that the effectiveness of the Water Chemistry Control - BWR program to manage the aging effect of loss of material due to pitting and crevice corrosion is confirmed by the One-Time Inspection Program, the project team found the applicant's response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.4 <u>Cracking Due to SCC, IGSCC (for SS only), and Thermal and Mechanical Loading</u>

In the discussion section of Table 3.1.1, Item 3.1.1-48, of the PNPS LRA, the applicant stated that at PNPS cracking in SS components of the RCPB exposed to reactor coolant is managed by the Water Chemistry Control – BWR Program and that the One-Time Inspection Program, which is consistent with GALL AMPS XI.M32, "One-Time Inspection," and XI.M35, "One-Time Inspection of ASME Code Class 1 Small Bore Piping," will verify the effectiveness of the Water Chemistry Program and will manage cracking in piping and fittings less than 4-inches nominal pipe size (NPS). The applicant stated that cracking in steel components due to thermal and mechanical loading is not directly dependent on water chemistry, so only the One-Time Inspection Program is credited. The applicant stated that the Inservice Inspection Program is also credited for those components greater than 4-inches NPS that are compared with this line of Table 3.1.1. The applicant stated that ISI is not applicable to components less than 4-inches NPS and that AMR results lines referenced to this line of Table 3.1.1 use either OTI or ISI, but not both, as listed in the GALL Report, so Note E is used for these AMR results lines. During the audit and review, the project team noted that the components referenced to Table 3.1.1, Item 3.1.1-48, are piping and fittings, valve bodies and thermowells less than 4-inches NPS,

plus other specialized piping components such as filter housings, orifices, condensing chambers, and accumulator tanks for which the NPS was not listed. The project team noted that the applicant included a reference to Note E for all of these components.

During the audit and review, the project team noted that the applicant's discussion for Table 3.1.1, Item 3.1.1-48, included a statement that "Inservice inspection is not applicable to components less than 4-inches NPS." The project team also noted that ASME Code Section XI, Table IWB-2500-1, Examination Category B-J (pressure retaining welds in piping), requires surface examination, but not volumetric examination, for Class 1 piping that is less than 4-inches NPS. The project asked the applicant to reconcile the discussion for Table 3.11, Item 3.1.1-48, with the ASME Code Section XI requirement cited.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised the discussion of LRA Table 3.1.1, Item 3.1.1-48, to delete the statement that "Inservice inspection is not applicable to components less than 4-inches NPS." On the basis that this change eliminates the conflict between the discussion in the LRA and the requirements of ASME Code Section XI and that examination requirements of ASME Section XI for components less than 4-inches NPS are applicable, the project team finds the applicant's response to be acceptable.

During the audit and review, the project team noted that in the AMR results table (LRA Table 3.1.2-2), the applicant identified the PNPS AMP for a few components as Water Chemistry Control – BWR, rather than Water Chemistry Control – BWR and One-Time Inspection or Water Chemistry Control – BWR and Inservice Inspection. The project team asked the applicant to justify why the One-Time Inspection Program was not credited explicitly in Table 3.1.2-2 even though it was credited in Table 3.1.1. In response to this question, the applicant stated that the One-Time Inspection Program is applicable to the water chemistry control program, so it is applicable to each line item that credits the water chemistry control program, and that LRA Table 3.1.2-2 credits the One-Time Inspection Program through reference to the associated Table 3.1.1 line item. On the basis that each of the Table 3.1.2-2 AMR results lines that point to Table 3.1.1, Item 3.1.1-48, credits the One-Time Inspection Program, as recommended by the GALL Report, through reference to the associated Table 3.1.1 line item, the project team found the applicant's response to be acceptable.

During the audit and review, the project team noted that Table 3.1.1, Item 3.1.1-48, is applicable to Class 1 piping, fittings, and branch lines less than 4-inches NPS made both of carbon steel and of SS; however, there were no AMR results lines for carbon steel piping, fittings, or branch lines less than 4-inches NPS that pointed to Table 3.1.1, Item 3.1.1-48. The project team asked the applicant to explain why there were no Class 1 carbon steel piping components less than 4-inches NPS included in the AMR results. In response to this request, the applicant provided the following response:

> Cracking due to flaw growth is managed by the inspection requirements for Class 1 components in accordance with ASME Section XI, Subsection IWB. Cracking due to flaw growth is considered equivalent to the GALL Report's entry of cracking due to thermal and mechanical loading. The ISI program applies to Class 1 carbon steel piping components at PNPS.

> The LRA will be clarified to show that cracking is an aging effect requiring management for Class 1 carbon steel components less than 4-inches NPS at PNPS. The discussion column for Item 3.1.1-48 will be revised to be consistent with this change. The credited aging management programs will be the same as those listed for the NUREG-1801 line items corresponding to LRA Table 3.1.1, Item 3.1.1-48.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised the LRA to delete the statement, "Cracking in steel components due to thermal and mechanical loading is not directly dependent on water chemistry, so only the One-Time Inspection Program is credited." In addition, the applicant revised LRA Table 3.1.2-3 by adding line items for carbon steel piping and fittings less than 4-inches NPS, one in a treated water environment and one in a treated water environment greater than 220°F. For both of these lines, the applicant credited the One-Time Inspection Program with managing the aging effect of cracking. The project team reviewed the applicant's changes to the LRA and determined that, with the changes incorporated, the AMR results for Class 1 carbon steel piping components less than 4-inches NPS exposed to reactor coolant are consistent with the recommendations of the GALL Report. On the basis that PNPS AMR results are consistent with the recommendations of the GALL Report, the project team found the applicant's changes to the LRA to be acceptable.

During the audit and review, the project team asked the applicant to describe its plans for examination of socket welds in small-bore piping. In its letter of September 13, 2006 (ADAMS Accession Number ML062650072), in PNPS License Renewal Commitment No. 20, the applicant stated that the One-Time Inspection Program will include destructive or nondestructive examination of one socket welded connection using techniques proven by past industry experience to be effective for the identification of cracking in small-bore socket welds. The applicant stated that should an inspection opportunity not occur (e.g., socket weld failure or socket weld replacement), a susceptible small-bore socket weld will be examined either destructively or nondestructively before entering the PEO. On the basis that the applicant's One-Time Inspection Program will include examination of a susceptible small-bore socket weld, the project team found the applicant's response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.5 <u>Cracking Due to SCC, IGSCC, IASCC</u>

In the discussion section of Table 3.1.1, Item 3.1.1-49, of the PNPS LRA, the applicant stated that PNPS has welded access hole covers with a crevice behind the weld and that cracking of the nickel-alloy shroud support access hole covers is managed by the BWR Vessel Internals and Water Chemistry Control – BWR Programs as described in Table 3.1.1, Item 3.1.1-44. The applicant stated that the BWR Vessel Internals Program augments the Inservice Inspection Program and includes either access hole cover visual examinations every 8 years or ultrasonic examinations every 12 years. During the audit and review, the project team noted that LRA Table 3.1.2-2 contains two complementary AMR results lines for the shroud support access

hole covers. One of the lines lists the Water Chemistry Control – BWR Program as an AMP applicable to the access hole covers, and the second of the lines lists the BWR Vessel Internals Program as an AMP applicable to the access hole covers. The project team noted that the applicant had included a reference to Note E for the AMR results line listing the Water Chemistry Control – BWR AMP.

During the audit and review, the project team noted that the GALL Report, Volume 1, Table 1, Item 49, recommends the use of an augmented inspection using UT or other demonstrated acceptable inspection for managing the aging effect of cracking in welded, creviced access hole covers. The project team asked the applicant whether the PNPS welded access hole covers are creviced, whether PNPS currently examines the access hole covers using UT, and whether PNPS plans to examine the access hole covers using UT during the PEO. In response to this question, the applicant provided the following information:

> The original equipment vendor issued a Service Information Letter (SIL) in 1988 after stress corrosion cracking was found in a creviced access hole cover fabricated of nickel alloy. The SIL and its supplements provided recommendations with regard to inspection of creviced access hole cover welds. In response to the SIL's recommendations, PNPS performed UT examinations of both access hole covers at its RFOs in 1991 and 1993, and it performed a UT examination of one access hole cover plus a visual inspection (VT-1) of both access hole covers at its refueling outage (RFO) in 1995. No indications were found in any of these examinations. The original equipment vendor updated its SIL in 2001 based on more recent industry experience and provided recommendations for access hole cover inspection methods and schedules that are currently still in effect. Although PNPS has implemented hydrogen water chemistry to mitigate potential for cracking due to IGSCC, PNPS currently follows the original equipment manufacturer's recommendations that are applicable to a nonhydrogen water chemistry plant. In 2003, PNPS performed an enhanced visual examination (EVT-1) of both access hole covers. In 2005, PNPS did not perform any examinations. In 2007, PNPS plans to perform a VT-1 examination of one access hole cover, and in 2009, PNPS plans to perform a VT-1 examination of the alternate access hole cover.
>
> PNPS will continue to inspect the two access hole covers visually, one at a 4-year interval and one at a 6-year interval, respectively, during the current licensing period. If new BWRVIP guidance is issued for these components, PNPS will perform inspections in accordance with that guidance.
>
> Within the first 6 years of the PEO and every 12 years thereafter, PNPS will inspect the access hole covers with UT methods. Alternatively, PNPS will inspect the access hole covers in accordance with future BWRVIP guidance, should such guidance become available.

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included the UT inspection of the access hole covers during the PEO, as described in its response, as License Renewal Commitment No. 34.

The project team reviewed the applicant's response, the original equipment vendor SIL (GE Nuclear Energy SIL 462, Revision 1, "Access Hole Cover Cracking"), and the applicant's license renewal commitment as documented in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072). The project team noted that the applicant assigns inspection of the access hole cover to the PNPS BWR Vessel Internals Program, rather than to the Inservice Inspection Program, as described in the GALL Report; however, the inspection methods of both programs provide equivalent examinations for the components included therein. Based on its review of the applicant's response, commitment letter, and related documentation, the project team determined that the applicant's current examination of the shroud support access hole covers is consistent with current vendor recommendations applicable to PNPS and that the applicant's proposed examination of the shroud support access hole covers during the PEO will use UT examination or other demonstrated acceptable inspection methods as recommended in the GALL Report. On the basis that the applicant's AMPs for the access hole covers are consistent with the GALL Report, with recommended examinations performed as part of the BWR Vessel Internals Program rather than the Inservice Inspection Program, the project team found the applicant's AMR results and its use of Note E for these components to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.6 Cracking Due to SCC and IGSCC

In the discussion section of Table 3.1.1, Item 3.1.1-50 of the PNPS LRA, the applicant stated that at PNPS the Reactor Head Closure Studs Program manages cracking in low-alloy steel head closure flange bolting and that the Inservice Inspection Program manages cracking in other low-alloy steel pressure boundary bolting. During the audit and review, the project team noted that LRA Table 3.1.2-1 contains two AMR results lines referring to Table 3.1.1, Item 3.1.1-50. One line, applicable to the top head closure flange studs, nuts, washers, and bushings, shows material, environment, aging effect, and AMP all consistent with recommendations of the GALL Report. The second line, applicable to other pressure boundary bolting attached directly to the RPV, shows material, environment, and aging effect consistent with the GALL Report; however, the PNPS AMP is shown as the Inservice Inspection Program, rather than the Reactor Head Closure Studs Program. The project team noted that the applicant included a reference to Note E in the second of these AMR results lines.

The applicant does not include a Bolting Integrity Program in the PNPS LRA. Instead, the applicant credits alternate programs such as System Walkdown, Service Water Integrity, and Buried Piping and Tanks Inspection Programs. The GALL AMP XI.M18, "Bolting Integrity," provides several recommendations in the 10-element evaluation, such as selection of bolting materials, use of lubricants and sealants, and additional recommendations of NUREG-1339. The alternate programs may be acceptable for inspection, but they do not address the preventive actions. The project team asked the applicant to clarify how PNPS meets these recommendations or to provide justification why a Bolting Integrity Program should not be provided.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The Bolting Integrity Program will be implemented before the PEO in accordance with Commitment No. 32. The LRA will be supplemented to include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included AMP B.1.33, "Bolting Integrity Program." This program is consistent with GALL AMP XI.M18, "Bolting Integrity." This program covers bolting within the scope of license renewal, including: (1) safety-related bolting; (2) bolting for NSSS component supports; (3) bolting for other pressure-retaining components, including NSR bolting; and (4) structural bolting (actual measured yield strength greater than 150 ksi). The aging management of reactor head closure studs is addressed by GALL AMP XI.M3 and is not included in this program. Therefore, the aging effects of component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program, instead of any other programs identified in the LRA Table 3.1.2-2s. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.7 Cracking Due to SCC, Loss of Material Due to Wear, Loss of Preload Due to Thermal Effects, Gasket Creep, and Self-Loosening

In Table 3.1.1, Item 3.1.1-52 of the PNPS LRA, the applicant identified the applicable aging management program as "Inservice Inspection," rather than "Bolting Integritiy," as specified in the GALL Report. During the audit and review, the project team noted that the applicant had not included a Bolting Integrity AMP comparable to the one described in the GALL Report, Section XI.M18, "Bolting Integrity." The project team asked the applicant to provide a Bolting Integrity AMP and to identify the components to which it will apply during the PEO. See Section 3.1.2.1.6 of this audit and review report for the applicant's response.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included B.1.33, Bolting Integrity Program. This program is consistent with the GALL Report AMP, XI.M18, "Bolting Integrity". This program covers bolting within the scope of license renewal, including 1) safety-related bolting, 2) bolting for NSSS component supports, 3) bolting for other pressure-retaining components, including nonsafety-related bolting, and 4) structural bolting (actual measured yield strength > 150 ksi). The aging management of reactor head closure studs is addressed by XI.M3 and is not included in this program. Therefore, the aging effects for the component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program, instead of any other programs identified in the LRA tables. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.8 Loss of Fracture Toughness Due to Thermal Aging Embrittlement

In the discussion section of Table 3.1.1, Item 3.1.1-55, of the PNPS LRA, the applicant stated that the Inservice Inspection Program manages the reduction of fracture toughness in CASS components of the RCPB. During the audit and review, the project team noted that LRA Table 3.1.2-3 contains three AMR results lines referring to Table 3.1.1, Item 3.1.1-55, in which the applicant includes a reference to Note E. These lines are for three component groups: pump casings and covers made of CASS in an environment of reactor coolant greater than 482°F; valve bodies greater than 4-inches NPS made of CASS in an environment of reactor coolant greater than 482°F; and valve bodies less than 4-inches NPS made of CASS in an environment of reactor coolant greater than 482°F, respectively. For the first two of these component groups, the applicant listed the aging effect of reduction in fracture toughness and identified the applicable AMP as Inservice Inspection. For the last of these component groups, the applicant listed the aging effect of reduction in fracture toughness and identified the applicable AMP as One-Time Inspection.

The project team noted that for the first two of these AMR results lines, the material, environment, aging effect, and AMP all appeared to be consistent with the corresponding recommendations of the GALL Report, which recommends Inservice Inspection as an appropriate AMP to manage the aging effect loss of fracture toughness. The project team reviewed the applicant's AMP description for the PNPS Inservice Inspection Program (AMP B.1.16.2) and noted that the applicant classified its Inservice Inspection Program as a plant-specific program because it is based on ASME Code Section XI, 1998 Edition with 2000 Addenda, consistent with the basis for the applicant's fourth 10-year ISI interval, rather than being based on ASME Code Section XI, 2001 Edition with 2002 and 2003 Addenda, as listed in the GALL Report. The project team also noted that relevant examination requirements for the subject components are identical in both the ASME Code edition/addenda referenced by the applicant and in the ASME Code edition/addenda. On this basis, the project team determined the applicant's AMP and the use of Note E for the first two AMR results lines to be acceptable.

The project team noted that for the third AMR result line, the material, environment, and aging effect are all consistent with the corresponding line of the GALL Report. However, where the GALL Report recommends use of the Inservice Inspection Program, the applicant listed use of the One-Time Inspection (OIT) Program. The project team reviewed the applicant's OTI AMP description and noted that the PNPS OTI Program encompasses, and is consistent with, both the OTIs described in GALL AMP XI.M32, "OTI ," and the OTIs described in GALL AMP XI.M35, "OTI of ASME Code Class 1 Small-Bore Piping." The project team noted that the OTI Program does not replace any of the required ASME Code Section XI examinations and that the surface examinations of Class 1 small-bore valves specified in ASME Code Section XI, Table IWB-2500-1, continue to be required. On the basis that the applicant's AMP provides an augmentation to the ASME Code Section XI requirements for Class 1 small-bore piping, and that the examinations required by ASME Code Section XI will continue to be performed, the

project team determined the applicant's AMP and the use of Note E for this AMR results line to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.1.2.1.9 Loss of Fracture Toughness Due to Thermal Aging Embrittlement

In the discussion section of Table 3.1.1, Item 3.1.1-57, of the PNPS LRA, the applicant stated that the One-Time Inspection Program manages the reduction of fracture toughness in CASS MS flow restrictors. PNPS has no other Class 1 piping, piping components, piping elements, or CRD housings made of CASS. Pump casings and valve bodies of CASS are included in Item 3.1.1-57 (discussed in the preceding section of this audit report). During the audit and review, the project team noted that LRA Table 3.1.2-3 contains only one AMR results line that references Table 3.1.1, Item 3.1.1-57, and that for this line the applicant included a reference to Note E. The project team noted that the AMR results line is for the MS line flow restrictors made of CASS in an environment of reactor coolant (steam) greater than 482°F and that the applicant listed the aging effect as reduction in fracture toughness and identified the applicable AMP as the One-Time Inspection Program.

The project team noted that for the AMR result line, the material, environment, and aging effect are all consistent with the corresponding line of the GALL Report. However, where the GALL Report recommends use of the Thermal Aging Embrittlement of CASS Program, the applicant listed use of the One-Time Inspection Program. The project team noted the applicant's statement in the LRA that, except for the MS line flow restrictors, PNPS has no other Class 1 piping, piping components, piping elements, or CRD housings made of CASS and that pump casings and valves bodies made of CASS are included in Item 3.1.1-57. The project team also noted that in the AMR results line, the intended function of the MS line flow restrictors is identified as flow control, rather than pressure boundary, because the components are mounted inside the MS lines and are not part of the RCPB. The project team noted that because the MS line flow restrictors are not part of the RCPB, they are not routinely inspected as part of the ASME Code Section XI Inservice Inspection Program.

The project team reviewed the GALL Report's description for AMP XI.M12, "Thermal Aging Embrittlement of CASS." The project team reviewed the applicant's AMPER, which includes a description of OTI activities. For the MS line flow restrictors, the project team noted that the applicant's AMPER lists the parameters monitored/inspected as presence and extent of cracking, wall thickness, and reduction in fracture toughness (presence and extent of cracking). Based on its review of the GALL Report's AMP description and the description of the applicant's One-Time Inspection Program documented in the PNPS AMPER, the project team determined that the examination methods that the applicant proposes to use for OTI of the MS line flow restrictors are consistent with the examination recommendations in the GALL Report's description of the Thermal Aging Embrittlement of CASS Program. On the basis that the applicant's proposed methods for detection of aging effects are consistent with what is

described in the GALL Report's recommended AMP, the project team determined the applicant's AMP and the use of Note E for this AMR results line to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

Conclusion

The project team evaluated the applicant's claim of consistency with the GALL Report. The project team also reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the project team found that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report.

3.1.2.2 AMR Results for which Further Evaluation Is Recommended

For some line items in the PNPS LRA Tables 3.1.2-1 through 3.1.2-3 that are identified to be consistent with the GALL Report, the applicant cross-referenced specific line items in the LRA Table 3.1.1 for which the GALL Report recommends further evaluation. Where the GALL Report recommends further evaluation, the project team reviewed the applicable further evaluations provided in LRA Sections 3.1.2.2, 3.2.2.2, 3.3.2.2, 3.4.2.2, 3.5.2.2, and 3.6.2.2 against the criteria provided in the SRP-LR Sections 3.1.2.2, 3.2.2.2, 3.3.2.2, 3.4.2.2, 3.5.2.2, and 3.6.2.2, respectively. The following provides the staff's assessment of the applicant's further evaluations.

Summary of Information in the Application

In PNPS LRA Section 3.1.2.2, the applicant provides further evaluation of aging management as recommended by the GALL Report for the RV, RV internals, and RCPB components and component groups. The applicant also provides information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in the PNPS LRA Table 3.1.1, the GALL Report recommends further evaluation. Where further evaluation is recommended, the project team reviewed these evaluations provided in PNPS LRA Section 3.1.2.2 against the criteria provided in the SRP-LR Section 3.1.2.2. The project team's assessments of these evaluations are documented in this section. These assessments are applicable to each Table 2 AMR line item in Section 3.1 citing the item in Table 1.

3.1.2.2.1 Cumulative Fatigue Damage

The applicant provided its aging management reviews (AMRs) for components in the RPV and for RPV nozzles and other appurtenances to the RPV in Table 3.1.2-1 of the LRA. The

applicant provided its AMRs for the RPV internal components in Table 3.1.2-2 of the LRA and for the commodity groups in piping systems of the reactor coolant pressure boundary (i.e., Class 1 safety-related piping) in Table 3.1.2-3 of the LRA. The project team reviewed those AMR line items in the LRA Tables 3.1.2-1, 3.1.2-2, and 3.1.2-3 in which fatigue-induced damage (referred to as cracking - fatigue in the AMR line items) was identified as an AERM and in which the "TLAA - Metal Fatigue" was credited for management of the aging effect. Henceforth, these AMR line items on Metal Fatigue of Class 1 components will be referred to as the "Class 1 Fatigue AMRs," and this TLAA will be referred to as the "TLAA on Metal Fatigue of Class 1 Components."

The project team determined that the scope of the applicant's TLAA on Metal Fatigue of Class 1 Components (refer to LRA Section 4.3) did not appear to cover all of the commodity groups in the Class 1 Fatigue AMRs for which the TLAA had been credited for aging management of fatigue-induced damage.

The project team asked the applicant to review these AMR lines items and to identify which of the commodity groups in the AMR line items were designed in accordance with Section III of the ASME Boiler and Pressure Vessel Code (Section III), the ANSI B31.1 design code (B31.1), or some other design code of record. For those commodity groups that were designed to Section III, the project team requested reconciliation of the commodity groups in the Class 1 Fatigue AMRs with those commodity groups that were analyzed for Section III cumulative usage factor values (CUF values) in LRA Table 4.3-1. For those commodity groups that were designed to B31.1, the project team asked the applicant to amend Section 4.3.1 of the LRA to include the same sort of B31.1 fatigue analysis that the applicant had included for Non-Class 1 B31.1 components in Section 4.3.2 of the LRA. For those commodity groups that were designed to a design code other than Section III or B31.1, the project team asked the applicant to clarify how the TLAA on metal fatigue was capable of managing fatigue-induced damage in the components or else credit an inspection-based AMP with management of the aging effect.

The applicant responded to the project team's questions on the Class 1 Fatigue AMRs for the components in the reactor coolant pressure boundary in a letter dated September 13, 2006 (ADAMS Accession Number ML062650072). In that letter, the applicant confirmed that all of the RPV components (including the RPV nozzles and other RPV appurtenances) were designed to Section III. The applicant clarified that these components had either been analyzed for the current operation period in accordance with the CUF calculation methods of Section III or been excluded from CUF calculations in accordance with the exclusion criteria of Paragraph N–415.1 of the 1965 Edition of Section III, which is the design code of record for PNPS. Therefore, it is acceptable to credit the "TLAA on Metal Fatigue" as the basis for managing fatigue-induced damage of the RPV components because these components are within scope of the fatigue analyses in Paragraphs N–415 or N–416 of the 1965 Edition of Section III, which are used to assess whether fatigue-induced damage could initiate in the components, and because this is consistent with the GALL Report. The project team reviewed the CUF calculations for the RPV components for the PEO, and its evaluation is provided in Section 4.3.1.2.2.1 of this audit and review report. This issue is closed with respect to the TLAA that is credited to manage fatigue-induced damage in the RPV components.

In its response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant confirmed that the core shroud repair hardware assemblies (core shroud tie rod assemblies) were the only RPV internal components that had been analyzed in accordance with a Section III CUF calculation for the current operating period. Therefore, the project team concluded that the core shroud tie rods were the only RPV internal components for which the applicant could credit the TLAA on Metal Fatigue with the aging management of fatigue-induced damage in the components. For the remaining commodity groups in the Class 1 Fatigue AMRs of the RPV internals, the applicant amended the AMR line items and credited the BWR Vessel Internals program to manage fatigue-induced damage in the commodity groups. These commodity groups include:

- control rod guide tubes
- core plate assemblies
- core spray lines
- fuel supports
- incore instrumentation and guide tubes
- jet pump assemblies
- core shroud and shroud support
- top guide assembly

The applicant's BWR Vessel Internals Program is a valid augmented inspection program to credit with the management of cracking because it incorporates both NRC-mandated inspections of the RPV internals that are required in accordance with 10 CFR 50.55a and Section XI of the ASME Code, as well as augmented inspection and evaluation activities that are performed in accordance with NRC-approved, recommended guidelines from the BWRVIP. The staff confirmed that these components are within the scope of the applicable BWRVIP reports that form the basis for the applicant's BWR Vessel Internals Program. Based on this analysis, the project team concludes that it is acceptable to credit the BWR Vessel Internals Program with aging management of fatigue-induced cracking in these RPV internal commodity groups. The applicant provides its BWR Vessel Internals Program in LRA Section B.1.8. The project team reviewed the BWR Vessel Internals Program, and its evaluation is provided in Section 3.0.3.2.7 of this audit and review report. This issue is closed.

In its response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant confirmed that the replacement piping for the RRS was procured to Section III and had been analyzed in accordance with a 40-year Section III CUF analysis. The project team reviewed the the CUF analysis for the RRS piping loops, and its evaluation is provided in Section 4.3.1.2.2.3 of this audit and review report. For the remaining Class 1 commodity groups in the metal fatigue AMRs of LRA Table 3.1.2-3, the applicant confirmed that the commodity groups were all designed to B31.1 design code, with the exception of the following commodity groups: (1) CRD detector, (2) CRD drives, (3) RRS pump casing and cover, and (4) main steam line flow restrictors. The project team evaluates how the applicant manages fatigue-induced damage in these commodity groups in the following four paragraphs.

In the response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the LRA to delete the Class 1 Fatigue AMR line item for the CRD detector. The applicant clarified that the component, although within scope of license renewal, does not

require an aging management review because the detector is periodically calibrated and checked for functionality and operability. The project team determined that this is an acceptable basis for removing this AMR from the LRA because the CRD detector is subject to periodic calibration and surveillance requirements. This issue is closed with respect to the CRD detector.

In the response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the Class 1 Fatigue AMR line item for the CRD drives to change the inside environment for the components to the "treated water < 270°F" environment and to delete fatigue-induced damage as an AERM. The applicant clarified that fatigue-induced damage is not considered to be an AERM for the CRD drives because the components operate at a temperature less than 250°F, and that this operating temperature is less than the applicant's thermal threshold of 270°F for inducing fatigue-induced damage in the components. The applicant clarified that intiation of fatigue-induced damage is not an applicable aging effect at temperature below 270°F. This is consistent with the environmental definitions for the PNPS LRA. Based on this assessment, the project team concludes that the applicant's amended environment for the CRD drives and basis for concluding that fatigue-induced damage is not an AERM for the CRD drives are acceptable because the operating temperature is less than the threshold for inducing thermal fatigue in the components. This issue is closed with respect to the CRD drives.

In the response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the Class 1 Fatigue AMR line item for the recirculation pump casings and covers and credited the ISI program to manage fatigue-induced damage in the components. The ISI examinations for recirculation pumps are mandated by 10 CFR 50.55a and ASME Section XI Examination Categories BL1 And BL2. The examination categories require volumetric examinations of the pump casing welds once every inspection internal and visual VT-3 examinations of the casings and covers once every inspection interval. The volumetric examinations are capable of detecting any cracks in the welds. It is expected that any fatigue-induced damage, as initiated in the form of a fatigue-induced crack, would initiate in the pump welds. Because the ISI examinations for the pump casing include volumetric examinations of the casing welds and visual examinations of the outside surfaces pump casing and cover base metal materials, the project team concludes that the ISI program is a valid AMP to credit to manage fatigue-induced damage in the components. The project team reviewed the ISI program and its evaluation is documented in Section 3.0.3.3.3 of this audit and review report. This issue is closed with respect to the recirculation pump casings and covers.

In the response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the Class 1 Fatigue AMR line item for the main steam line (MS) flow restrictors and credited the One-Time Inspection Program to manage fatigue-induced damage in the components. The applicant stated that the MS flow restrictors are non-pressure boundary components because they are welded internally to pipes that do serve as the pressure-retaining components. Instead, the applicant stated that the MS flow restrictors are designed to limit the rate of radioactive steam release during a design basis main steam line break downstream of the MS flow restrictors. The project team reviewed the One-Time Inspection Program, and its evaluation is documented in Section 3.0.3.1.8 of this audit and review report. In this section of the audit and review report, the project team concluded that the

program attributes for the applicant's One-Time Inspection Program are consistent with those program attributes of GALL AMP XI.M.32, "One-Time Inspection." For detection of cracking, GALL AMP XI.M.32 recommends that the inspections either be based on volumetric examination methods or be based on enhanced VT-1 visual examination methods. Based on this discussion, the project team concurs that the MS flow restrictors do not serve a reactor coolant pressure boundary function for PNPS, and that based on the function to limit the rate of radioactive release during a postulated MS break, a one-time inspection using enhanced VT-1 visual examination (EVT-1) techniques is an appropriate inspection to determine whether fatigue-induced cracking is occurring in the MS flow restrictors. The project team reviewed the One-Time Inspection Program, and its evaluation is documented in Section 3.0.3.1.8 of this audit and review report. This issue is closed with respect to the MS flow restictors.

In the applicant's response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant also amended Section 4.3.1 of the LRA to include a metal fatigue analysis discussion for those Class 1 piping components that were designed to B31.1. The project team reviewed this amendment of the LRA, and its evaluation is provided in Section 4.3.1.2.2.3 of this audit and review report. This issue is closed with respect to amending the LRA to include an writeup for those Class 1 piping components that were designed to B31.1 requirements.

3.1.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

3.1.2.2.2.1 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.2.1 against the criteria in SRP-LR Section 3.1.2.2.2.1.

SRP-LR Section 3.1.2.2.2.1 states that the loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator shell assembly exposed to secondary feedwater and steam. Loss of material due to general, pitting, and crevice corrosion could also occur for the steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.1.2.2.2.1, the applicant addresses the loss of material due to general, pitting, and crevice corrosion in steel components of the RV exposed to reactor coolant. The PNPS LRA states that the aging effect is managed by the PNPS Water Chemistry Control – BWR Program. In addition, the PNPS LRA states that the effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow. The Inservice Inspection Program supplements the Water Chemistry Control – BWR Program for these components.

In the discussion section of Table 3.1.1, Item 3.1.1-11 and Item 3.1.1-14, of the PNPS LRA, the applicant stated that the Water Chemistry Control – BWR program, augmented by the One-Time Inspection Program to verify program effectiveness, will be used to manage loss of material in carbon steel components and in SS, nickel-alloy, and steel with SS clad components of the RV and that some of these components also credit the Inservice Inspection Program to manage loss of material. The project team noted that the applicant states that PNPS will perform the OTI of carbon steel and of SS, nickel-alloy, and steel with SS clad RV components exposed to reactor coolant by inspection of selected components in areas of stagnant flow and that the PNPS selection criteria is consistent with the selection criteria recommended in SRP-LR Section 3.1.2.2.2.1. On the basis that the applicant's AMPs and components inspection selection criteria are consistent with the recommendations in the SRP-LR, the project team found the applicant's AMP for these components to be acceptable.

During the audit and review, the project team noted that a few of the AMR results lines in LRA Table 3.1.2-1 that reference to LRA Table 3.1.1, Items 3.1.1-11 and 3.1.1-14, identify the AMPs as Water Chemistry Control – BWR and Inservice Inspection or as only Water Chemistry Control – BWR, rather than Water Chemistry Control – BWR and One-Time Inspection. The project team asked the applicant to justify why the One-Time Inspection Program was not credited explicitly in Table 3.1.2-1 even though it was credited in Table 3.1.1. In response to this question, the applicant stated that the One-Time Inspection Program is applicable to the water chemistry control program, so it is applicable to each line item that credits the water chemistry control program, and that LRA Table 3.1.2-1 credits the One-Time Inspection Program through reference to the associated Table 3.1.1 line item. On the basis that each of the Table 3.1.2-1 AMR results lines that points to Table 3.1.1, Items 3.1.1-11 or 3.1.1-14, credits the One-Time Inspection Program, as recommended by the GALL Report, through reference to the associated Table 3.1.1 line item, the project team found the applicant's response to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.2.1 for further evaluation.

3.1.2.2.2.2 Loss of Material Due to General (Steel Only), Pitting, and Crevice Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.1.2.2.2.2 against the criteria in SRP-LR Section 3.1.2.2.2.2.

SRP-LR Section 3.1.2.2.2.2 states that the loss of material due to pitting and crevice corrosion could occur in SS BWR isolation condenser components exposed to reactor coolant. loss of material due to general, pitting, and crevice corrosion could occur in steel BWR isolation condenser components. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.1.2.2.2.2, the applicant stated that this section of the SRP-LRA pertains to BWR isolation condenser components. PNPS does not have an isolation condenser; however, the loss of material due to general, pitting, and crevice corrosion in other steel components within the RCPB exposed to reactor coolant is managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow. For some components, the Inservice Inspection Program supplements the Water Chemistry Control – BWR Program.

In the discussion section of Table 3.1.1, Item 3.1.1-13, of the PNPS LRA, the applicant stated that although PNPS has no isolation condenser, loss of material in other steel components within the RCPB is managed by the Water Chemistry Control – BWR Program, augmented by the One-Time Inspection Program to verify program effectiveness, and that for some components, the Inservice Inspection Program is also credited with managing loss of material. The project team noted that the applicant stated that PNPS will perform the OTI of carbon steel RV components exposed to reactor coolant by inspection of selected components in areas of stagnant flow and that the PNPS selection criteria is consistent with the selection criteria recommended in SRP-LR Section 3.1.2.2.2.2. On the basis that the applicant's AMPs and components inspection selection criteria are consistent with the recommendations in the SRP-LR, the project team found the applicant's AMP for these components to be acceptable.

During the audit and review, the project team noted that the AMR results lines in LRA Table 3.1.2-3 that reference to LRA Table 3.1.1, Item 3.1.1-13, identify the AMPs as Water Chemistry Control – BWR and Inservice Inspection or as only Water Chemistry Control – BWR, rather than Water Chemistry Control – BWR and One-Time Inspection. In the discussion column of Table 3.1.1, Item 3.1.1-13, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the Water Chemistry Program. However, for line items in Table 3.1.2-3, where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.1.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control

programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.2.2 for further evaluation.

3.1.2.2.2.3 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 3]

The project team reviewed PNPS LRA Section 3.1.2.2.2.3 against the criteria in SRP-LR Section 3.1.2.2.2.2.3.

SRP-LR Section 3.1.2.2.2.3 states that the loss of material due to pitting and crevice corrosion could occur for SS, nickel alloy, and steel with SS or nickel alloy cladding flanges, nozzles, penetrations, pressure housings, safe ends, and vessel shells, heads, and welds exposed to reactor coolant. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.1.2.2.2.3, the applicant addressed the loss of material due to general, pitting, and crevice corrosion in SS, nickel-alloy, and steel with SS clad components of the RV, and loss of material in SS (including CASS) components of the RCPB exposed to reactor coolant, which are managed at PNPS by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow. The One-Time Inspection Program is also used to manage loss of material for the MS flow restrictors by means of a component-specific inspection. For some components, the Inservice Inspection or BWR Vessel Internals Program supplements the Water Chemistry Control – BWR Program.

In the discussion section of Table 3.1.1, Item 3.1.1-15, of the PNPS LRA, the applicant stated that at PNPS, loss of material in SS (including CASS) components of the RCPB is managed by the Water Chemistry Control – BWR Program, augmented by the One-Time Inspection Program to verify effectiveness. Additionally, the applicant stated that the One-Time Inspection Program is also used to manage loss of material for the MS line flow restrictors by means of a component-specific inspection and that for some components, the Inservice Inspection Program is also credited with managing loss of material. The project team noted that the applicant states that PNPS will perform the OTI of carbon steel RV components exposed to reactor coolant by inspection of selected components in areas of stagnant flow and that the PNPS selection criteria is consistent with the selection criteria recommended in SRP-LR Section 3.1.2.2.2.3. On the basis that the applicant's AMPs and components inspection selection criteria are consistent with the recommendations in the SRP-LR, the project team found the applicant's AMP for these components to be acceptable.

During the audit and review, the project team noted that the AMR results lines in LRA Table 3.1.2-3 that reference to LRA Table 3.1.1, Item 3.1.1-15, identify the AMPs as Water Chemistry

Control – BWR and Inservice Inspection, or as only Water Chemistry Control – BWR, rather than Water Chemistry Control – BWR and One-Time Inspection. In the discussion column of Table 3.1.1, Item 3.1.1-15, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the Water Chemistry Program. However, for line items in Table 3.1.2-3, where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.1.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, “The One-Time Inspection Program will confirm the effectiveness of the program.”

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.2.3 for further evaluation.

3.1.2.2.2.4 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 4]

The project team reviewed PNPS LRA Section 3.1.2.2.2.4 against the criteria in SRP-LR Section 3.1.2.2.2.2.4.

In PNPS LRA Section 3.1.2.2.2.4, the applicant identifies that this section is applicable to PWRs only and is not applicable to PNPS.

Because PNPS is a BWR and this recommendation is applicable only for PWRs, the project team found that this section is not applicable to PNPS.

3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

3.1.2.2.3.1 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.3.1 against the criteria in SRP-LR Section 3.1.2.2.3.1.

SRP-LR Section 3.1.2.2.3.1 states that neutron irradiation embrittlement is a TLAA to be evaluated for the PEO for all ferritic materials that have a neutron fluence greater than 10E17 neutrons per square centimeter (n/cm^2) (E >1 MeV) at the end of the license renewal term. 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). This TLAA is addressed separately in Section 4.2, "Reactor Vessel Neutron Embrittlement Analysis," of the SRP-LR.

In PNPS LRA Section 3.1.2.2.3.1, the applicant states that neutron irradiation embrittlement is a TLAA evaluated for the PEO in accordance with 10 CFR 54.21(c). The project team's evaluation of TLAAs is addressed separately in Section 4 of the SER related to the PNPS LRA.

3.1.2.2.3.2 <u>Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement [Item 2]</u>

The project team reviewed PNPS LRA Section 3.1.2.2.3.2 against the criteria in SRP-LR Section 3.1.2.2.3.2.

SRP-LR Section 3.1.2.2.3.2 states that the loss of fracture toughness due to neutron irradiation embrittlement could occur in BWR and PWR RV beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. A Reactor Vessel Materials Surveillance Program monitors neutron irradiation embrittlement of the RV. The Reactor Vessel Surveillance Program is 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 before implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further staff evaluation is required for license renewal. Specific recommendations for an acceptable AMP are provided in Chapter XI, Section M31, of the GALL Report.

In PNPS LRA Section 3.1.2.2.3.2, the applicant states that the Reactor Vessel Surveillance Program manages reduction of fracture toughness due to neutron embrittlement of RV beltline materials. PNPS is a participant in the BWRVIP Integrated Surveillance Program (see Reactor Vessel Surveillance Program in PNPS LRA Appendix B). This program monitors changes in the fracture toughness properties of ferritic materials in the RV beltline region.

The project team noted that in LRA Table 3.1.2-1 the applicant identified only the vessel beltline shell (plates and joining welds) as susceptible to the aging effect of reduction in fracture toughness due to neutron irradiation embrittlement; however, the GALL Report also identifies nozzles in the beltline region and safety injection nozzles, which are not BWR vessel components, as susceptible to this aging effect. During the audit and review, the project team reviewed the applicant's AMR documentation of the RPV and noted that at PNPS the RV beltline consists only of vessel shell plates and joining welds and that there are no nozzles in the beltline region. On the basis that there are no nozzles in the RV beltline region, the project team determined that the applicant had identified all PNPS components that are subject to this aging effect consistent with the GALL Report. The project team also reviewed the applicant's Reactor Vessel Surveillance Program (PNPS AMP B.1.26), and results of the project team's review are documented in Section 3.0.3.2.15 of this audit and review report. On the basis of

the project team's evaluation of the AMP as documented in Section 3.0.3.2.15 of this audit and review report, and the project team's determination that all PNPS components susceptible to this aging effect were identified by the applicant, the project team determined the applicant's AMR results to be consistent with the GALL Report and, therefore, to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.3.2 for further evaluation.

3.1.2.2.4 Cracking Due to SCC and IGSCC

3.1.2.2.4.1 Cracking Due to SCC and IGSCC [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.4.1 against the criteria in SRP-LR Section 3.1.2.2.4.1.

SRP-LR Section 3.1.2.2.4.1 states that cracking due to SCC and IGSCC could occur in the SS and nickel alloy BWR top head enclosure vessel flange leak detection lines. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting cracking due to SCC and IGSCC. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.1.2.2.4.1, the applicant states that the Water Chemistry Control – BWR and One-Time Inspection Programs will manage cracking due to SCC and IGSCC in the SS head seal leak detection lines. The One-Time Inspection Program will include a volumetric examination for the detection of cracking.

The project team noted that LRA Table 3.1.2-3 contains one AMR results line that refers to LRA Table 3.1.1, Item 3.1.1-19, SS and nickel alloy top head enclosure vessel flange leak detection line. The AMR results line is for SS piping and fittings less than 4-inches NPS, in a reactor coolant environment, having an aging effect of cracking, and with the AMP shown as One-Time Inspection. The project team noted that LRA Table 3.1.1, Item 3.1.1-19, includes a statement that the Water Chemistry Control – BWR and One-Time Inspection Programs manage cracking in the SS head seal leak detection lines. On the basis that the GALL Report recommends Water Chemistry Control together with OTI as appropriate programs to manage this aging effect in other similar components made of this same material and in this same environment, the project team finds the AMPs identified by the applicant for the vessel flange leak detection line to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.4.1 for further evaluation.

3.1.2.2.4.2 Cracking Due to SCC and IGSCC [Item 2]

The project team reviewed PNPS LRA Section 3.1.2.2.4.2 against the criteria in SRP-LR Section 3.1.2.2.4.2.

In PNPS LRA Section 3.1.2.2.4.2, the applicant states that this section pertains to BWRs with isolation condenser components. PNPS does not have an isolation condenser; therefore, this section is not applicable.

On the basis that PNPS does not have an isolation condenser, the project team found that this section does not apply to PNPS.

3.1.2.2.5 Crack Growth Due to Cyclic Loading

The project team reviewed PNPS LRA Section 3.1.2.2.5 against the criteria in SRP-LR Section 3.1.2.2.5.

In PNPS LRA Section 3.1.2.2.5, the applicant states that this section applies to PWRs and is not applicable to PNPS.

The project team found that this section is not applicable to PNPS.

3.1.2.2.6 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement and Void Swelling

The project team reviewed PNPS LRA Section 3.1.2.2.6 against the criteria in SRP-LR Section 3.1.2.2.6.

In PNPS LRA Section 3.1.2.2.6, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since void swelling is a phenomenon applicable to PWRs, the project team found that this section is not applicable to PNPS.

3.1.2.2.7 Cracking Due to SCC

3.1.2.2.7.1 Cracking Due to SCC [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.7.1 against the criteria in SRP-LR Section 3.1.2.2.7.1.

In PNPS LRA Section 3.1.2.2.7.1, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses PWR SS reactor vessel, the project team found that this section is not applicable to PNPS.

3.1.2.2.7.2 Cracking Due to SCC [Item 2]

The project team reviewed PNPS LRA Section 3.1.2.2.7.2 against the criteria in SRP-LR Section 3.1.2.2.7.2.

In PNPS LRA Section 3.1.2.2.7.2, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses class 1 PWR cast SS piping components, the project team found that this section is not applicable to PNPS.

3.1.2.2.8 Cracking Due to Cyclic Loading

3.1.2.2.8.1 Cracking Due to Cyclic Loading [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.8.1 against the criteria in SRP-LR Section 3.1.2.2.8.1.

SRP-LR Section 3.1.2.2.8.1 states that cracking due to cyclic loading could occur in the SS BWR jet pump sensing lines. The GALL Report recommends that a plant-specific AMP be evaluated to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.1.2.2.8.1, the applicant states that this section pertains to the jet pump sensing lines inside the RV. At PNPS, these lines have no license renewal intended function and thus are not subject to AMR.

The jet pump instrumentation provides indication of jet pump flow. As the jet pump flow is not a safety-related function, indication of that flow is not a license renewal function. The lines inside the vessel do not contribute to the pressure boundary. The lines outside the vessel are part of the RCS pressure boundary and are subject to AMR.

The project team noted the applicant's statements in the LRA that indication of jet pump flow is not a license renewal function and that the jet pump sensing lines inside the RPV are not part of the RCPB. On the basis that the jet pump sensing lines do not provide a license renewal function, the project team determined that AMR for the jet pump sensing lines inside the RPV is not required.

During the audit and review, the project team noted the applicant's statement in the LRA that Section 3.1.2.2.8.1 of the SRP-LR describing cracking due to cyclic loading pertains only to the jet pump sensing lines inside the RV. The project team noted that only the jet pump sensing lines inside the RV are directly in, or in direct contact with, components in the recirculation flow stream; for this reason, it is only the jet pump sensing lines inside the RV that are potentially affected by flow-induced vibrations and cracking due to cyclic loading caused by flow-induced vibrations. The applicant stated that the jet pump sensing lines outside the RV are the same as other small-bore SS instrument lines attached to a RV penetration and that they will be subject to the same aging effects and AMPs that apply for small-bore SS piping exposed to reactor coolant. However, they will not be subject to potential cracking due to cyclic loading caused by flow-induced vibrations. The applicant stated that aging management for the jet pump sensing lines outside the RPV will be provided by the Water Chemistry Control – BWR, Inservice Inspection, and One-Time Inspection Programs as described in LRA Table 3.1.1, Item 3.1.1-48, for small-bore steel and SS Class 1 piping, fittings, and branch connections less than 4-inches

NPS exposed to reactor coolant. On the basis that the aging effects for the jet pump sensing lines outside the reactor coolant pressure vessel are the same as for other small-bore SS piping exposed to reactor coolant and that the aging effects for these components are being managed by the AMPs recommended in the GALL Report, the project team found the applicant's aging management of the jet pump sensing lines to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.8.1 for further evaluation.

3.1.2.2.8.2 Cracking Due to Cyclic Loading [Item 2]

The project team reviewed PNPS LRA Section 3.1.2.2.8.2 against the criteria in SRP-LR Section 3.1.2.2.8.2.

In PNPS LRA Section 3.1.2.2.8.2, the applicant states that this section pertains to BWR isolation condenser components. Because PNPS does not have an isolation condenser, this section is not applicable to PNPS.

On the basis that PNPS does not have an isolation condenser, the project team found that this section is not applicable to PNPS.

3.1.2.2.9 Loss of Preload Due to Stress Relaxation

The project team reviewed PNPS LRA Section 3.1.2.2.9 against the criteria in SRP-LR Section 3.1.2.2.9.

In PNPS LRA Section 3.1.2.2.9, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section is applicable to SS and nickel alloy PWR reactor vessel bolting, the project team found that this section is not applicable to PNPS.

3.1.2.2.10 Loss of Material Due to Erosion

The project team reviewed PNPS LRA Section 3.1.2.2.10 against the criteria in SRP-LR Section 3.1.2.2.10.

In PNPS LRA Section 3.1.2.2.10, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses steam generators, the project team found that this section is not applicable to PNPS.

3.1.2.2.11 Cracking Due to Flow-Induced Vibration

The project team reviewed PNPS LRA Section 3.1.2.2.11 against the criteria in SRP-LR Section 3.1.2.2.11.

SRP-LR Section 3.1.2.2.11 states that cracking due to flow-induced vibration could occur for the BWR SS steam dryers exposed to reactor coolant. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.1.2.2.11, the applicant states that cracking due to flow-induced vibration in the SS steam dryers is managed by the BWR Vessel Internals Program. The BWR Vessel Internals Program incorporates the guidelines of GE-SIL-644, Revision 1. PNPS will evaluate BWRVIP-139 upon approval by the NRC staff and either include its recommendations in the PNPS BWR Vessel Internals Program or inform the staff of PNPS's exceptions to that document.

During the audit and review, the project team reviewed BWRVIP-139, “Steam Dryer Inspection and Flaw Evaluation Guidelines,” which was accepted for review by the NRC in June 2005 (ML051860129). The project team noted that the applicant’s BWR Vessel Internals Program currently includes inspections of the steam dryer consistent with the guidelines provided by the original equipment manufacturer. In addition, the PNPS LRA includes a statement that PNPS will evaluate BWRVIP-139 upon its approval by the NRC staff and either include its recommendations in the PNPS BWR Vessel Internals Program or inform the staff of PNPS’s exceptions to that document. On the basis that the applicant’s BWR Vessel Internals Program currently provides for steam dryer inspection consistent with recommendations of the original equipment manufacturer and that the applicant has stated in the LRA that PNPS will include the recommendations of BWRVIP-139, when approved, in the PNPS BWR Vessel Internals Program or inform the NRC staff of exceptions to those recommendations, the project team finds the applicant’s aging management of the steam dryer to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.11 for further evaluation.

3.1.2.2.12 Cracking Due to SCC and IASCC

The project team reviewed PNPS LRA Section 3.1.2.2.12 against the criteria in SRP-LR Section 3.1.2.2.12.

In PNPS LRA Section 3.1.2.2.12, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses PWR SS reactor internals, the project team found that this section is not applicable to PNPS.

3.1.2.2.13 Cracking Due to Primary Water Stress Corrosion Cracking (PWSCC)

The project team reviewed PNPS LRA Section 3.1.2.2.13 against the criteria in SRP-LR Section 3.1.2.2.13.

In PNPS LRA Section 3.1.2.2.13, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since PWSCC is a PWR phenomenon, the project team found that this section is not applicable to PNPS.

3.1.2.2.14 Wall Thinning Due to FAC

The project team reviewed PNPS LRA Section 3.1.2.2.14 against the criteria in SRP-LR Section 3.1.2.2.14.

In PNPS LRA Section 3.1.2.2.14, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses steam generator feedwater piping, the project team found that this section is not applicable to PNPS.

3.1.2.2.15 Changes in Dimensions Due to Void Swelling

The project team reviewed PNPS LRA Section 3.1.2.2.15 against the criteria in SRP-LR Section 3.1.2.2.15.

In PNPS LRA Section 3.1.2.2.15, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since void swelling is a PWR phenomenon, the project team found that this section is not applicable to PNPS.

3.1.2.2.16 Cracking Due to SCC and PWSCC

3.1.2.2.16.1 Cracking Due to SCC and PWSCC [Item 1]

The project team reviewed PNPS LRA Section 3.1.2.2.16.1 against the criteria in SRP-LR Section 3.1.2.2.16.1.

In PNPS LRA Section 3.1.2.2.16.1, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses PWR steam generator, the project team found that this section is not applicable to PNPS.

3.1.2.2.16.2 Cracking Due to SCC and PWSCC [Item 2]

The project team reviewed PNPS LRA Section 3.1.2.2.16.2 against the criteria in SRP-LR Section 3.1.2.2.16.2.

In PNPS LRA Section 3.1.2.2.16.2, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses pressurizer spray heads, the project team found that this section is not applicable to PNPS.

3.1.2.2.17 Cracking Due to SCC, PWSCC, and IASCC

The project team reviewed PNPS LRA Section 3.1.2.2.17 against the criteria in SRP-LR Section 3.1.2.2.17.

In PNPS LRA Section 3.1.2.2.17, the applicant states that this section applies to PWRs and is not applicable to PNPS.

Since this section addresses PWR reactor vessel internals, the project team found that this section is not applicable to PNPS.

3.1.2.2.18 QA for Aging Management of NSR Components

The applicant referenced LRA Section B.0.3. The project team's evaluation of Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

Conclusion

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were further evaluated.

3.1.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.1.1, "Summary of Aging Management Evaluations for the Reactor Coolant System Evaluation in Chapter IV of NUREG-1801," the applicant provided information on components or material/environment combinations in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Tables 3.1.2.1-1 through 3.1.2.1-3, the applicant provided additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicated, via Notes F through J, that neither the identified component nor the material/ environment combination is evaluated in the GALL Report and provided information concerning how the aging effect will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

AEMs in Table 3.1.1 That Are Not Applicable to PNPS

The project team reviewed PNPS LRA Table 3.1.1, which provides a summary of aging management evaluations for the RV, internals, and RCS evaluated in the GALL Report.

In PNPS LRA Table 3.1.1, Item 3.1.1-46 discussion column, the applicant states that the PNPS access hole covers are welded, not mechanical (bolted). On the basis that PNPS has welded, not mechanical, access hole covers, the project team finds that this AMP summary line in LRA Table 3.1.1 is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 3.1.1-53 discussion column, the applicant states that in the RCS loss of material due to general, pitting, and crevice corrosion of steel piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because there are no steel components of the Class 1 RV, reactor internals, or RCPB exposed to CCW at PNPS.

On the basis that there are no steel piping, piping components, or piping elements exposed to CCW in the RV, internals, and RCS at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 3.1.1-54 discussion column, the applicant states that the loss of material due to general, pitting, and crevice corrosion of copper alloy piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because there are no copper alloy components of the Class 1 RV, vessel internals, or RCPB exposed to CCW at PNPS. On the basis that there are no copper alloy piping, piping components, or piping elements exposed to CCW in the RV, internals, and RCS at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPs LRA Table 3.1.1, Item 3.1.1-56 discussion column, the applicant states that the loss of material due to selective leaching of copper alloy (greater than 15-percent zinc) piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because there are no copper alloy components in the Class 1 RV, vessel internals, or RCPB at PNPS.

On the basis that there are no copper alloy (greater than 15-percent zinc) piping, piping components, and piping elements exposed to CCW in the RV, internals, and RCS at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 3.1.1-87 discussion column, the applicant states that the aging of steel piping, piping components, and piping elements in concrete is not applicable to PNPS because there are no components of the Class 1 RV, vessel internals, or RCPB exposed to concrete at PNPS.

On the basis that there are no steel piping, piping components, and piping elements in concrete in the RV, internals, and RCS at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

RV, Internals, and RCS AMR Line Items That Have No Aging Effect (PNPS LRA Tables 3.1.2.1-1 through 3.1.2.1.-3)

In LRA Tables 3.1.2-1 through 3.1.2-3, the applicant identifies line items where no aging effects were identified as a result of its aging review process. Specific instances in which the applicant states that no aging effects were identified occurred in the following areas:

- Components fabricated from low-alloy steel with SS cladding used for the containment dome upper closure head, RV flanges, RV shell, and RV nozzles that are subject to an indoor air environment require no AMR. The environment is not in the GALL Report for this component and material, and the high component surface temperature precludes moisture accumulation that could result in corrosion.

On the basis of its review of current industry research and operating experience, the project team found that an indoor air environment on low-alloy steel with SS cladding for the containment dome upper closure head, RV flanges, RV shell, and RV nozzles will not result in aging that will be of concern during the PEO. The project team noted that although the material of construction for these components is described in the LRA as “steel with stainless steel cladding,” the material exposed to the indoor air environment is the low-alloy steel external surface, not the SS cladding. The project team reviewed NUREG-1833, “Technical Basis for Revision to the License Renewal Guidance Documents,” and noted that Table II.A, Item AP-2 / EP-4 / SP-1 of the NUREG is applicable to piping, piping components, and piping elements made of carbon steel in an indoor air environment. The project team noted that the NUREG states that both oxygen and moisture must be present to corrode steel, and experience has shown that general corrosion of carbon steel or low-alloy steel components would occur only if the components were exposed to outdoor environments or to indoor environments that could promote the condensation of water on the external surface of the components. On the basis that the component’s high surface temperature during operation precludes accumulation of moisture and that moisture is required for corrosion of low-alloy steel, the project team concluded that there are no applicable AERMs for these low-alloy steel components with SS cladding exposed to an indoor air environment.

- Components fabricated from low-alloy steel used for the RV nozzle safe ends and subject to an indoor air environment require no AMR. The environment is not in the GALL Report for this component and material, and the high component surface temperature precludes moisture accumulation that could result in corrosion.

On the basis of its review of current industry research and operating experience, the project team found that an indoor air environment on low-alloy steel in RV nozzle safe ends will not result in aging that will be of concern during the PEO. As discussed in an earlier paragraph, the project team noted that NUREG-1833 states that both oxygen and moisture must be present to corrode steel, and experience has shown that general corrosion of carbon steel or low-alloy steel components would occur only if the components were exposed to outdoor environments

or to indoor environments that could promote the condensation of water on the external surface of the components. On the basis that the component's high surface temperature during operation precludes accumulation of moisture and that moisture is required for corrosion of low-alloy steel, the project team concluded that there are no applicable AERMs for these low-alloy steel components exposed to an indoor air environment.

- Components fabricated from carbon steel used for piping and fittings and for valve bodies subject to an indoor air environment require no AMR. The aging effect in the GALL Report for this component, material, and environment combination is not applicable, and the high component surface temperature precludes moisture accumulation that could result in corrosion.

On the basis of its review of current industry research and operating experience, the project team found that an indoor air environment on carbon steel piping and fittings and valve bodies with a normally hot surface temperature will not result in aging that will be of concern during the PEO. As discussed in an earlier paragraph, the project team noted that NUREG-1833 states that both oxygen and moisture must be present to corrode steel, and experience has shown that general corrosion of carbon steel or low-alloy steel components would occur only if the components were exposed to outdoor environments or to indoor environments that could promote the condensation of water on the external surface of the components. On the basis that the component's high surface temperature during operation precludes accumulation of moisture and that moisture is required for corrosion of carbon steel, the project team concluded that there are no applicable AERMs for carbon steel piping and fitting components exposed to an indoor air environment.

During the audit and review, the project team noted that Table 3.1.2-3 of the LRA included some AMR results lines for piping and fittings and for valves made of carbon steel where the external environment is identified as indoor air, the aging effect is loss of material, and the AMP is System Walkdown, referenced to LRA Table 3.2.1, Item 3.2.1-31. Table 3.1.2-3 included other AMR results lines for piping and fittings and for valves made of carbon steel where the external environment is identified as indoor air, but the aging effect is identified as "none," and no AMP is listed. The project team also noted that the AMR results lines where the aging effect is identified as "none" provides a note stating that the components operate at a high surface temperature which precludes moisture accumulation that could cause corrosion, as evaluated in the preceding paragraphs. The project team asked the applicant to identify the high-temperature threshold and to discuss the methodology that PNPS will use to identify which piping is classified as having the aging effect of loss of material and which is classified as having no aging effect. In response to this request, the applicant provided the following response:

> The selection of the aging effect of loss of material or of no aging effect was dependent on the temperature of the component during normal operation. Components with a temperature above the boiling point of water will preclude moisture accumulation. As a matter of convenience, the transition point was assumed at the temperature threshold of 220°F, which corresponds to the temperature threshold for cracking due to fatigue in carbon steel and above the boiling point of water. Although these components can be below this threshold during shutdown conditions, and some components could possibly see

temperatures both above and below this threshold during normal operation, these components should rarely, if ever, be at a temperature below the local dewpoint. Consequently, even during shutdown conditions, moisture accumulation should be negligible.

The PNPS position on loss of material on exterior surfaces of steel piping grew out of earlier LRA experience. loss of material on external surfaces is normally managed by system walkdowns; however, system walkdowns do not inspect the exterior surface of insulated piping unless the insulation is removed for maintenance. There is no need to remove insulation and directly inspect pipe external surfaces as the heat that requires the insulation prevents moisture accumulation which, in turn, precludes loss of material due to corrosion. PNPS plans to inspect uninsulated steel piping for loss of material due to corrosion through system walkdowns and not remove any insulation solely for the purpose of the inspection.

The project team reviewed the applicant's response and found that it provides an acceptable methodology for distinguishing the hot carbon steel pipe (where no aging effect is expected) from the cooler carbon steel pipe (where loss of material due to corrosion may occur). On the basis that the applicant's methodology for selecting which carbon steel piping is subject to examination by the System Walkdown Program is adequate, the project team found the applicant's response to be acceptable.

The project team reviewed all AMR results lines in LRA Tables 3.2.1-1 through 3.2.1-3 where the applicant determined that for the subject component there is no aging effect and no AMP is required. On the basis of the evaluations documented in the preceding paragraphs, the project team determined that no AMP is required for these components during the PEO.

3.1.2.3.1 <u>RV – Summary of Aging Management Evaluation – PNPS LRA Table 3.1.2-1</u>

The project team reviewed PNPS LRA Table 3.1.2-1, which summarizes the results of AMR evaluations for the RV component groups.

In PNPS LRA Table 3.1.2-1, the applicant proposed to manage loss of material of low-alloy steel for the reactor head closure studs exposed to an indoor air environment using PNPS AMP B.1.25, "Reactor Head Closure Studs."

The project team reviewed the Reactor Head Closure Studs Program, and the evaluation is documented in Section 3.0.3.2.14 of this audit report. The project team concluded that the applicant's Reactor Head Closure Studs Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of low-alloy steel material exposed to an indoor air environment is effectively managed using the Reactor Head Closure Studs Program. On this basis, the project team found that management of loss of material for the reactor head closure studs in PNPS LRA Table 3.1.2-1, "Reactor Vessel – Summary of Aging Management Evaluation," is acceptable.

In PNPS LRA Table 3.1.2-1, the applicant proposed to manage cracking of low-alloy steel with SS or partial SS cladding for the RV upper head and bottom head, vessel flanges, vessel shells, and MS line nozzles exposed to reactor coolant environment using PNPS AMP B.1.16.2, "Inservice Inspection Program," and AMP B.1.32.2, "Water Chemistry Control – BWR Program."

The project team reviewed the Inservice Inspection Program and the Water Chemistry Control – BWR Program, and the evaluations are documented in Sections 3.0.3.3.3 and 3.0.3.1.13, respectively, of this audit report. The project team concluded that the applicant's Inservice Inspection and Water Chemistry Control – BWR Programs will adequately manage the aging effects that are identified in the PNPS LRA for which these AMPs are credited. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking of low-alloy steel with SS or partial SS clad material exposed to a reactor coolant environment is effectively managed using the Inservice Inspection and Water Chemistry Control – BWR Programs. On this basis, the project team found that management of cracking for the RV upper head and bottom head, vessel flanges, vessel shells, and MS line nozzles in PNPS LRA Table 3.1.2-1, "Reactor Vessel – Summary of Aging Management Evaluation," is acceptable.

In PNPS LRA Table 3.1.2-1, the applicant proposed to manage cracking of nickel-based alloy for the CRD return line nozzle cap exposed to a reactor coolant environment using PNPS AMP B.1.3, "BWR Control Rod Drive Return Line Nozzle Program," and AMP B.1.32.2, 5"Water Chemistry Control – BWR Program."

The project team reviewed the BWR Control Rod Drive Return Line Nozzle Program and the Water Chemistry Control – BWR Program, and the evaluations are documented in Sections 3.0.3.2.2 and 3.0.3.1.13, respectively, of this audit report. The project team concluded that the applicant's BWR Control Rod Drive Return Line Nozzle and Water Chemistry Control – BWR Programs will adequately manage the aging effects that are identified in the PNPS LRA for which these AMPs are credited. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking of nickel-based alloy material exposed to a reactor coolant environment is effectively managed using the BWR Control Rod Drive Return Line Nozzle and Water Chemistry Control – BWR Programs. On this basis, the project team found that management of cracking for the CRD return line nozzle cap in PNPS LRA Table 3.1.2-1, "Reactor Vessel – Summary of Aging Management Evaluation," is acceptable.

In PNPS LRA Table 3.1.2-1, the applicant proposed to manage loss of material of carbon steel for the RV stabilizer pads and the RV support skirt exposed to an indoor air environment using PNPS AMP B.1.16.2, "Inservice Inspection Program."

During the audit and review, the project team asked the applicant to identify the mechanism that causes the aging effect of loss of material in the stabilizer pads. In response to this request, the applicant stated that the stabilizer pads are located on the sides of the RV and are typically at a temperature greater than 220°F. The applicant stated that consistent with other LRA components made of carbon steel in an indoor environment and operating at greater than 220°F, these components should not be subject to loss of material. In its letter dated

September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised the LRA to indicate that the aging effect applies to the RV support skirt but not to the RV stabilizer pads. Because the applicant's change results in the aging effect identified for the carbon steel RV stabilizer pads in an indoor air environment being the same as for other components made of the same material, in the same environment, and with a normal operating temperature greater than 220°F, the project team finds the applicant's change to be acceptable.

The project team reviewed the Inservice Inspection Program, and the evaluation is documented in Section 3.0.3.3.3 of this audit report. The project team concluded that the applicant's Inservice Inspection Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of carbon steel material exposed to an indoor air environment is effectively managed using the Inservice Inspection Program. On this basis, the project team found that management of loss of material for the RV support skirt in PNPS LRA Table 3.1.2-1, "Reactor Vessel – Summary of Aging Management Evaluation," is acceptable.

3.1.2.3.2 RV Internals – Summary of Aging Management Evaluation – PNPS LRA Table 3.1.2-2

The project team reviewed PNPS LRA Table 3.1.2-2, which summarizes the results of AMR evaluations for the RV internals component groups. The results of these evaluations are all consistent with the GALL Report.

3.1.2.3.3 RCPB – Summary of Aging Management Evaluation – PNPS LRA Table 3.1.2-3

The project team reviewed PNPS LRA Table 3.1.2-3, which summarizes the results of AMR evaluations for the RV component groups.

In PNPS LRA Table 3.1.2-3, the applicant proposed to manage cracking of low-alloy steel or SS for the bolting in the RCPB exposed to an indoor air environment using PNPS AMP B.1.16.2, "Inservice Inspection Program."

The applicant does not include a Bolting Integrity Program in the PNPS LRA. Instead, the applicant credits alternate programs such as the System Walkdown and Inservice Inspection Programs. GALL AMP XI.M18, "Bolting Integrity," provides several recommendations in the 10-element evaluation, such as selection of bolting materials, use of lubricants and sealants, and additional recommendations of NUREG-1339. The alternate programs may be acceptable for inspection; however, they do not address the preventive actions. The project team asked the applicant to clarify how PNPS meets these recommendations or provide justification why a Bolting Integrity Program should not be provided.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The Bolting Integrity Program will be implemented before the PEO in accordance with Commitment No. 32. The LRA will be supplemented to

include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included AMP B.1.33, "Bolting Integrity Program." This program is consistent with GALL AMP XI.M18, "Bolting Integrity." This program covers bolting within the scope of license renewal, including (1) safety-related bolting; (2) bolting for NSSS component supports; (3) bolting for other pressure-retaining components, including NSR bolting; and (4) structural bolting (actual measured yield strength greater than150 ksi). The aging management of reactor head closure studs is addressed by GALL AMP XI.M3 and is not included in this program. Therefore, the aging effects of component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program, instead of any other programs identified in LRA Table 3.3.2-2s. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

On the basis of its review of the applicant's operating experience, the project team found the aging effect of cracking of low-alloy steel or SS material exposed to an indoor air environment is effectively managed using the Bolting Integrity Program. On this basis, the project team found that management of cracking of bolting in PNPS LRA Table 3.1.2-3, "Reactor Coolant Pressure Boundary – Summary of Aging Management Evaluation," is acceptable.

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

Conclusion

On the basis of its review, the project team found that the applicant appropriately evaluated AMR results involving material, environment, AERMs, and AMP combinations that are not addressed in the GALL Report.

3.1.3 Conclusion

On the basis of its review, the project team concluded that the applicant has demonstrated that the aging effects associated with the RV, internals, and RCS components will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concluded that they adequately describe the AMPs credited for managing aging of the RV, internals, and RCS components, as required by 10 CFR 54.21(d).

3.2 PNPS LRA Section 3.2 - Aging Management of Engineered Safety Features

This section of the audit and review report documents the project team's review and evaluation of PNPS AMR results for the aging management of the ESF component and component groups associated with the following systems:

- RHR system
- core spray system
- automatic depressurization system (ADS)
- HPCI system
- RCIC system
- SGT system
- primary containment penetrations (PCP)
- miscellaneous systems in scope for 10 CFR 54.4(a)(2) (these ESF systems are included by PNPS in LRA Section 3.3, "Auxiliary Systems," but are evaluated in this section)

3.2.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.2, the applicant provided the results of its AMRs for the ESF components and component groups.

In PNPS LRA Table 3.2.1, "Summary of Aging Management Programs for Engineered Safety Features in Chapter V of NUREG-1801," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the ESF components and component groups. The applicant also identified for each component type in the PNPS LRA Table 3.2.1 those components that are consistent with the GALL Report, those for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In PNPS LRA Tables 3.2.2-1 through 3.2.2-7, the applicant provided a summary of the AMR results for component types associated with (1) RHR system, (2) core spray system, (3) ADS, (4) HPCI system, (5) RCIC system, (6) SGT system, and (7) PCP.

In PNPS LRA Tables 3.3.2-14-7, 3.3.2-14-16, 3.3.2-14-25, and 3.3.2-14-28, the applicant provided results for component types associated with the following ESFs:

Miscellaneous systems in scope for 10 CFR 54.4 (a)(2)

- core spray system, NSR components affecting safety-related systems
- HPCI system, NSR components affecting safety-related systems
- RCIC system, NSR components affecting safety-related systems (RCIC)
- RHR system, NSR components affecting safety-related systems

Specifically, the information for each component type includes intended function, material, environment, AERM, AMPs, the GALL Report Volume 2 item, cross-reference to PNPS LRA Table 3.2.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporate applicable operating experience in the determination of AERMs. These reviews include evaluation of plant-specific and industry operating experience.

The plant-specific evaluation includes reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience includes a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.2.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.2 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the ESF components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.2.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further evaluations were in accordance with the acceptance criteria in SRP-LR. The project team's audit evaluation is documented in Section 3.2.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.2.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the ESF components.

Table 3.2-1 of this audit and review report provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in LRA Section 3.2 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.2-1 Project Team Evaluation for Engineered Safety Features Components in the GALL Report

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-1	Steel and SS piping, piping components, and piping elements in emergency core cooling system (ECCS)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.1.
3.2.1-3	SS containment isolation piping and components internal surfaces exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32) and One-Time Inspection (B.1.23)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.3.1.
3.2.1-4	SS piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	None	Not applicable. See audit report Section 3.2.2.2.3.2.
3.2.1-5	SS and aluminum piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32) and One-Time Inspection (B.1.23)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.3.3.
3.2.1-6	SS and copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program (B.1.22)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.3.4.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-7	Partially encased SS tanks with breached moisture barrier exposed to raw water	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated for pitting and crevice corrosion of tank bottoms because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	None	Not applicable. See audit report Section 3.2.2.2.3.5.
3.2.1-8	SS piping, piping components, piping elements, and tank internal surfaces exposed to condensation (internal)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	None	Not applicable. See audit report Section 3.2.2.2.3.6.
3.2.1-9	Steel, SS, and copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program (B.1.22)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.4.1.
3.2.1-10	SS heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32) and One-Time Inspection (B.1.23)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.4.2.
3.2.1-11	Elastomer seals and components in SGT system exposed to air-indoor uncontrolled	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Plant-specific Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.5.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-13	Steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air-indoor uncontrolled (internal)	Loss of material due to general corrosion and fouling	A plant-specific AMP is to be evaluated.	None	Not applicable. See audit report Section 3.2.2.2.3.7.
3.2.1-14	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32) and One-Time Inspection (B.1.23)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.8.1.
3.2.1-15	Steel containment isolation piping, piping components, and piping elements internal surfaces exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	None	Not applicable. See audit report Section 3.2.2.2.8.2.
3.2.1-16	Steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program (B.1.22)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.8.3.
3.2.1-17	Steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program (B.1.2)	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.2.2.2.9
3.2.1-18	SS piping, piping components, and piping elements exposed to treated water > 140°F	Cracking due to SCC and IGSCC	BWR Stress Corrosion Cracking and Water Chemistry	Water Chemistry Control – BWR (B.1.32.2) and One-Time Inspection (B.1.23)	Consistent with the GALL Report. See audit report Section 3.2.2.1.7 for evaluation.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-19	Steel piping, piping components, and piping elements exposed to steam or treated water	Wall thinning due to FAC	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion Program (B.1.14) or Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with the GALL Report . See audit report Section 3.2.2.1.8 for evaluation.
3.2.1-20	CASS piping, piping components, and piping elements exposed to treated water (borated or unborated) > 482°F	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-21	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, SCC	Bolting Integrity	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-22	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	Bolting Integrity	Bolting Integrity	Consistent with the GALL Report. See audit report Section 3.2.2.1.5
3.2.1-23	Steel bolting and closure bolting exposed to air-outdoor (external), or air-indoor uncontrolled (external)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	Bolting Integrity	Consistent with the GALL Report. See audit report Section 3.2.2.1.5
3.2.1-24	Steel closure bolting exposed to air-indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	Bolting Integrity	Consistent with the GALL Report. See audit report Section 3.2.2.1.5
3.2.1-25	SS piping, piping components, and piping elements exposed to CCW > 140°F	Cracking due to SCC	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-26	Steel piping, piping components, and piping elements exposed to CCW	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-27	Steel heat exchanger components exposed to CCW	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)	Consistent with the GALL Report.
3.2.1-28	SS piping, piping components, piping elements, and heat exchanger components exposed to CCW	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)	Consistent with the GALL Report.
3.2.1-29	Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to CCW	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)	Consistent with the GALL Report.
3.2.1-30	SS and copper alloy heat exchanger tubes exposed to CCW	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program (B.1.32.3)	Consistent with the GALL Report.
3.2.1-31	External surfaces of steel components including ducting, piping, ducting closure bolting, and containment isolation piping external surfaces exposed to air-indoor uncontrolled (external); condensation (external) and air-outdoor (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program (B.1.30)	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-32	Steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (Internal)	Loss of material due to general corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	System Walkdown Program (B.1.30), Periodic Surveillance and Preventive Maintenance Program (B.1.24), One-Time Inspection Program (B.1.23)	Consistent with the GALL Report. See audit report Section 3.2.2.1.1.
3.2.1-33	Steel encapsulation components exposed to air-indoor uncontrolled (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-34	Steel piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with the GALL Report. See audit report Section 3.2.2.1.2.
3.2.1-35	Steel containment isolation piping and components internal surfaces exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	Periodic Surveillance and Preventive Maintenance Program (B.1.24) and Containment Leak Rate Program (B.1.9)	Consistent with the GALL Report. See audit report Section 3.2.2.1.3.
3.2.1-36	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-37	SS piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-38	SS containment isolation piping and components internal surfaces exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-39	SS heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-40	Steel and SS heat exchanger tubes (serviced by open-cycle cooling water) exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-41	Copper alloy > 15% zinc piping, piping components, piping elements, and heat exchanger components exposed to CCW	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching Program (B.1.27)	Consistent with the GALL Report.
3.2.1-42	Gray cast iron piping, piping components, piping elements exposed to CCW	Loss of material due to selective leaching	Selective Leaching of Materials	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-43	Gray cast iron piping, piping components, and piping elements exposed to soil	Loss of material due to selective leaching	Selective Leaching of Materials	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-44	Gray cast iron motor cooler exposed to treated water	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching Program (B.1.27)	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-50	Aluminum piping, piping components, and piping elements exposed to air-indoor uncontrolled (internal/external)	None	None	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-51	Galvanized steel ducting exposed to air-indoor controlled (external)	None	None	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-52	Glass piping elements exposed to air-indoor uncontrolled (external), lubricating oil, raw water, treated water, or treated borated water	None	None	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-53	SS, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external)	None	None	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-54	Steel piping, piping components, and piping elements exposed to air –- indoor controlled (external)	None	None	None	Not applicable. See audit report Section 3.2.2.3.
3.2.1-55	Steel and SS piping, piping components, and piping elements in concrete	None	None	None	Not applicable. See audit report Section 3.2.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.2.1-56	Steel, SS, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	None	Not applicable. See audit report Section 3.2.2.3.

3.2.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Section 3.2.2.1, the applicant identifies the materials, environments, and AERMs. The applicant identifies the following programs that manage the aging effects related to the RHR system, core spray system, ADS, HPCI system, RCIC system, SGT system, and PCP components and component groups:

- Buried Piping and Tanks Inspection Program (B.1.2)
- Containment Leak Rate Program (B.1.9)
- Flow-Accelerated Corrosion Program (B.1.14)
- Heat Exchanger Monitoring Program (B.1.15)
- Instrument Air Quality Program (B.1.17)
- Oil Analysis Program (B.1.22)
- One-Time Inspection Program (B.1.23)
- Periodic Surveillance and Preventive Maintenance Program (B.1.24)
- Selective Leaching Program (B.1.27)
- System Walkdown Program (B.1.30)
- Water Chemistry Control – BWR Program (B.1.32.2)
- Water Chemistry Control – Closed Cooling Water (B.1.32.3)

Project Team Evaluation

The project team reviewed its assigned PNPS LRA AMR line items to determine that the applicant (1) provides a brief description of the system, components, materials, and environment; (2) states that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the RHR system, core spray system, ADS, HPCI system, RCIC system, SGT system, and PCP components and component groups that are subject to an AMR.

3.2.2.1.1 Loss of Material Due to General Corrosion

In the discussion section of Table 3.2.1, Item 3.2.1-32, of the PNPS LRA, the applicant stated that loss of material due to general corrosion in steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal) for the ESF systems are managed with the Periodic Surveillance and Preventive Maintenance Program (B.1.24). During the audit and review, the project team noted that for 14 AMR result lines that point to Table 3.2.1, Item 3.2.1-32, the applicant included a reference to Note E. The lines that refer to Note E summarize AMR results for internal surfaces in miscellaneous piping and ducting components of the RHR, ADS, SGT, and PCP systems. The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report.

The GALL Report recommends using GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program," to manage aging effects. The project team noted that the System Walkdown Program (B.1.30), Periodic Surveillance and Preventive Maintenance Program (B.1.24), and One-Time Inspection Program (B.1.23) all provide for visual or NDE inspection of external surfaces of these components. In addition, it noted that GALL AMP XI.M36, "External Surfaces Monitoring," states in the fourth paragraph of Element 1, "Scope of Program," that this AMP may also be credited with managing loss of material from internal surfaces for situations in which material and environmental combinations are the same for internal and external surfaces. Since these components are all exposed to the same environment on the inside and the outside (air-indoor uncontrolled), the PNPS Periodic Surveillance and Preventive Maintenance Program, the System Walkdown Program, and the One-Time Inspection Program provide for inspection of representative samples of external and internal surfaces using visual or NDE techniques consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program."

On this basis, the project team found the applicant's use of the PNPS Periodic Surveillance and Preventive Maintenance Program, the System Walkdown Program, and the One-Time Inspection Program for aging management of the internal surfaces in miscellaneous piping and ducting components of the RHR, ADS, SGT, and PCP systems to be acceptable. On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.2 Loss of Material Due to General Corrosion, Pitting, and Crevice Corrosion

In the discussion section of Table 3.2.1, Item 3.2.1-34, of the PNPS LRA, the applicant stated that loss of material due to general corrosion, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to condensation (internal) for the ESF systems are managed with the Periodic Surveillance and Preventive Maintenance Program (B.1.24). During the audit and review, the project team noted that for two AMR results lines that point to Table 3.2.1, Item 3.2.1-34, the applicant included a reference to Note E. The lines that refer to Note E summarize AMR results for piping and blower housing of the HPCI system. The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report.

However, where the GALL Report recommends GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the project team noted that the Periodic Surveillance and Preventive Maintenance Program (B.1.24) provides for visual or NDE inspection of external surfaces of these components and that the GALL AMP XI.M36, "External Surfaces Monitoring," states in the fourth paragraph of Element 1, "scope of program," that this AMP may also be credited with managing loss of material from internal surfaces for situations in which material and environmental combinations are the same for internal and external surfaces. Since these components are exposed to the same environment on the inside and the outside, the PNPS Periodic Surveillance and Preventive Maintenance Program provides for inspection of external and internal surfaces using visual or NDE techniques consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program."

On this basis, the project team found the applicant's use of the PNPS Periodic Surveillance and Preventive Maintenance Program for aging management of the HPCI system piping and blower housing to be acceptable. On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.3 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

In the discussion section of Table 3.2.1, Item 3.2.1.35, of the PNPS LRA, the applicant stated that at PNPS, loss of material in steel containment isolation piping and components internal surfaces exposed to raw water are managed with the Periodic Surveillance and Preventive Maintenance Program (B.1.24) and the Containment Leak Rate Program (B.1.9). The GALL Report recommends managing these components with GALL AMP XI.M20, "Open-Cycle Cooling Water System Program." During the audit and review, the project team noted that although the plant-specific program provides for visual and/or UT inspection as in GALL AMP XI.M20, it does not provide for preventive actions. The applicant was asked what preventive actions are implemented at PNPS to manage loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling. The response from the applicant stated that the environment for these components was not strictly raw water but was actually untreated water in containment drain lines. The raw water environment was selected because no other environment specified in the GALL Report provided a better match. Additionally, these components are not part of the raw water cooling system and, therefore, the preventive action requirements of NRC GL 88-13 do not apply. NRC GL 88-13 provides the primary basis for the Open-Cycle Cooling Water System Program, GALL AMP XI.M20. The project team noted that for four AMR results lines that point to Table 3.2.1, Item 3.2.1-35, the applicant included a reference to Note E. Two lines that refer to Note E summarize AMR results for which the AMP is the Periodic Surveillance and Preventive Maintenance Program (B.1.24). The project team determined that the Periodic Surveillance and Preventive Maintenance Program (B.1.24) provides inspection activities that will manage aging. Based on this determination, the project team found the applicant's use of Note E appropriate and found these AMR results for these two lines to be acceptable.

Two lines that refer to Note E summarize AMR results for which the AMP is the Containment Leak Rate Program (B.1.9). The project team noted that the Containment Leak Rate Program

(B.1.9) is in accordance with GALL AMP XI.S4, "10 CFR 50, Appendix J." This program does not provide for detection of initiation aging. The project team requested that the applicant provide a justification for using the Containment Leak Rate Program alone to manage the aging effects. In response to this request, the applicant stated that the Periodic Surveillance and Preventive Maintenance Program is more appropriate to manage loss of material for piping and valve bodies in a raw water internal environment. Therefore, the applicant committed to revise the LRA to credit the Periodic Surveillance and Preventive Maintenance Program to manage the aging effects instead of the Containment Leak Rate Program. Additionally, the applicant committed to revise Item 3.2.1-35 of Table 3.2.1 to state that the Periodic and Preventive Maintenance Program manages the loss of material for steel components exposed to raw water.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.2.2-7 line items with components piping and valve body exposed to raw water (internal) managed by the Containment Leak Rate Program are revised to credit the Periodic Surveillance and Preventive Maintenance Program for management of aging effects. LRA Table 3.2.1, Item 3.2.1-35 discussion is revised as follows:

> The Periodic Surveillance and Preventive Maintenance Program manages loss of material for steel components exposed to raw water.
>
> LRA Section B.1.24 Program Description is revised to specify program activities for primary containment penetrations including visual or other NDE techniques to inspect internal surfaces of carbon steel penetration components.

The project team determined that the Periodic Surveillance and Preventive Maintenance Program (B.1.24) provides inspection activities that will manage aging. Based on this determination, the project team found the applicant's use of Note E appropriate and found these AMR results lines to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM as recommended by the GALL Report.

3.2.2.1.4 <u>Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion and Cracking Due to SCC Where PNPS Has Credited the Water Chemistry Program with the One-Time Inspection Program as the Verification Program</u>

In the discussion section of Table 3.2.1, Items 3, 5, 10, 14, and 18, the applicant stated in the discussion column that the One-Time Inspection Program will be used to verify the effectiveness of the Water Chemistry Program. However, for those line items in Table 3.2.2-X where these Table 3.2.1 line items are referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy of why the One-Time Inspection Program was not credited in the Table 2 line items that reference these Table 1 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.2.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Tables 3.2.2-X credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.5 Loss of Material, Loss of Preload, and Cracking of Carbon Steel and SS Bolting in Various External Environments

The applicant does not include a Bolting Integrity Program in the PNPS LRA. Instead, the applicant credits alternate programs such as the System Walkdown, Service Water Integrity, and Buried Piping and Tanks Inspection Programs. GALL AMP XI.M18, "Bolting Integrity," provides several recommendations in the 10-element evaluation, such as selection of bolting materials, use of lubricants and sealants, and additional recommendations of NUREG-1339. The alternate programs may be acceptable for inspection; however, they do not address the preventive actions. This applies to Table 3.2.1, Items 22, 23, and 24. The project team asked the applicant to clarify how PNPS meets these recommendations or provide justification why a bolting program should not be provided.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The Bolting Integrity Program will be implemented before the PEO in accordance with Commitment No. 32. The LRA will be supplemented to include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included AMP B.1.33, "Bolting Integrity Program." This program is consistent with GALL AMP XI.M18, "Bolting Integrity." This program covers bolting within the scope of license renewal, including (1) safety-related bolting; (2) bolting for NSSS component supports; (3) bolting for other pressure-retaining components, including NSR bolting; and (4) structural bolting (actual measured yield strength greater than 150 ksi). The aging management of reactor head closure

studs is addressed by GALL AMP XI.M3 and is not included in this program. Therefore, the aging effects of component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program, instead of any other programs identified in the LRA Table 3.3.2-2s. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.6 Loss of Material Due to Pitting and Crevice Corrosion of Copper Alloy Fire Protection Piping, Piping Components, and Piping Elements Exposed to Condensation (Internal)

During the audit and review, the project team noted that some AMR results lines for the SGT system pointed to Section 3.3, "Auxiliary Systems," Table 3.3.1, Item 3.3.1-28. For these line items, the applicant included a reference to Note E. This line item applies to copper alloy components with internal surfaces exposed to a treated air environment. This line item was referenced on two component types (i.e., tubing and valve body).

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report. The GALL Report recommends a plant-specific AMP which is to be evaluated. Table 3.3.1, Item 3.3.1-28, of the PNPS LRA specifies the Periodic Surveillance and Preventive Maintenance, One-Time Inspection, and Instrument Air Quality Programs to manage loss of material in copper alloys. However, the AMR line items specify only the Instrument Air Quality Program to manage loss of material. The project team noted that the Instrument Air Quality Program only monitors air quality and does require testing for leakage rates, inspection for corrosion, and performance testing of components as recommended by GALL AMP XI.M24, "Compressed Air Monitoring Program." The project team requested that the applicant identify additional programs that provide inspection, functional testing, and leakage testing for these components or provide justification for not requiring these activities. In its response, the applicant stated that performance monitoring under the Maintenance Rule addresses active components that would be included in performance testing. Recent internal inspections of the air receiver tanks and moisture checks of the IA system have not detected significant corrosion or moisture in the system. These past inspections provide the confirmation that the actions performed by the Instrument Air Quality Program are effective in managing the aging effects of components exposed to IA without the additional program attributes recommended by GALL AMP XI.M.24. No aging effects were identified where additional management measures would be required, which is also reflected by the operating experience of components exposed to IA. On this basis, the project team found this plant-specific program acceptable to manage loss of material of copper alloys exposed to IA.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.7 Cracking Due to SCC and IGSCC SS Piping, Piping Components, and Piping Elements Exposed to Treated Water Greater Than 140°F

In the discussion section of Table 3.2.1, Item 18, of the PNPS LRA, the applicant stated that the Water Chemistry Control – BWR Program manages cracking of SS components. None of the ESF system components are within the scope of the BWR Stress Corrosion Cracking Program (all relevant components are included in the RV, internals, and RCS). The OTI will be used to verify the effectiveness of the Water Chemistry Program. During the audit and review, the project team noted that in Table 3.2.1, Item 18, of the PNPS LRA, it is stated that none of the ESF system components are within the scope of the BWR Stress Corrosion Cracking Program. The project team requested the applicant to provide the details that justify this statement. The project team is waiting for input from the applicant to finish the evaluation. This is Follow-up Item 3.2.2.1.7-1.

On the basis of its audit and review of the applicant's program, predicated on the satisfactory resolution of Follow-up Item 3.2.2.2.7-1, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.2.2.1.8 Wall Thinning Due to FAC of Steel Piping, Piping Components, and Piping Elements Exposed to Steam or Treated Water

In the discussion section of Table 3.2.1, Item 19, of the PNPS LRA, the applicant stated that consistent with NUREG-1801 for steel piping exposed to steam in the HPCI system, the Flow-Accelerated Corrosion Program manages wall thinning in steel piping. For steel piping exposed to steam in the RCIC system, loss of material is managed by the Periodic Surveillance and Preventive Maintenance Program. This program includes periodic nondestructive evaluations to identify wall thinning, thereby managing loss of material due to erosion for this piping. During the audit and review, the project team noted that the piping of the RCIC system is subject to FAC. The PNPS LRA Table 3.2.1-19 ESF and Table 3.2.1 credit the plant-specific Periodic Surveillance and Preventive Maintenance Program for the management of wall thinning. The GALL Report recommends using the Flow-Accelerated Corrosion Program, GALL AMP XI.M17, to manage wall thinning. The Periodic Surveillance and Preventive Maintenance Program provides for inspection for wall thinning every 5 years, but no monitoring and trending activities to predict areas of high wall thinning rates or for trending of thinning as does GALL AMP XI.M17. The project team requested the applicant to provide justification for not providing for monitoring and trending of wall thinning for RCIC piping. The project team is waiting for input from the applicant to finish the evaluation. This is Follow-up Item 3.2.2.1.8-1.

On the basis of its audit and review of the applicant's program, predicated on the satisfactory resolution of Follow-up Item 3.2.2.2.8-1, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

Conclusion

The project team has evaluated the applicant's claim of consistency with the GALL Report. The project team also has reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its

review, the project team found that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report.

3.2.2.2 AMR Results for Which Further Evaluation Is Recommended

Summary of Information in the Application

In PNPS LRA Section 3.2.2.2, the applicant provides further evaluation of aging management as recommended by the GALL Report for the aging effects related to the RHR system, core spray system, ADS, HPCI system, RCIC system, SGT system, and PCP components and component groups. The applicant also provided information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in the PNPS LRA Table 3.2.1, the GALL Report recommends further evaluation. When further evaluation is recommended, the project team reviewed these further evaluations provided in PNPS LRA Section 3.2.2.2 against the criteria provided in SRP-LR Section 3.2.2.2. This section documents the project team's assessment of these evaluations. These assessments are applicable to each Table 2 AMR line item in Section 3.2 citing the item in Table 1.

3.2.2.2.1 Cumulative Fatigue Damage

The project team reviewed the AMR line items in the Type 2 AMR Tables for the Emergency Safety Feature Systems in which fatigue-induced damage (which is referred to as fatigue - cracking in the AMR line items) was identified as an AERM and in which the "TLAA - Metal Fatigue" was credited as the basis for management of the aging effect. Henceforth, these AMR line items in the Type 2 AMR tables for the emergency safety feature systems will be referred in this audit and review report as the "AMRs on Non-Class 1 Fatigue," and the relevant TLAA will be referred to as the "TLAA on Metal Fatigue of Non-Class 1 Components."

The project team reviewed the applicant's TLAA on Metal Fatigue of Non-Class 1 Components, as provided in Section 4.3.2 of the application. The project team determined that the applicant had indicated that all of the AMRs on Non-Class 1 Fatigue of the emergency safety feature components were within the scope of the ANSI B31.1 design code (B31.1) fatigue analysis discussion in Section 4.3.2 of the LRA. However, the project team determined that these AMRs on Non-Class 1 Fatigue did not clearly indicate which of the emergency safety feature components were designed to B31.1 and which of these components were designed to a design code other than B31.1. Thus, the project team was unable to conclude that the TLAA on Metal Fatigue of Non-Class 1 Components was an appropriate means of aging management for emergency safety feature commodity groups that were designed to a design code other than B31.1. The project team asked the applicant to respond to the following requests:

(1) Identify which design codes were applied to the non-piping commodity groups in the AMRs on Non-Class 1 Fatigue for the emergency safety feature systems.

(2) Clarify whether the design codes required a metal fatigue analysis, and summarize what type of metal fatigue analysis calculation was required by the design code, if applicable.

(3) Discuss how the metal fatigue analysis was acceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii), if applicable.

(4) Propose an acceptable AMP to manage fatigue-induced damage for the PEO if the design code for the particular Non-Class 1 commodity group did not require a metal fatigue analysis.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant clarified that all of the commodity groups in the AMRs for Non-Class 1 fatigue for the emergency safety feature systems were designed in accordance with B31.1, with the following exceptions:

- RHR system heat exchanger shells and tubes, which were designed in accordance with Section III Class C and ASME Section VIII, Division 1 requirements
- RHR pump casings, which were designed to Section III, Class C requirements
- turbine casings in the RCIC and HPCI systems, which were designed in accordance with NEMA SM 23 requirements

The applicant clarified that the design codes for these specific components in the list above do not require metal fatigue analyses. Therefore, the applicant amended the AMR line item and credited the One-Time Inspection Program to manage fatigue-induced damage in these components in lieu of the TLAA on Metal Fatigue of Non-Class 1 Components. The applicant's One-Time Inspection Program is used, in part, to determine whether a specific aging effect of concern is occurring in components in which there has been no plant-specific operating experience with the aging effect. The applicant has not indicated any relevant operating experience with respect to the occurrence of fatigue-induced damage in the RHR heat exchanger tubes and shells, RHR pump casings, or turbine casings for the HPCI and RCIC systems. GALL Program XI.M32, "One Time Inspection," states that either an enhanced VT-1 (EVT-1) visual examination or volumetric examination techniques (i.e., either ultrasonic or radiographic techniques) are to be used to detect cracking in plant components.

The project team has reviewed the applicant's One-Time Inspection Program (LRA AMP B.1.23), and its evaluation is provided in Section 3.0.3.1.8 of this audit report. In this evaluation, the project team concluded that the applicant's One-Time Inspection Program is consistent with GALL AMP XI.M32 without exception and acceptable for implementation. Therefore, staff concludes that it will be appropriate to credit a one-time inspection of these components using either an EVT-1 or volumetric examination technique to determine whether fatigue-induced damage is an AERM for the PEO. This issue is closed with respect to confirming that a valid AMP is being credited to manage fatigue-induced damage in these emergency safety feature components (i.e., in the RHR heat exchanger tubes and shells, in the RHR pump casings, and in the RCIC and HPCI turbine casings).

For the remaining AMRs on Non-Class 1 Fatigue of the emergency safety feature systems, the applicant confirmed that the design code for the components in the AMRs is B31.1, and that the TLAA on Metal Fatigue is credited to manage fatigue-induced damage in these components. Therefore, the project team concludes that it is valid and acceptable to use the TLAA on Metal Fatigue of Non-Class 1 Components as the basis for managing fatigue-induced damage in these components because (1) these components are designed to B31.1, (2) B31.1 includes a metal fatigue analysis methodology for B31.1-designed components, and (3) Section 4.3.2 of the LRA includes a B31.1-based fatigue assessment for these components. The project team reviewed the ability of the TLAA on Metal Fatigue to manage fatigue-induced damage in these components, and its evaluation is provided in Section 4.3.2.2.2 of this audit and review report. This issue is closed.

3.2.2.2.2 Loss of Material Due to General Corrosion

The project team reviewed PNPS LRA Section 3.2.2.2.2 against the criteria in SRP-LR Section 3.2.2.2.2.

SRP-LR Section 3.2.2.2.2 states that the loss of material due to cladding breach could occur for PWR steel pump casings with SS cladding exposed to treated borated water. The GALL Report references NRC IN 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks,” and recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.2, the applicant states that this item covers underclad cracking of cladding on PWR steel pump casings. Because PNPS is a BWR and does not have charging pumps or steel pump casings with SS cladding, this item is not applicable to PNPS.

The project team found that this section is not applicable to PNPS.

3.2.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion

3.2.2.2.3.1 Loss of Material Due to Pitting and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.2.2.2.3.1 against the criteria in SRP-LR Section 3.2.2.2.3.1.

SRP-LR Section 3.2.2.2.3.1 states that the loss of material due to pitting and crevice corrosion could occur for internal surfaces of SS containment isolation piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging

effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.3.1, the applicant states that the loss of material due to pitting and crevice corrosion for internal surfaces of SS piping and components in ESF systems exposed to treated water is managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components including areas of stagnant flow. The project team reviewed PNPS LRA Appendix B, Sections B.1.23, "One-Time Inspection Program," and B.1.32.2, "Water Chemistry Control – BWR Program," and determined that these programs will provide for inspection of select SS components exposed to treated water at susceptible locations such as stagnant areas for loss of material due to pitting and crevice corrosion in applicable ESF systems.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.3.1 for further evaluation. The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.2.2.2.3.2 Loss of Material Due to Pitting and Crevice Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.2.2.2.3.2 against the criteria in SRP-LR Section 3.2.2.2.3.2.

The SRP-LR Section 3.2.2.2.3.2 states that the loss of material from pitting and crevice corrosion could occur for SS piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.3.2, the applicant states that at PNPS there are no SS ESF components that are in contact with a soil environment. Therefore, this item is not applicable.

The project team determined that this item is not applicable to PNPS.

3.2.2.2.3.3 Loss of Material Due to Pitting and Crevice Corrosion [Item 3]

The project team reviewed PNPS LRA Section 3.2.2.2.3.3 against the criteria in SRP-LR Section 3.2.2.2.3.3.

SRP-LR Section 3.2.2.2.3.3 states that the loss of material from pitting and crevice corrosion could occur for BWR SS and aluminum piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to

verify the effectiveness of the water chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.3.3, the applicant states that the loss of material from pitting and crevice corrosion for BWR SS piping and piping components exposed to treated water at PNPS is managed by the Water Chemistry Control – BWR Program. ESF systems at PNPS do not contain any components made of aluminum. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow.

The project team reviewed PNPS LRA Appendix B, Sections B.1.23, "One-Time Inspection," and B.1.32.2, "Water Chemistry Control – BWR Program," and determined that these programs will provide for inspection of select SS components exposed to treated water at susceptible locations, such as stagnant areas for loss of material due to pitting and crevice corrosion in applicable ESF systems.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.3.3 for further evaluation. The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.2.2.2.3.4 <u>Loss of Material Due to Pitting and Crevice Corrosion [Item 4]</u>

The project team reviewed PNPS LRA Section 3.2.2.2.3.4 against the criteria in SRP-LR Section 3.2.2.2.3.4.

SRP-LR Section 3.2.2.2.3.4 states that the loss of material from pitting and crevice corrosion could occur for SS and copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.3.4, the applicant states that the loss of material is managed by the Oil Analysis Program, which includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. A review of operating experience at PNPS for the last 5 years did not identify any Corrective Action Reports (CRs) that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an One Time Inspection to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.3.4 for further evaluation. The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.2.2.2.3.5 Loss of Material Due to Pitting and Crevice Corrosion [Item 5]

The project team reviewed PNPS LRA Section 3.2.2.2.3.5 against the criteria in SRP-LR Section 3.2.2.2.3.5.

SRP-LR Section 3.2.2.2.3.5 states that the loss of material from pitting and crevice corrosion could occur for partially encased SS tanks exposed to raw water due to cracking of the perimeter seal from weathering. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated because moisture and water can egress under the tank if the perimeter seal is degraded. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.3.5, the applicant stated that at PNPS there are no outdoor SS tanks in ESF systems. This item is therefore not applicable.

The project team found that this item is not applicable to PNPS.

3.2.2.2.3.6 Loss of Material Due to Pitting and Crevice Corrosion [Item 6]

The project team reviewed PNPS LRA Section 3.2.2.2.3.6 against the criteria in SRP-LR Section 3.2.2.2.3.6.

SRP-LR Section 3.2.2.2.3.6 states that the loss of material from pitting and crevice corrosion could occur for SS piping, piping components, piping elements, and tanks exposed to internal condensation. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.3.6, the applicant states that at PNPS there are no components in ESF systems exposed to internal condensation. This item is therefore not applicable.

The project team found that this item is not applicable to PNPS.

3.2.2.2.4 Loss of Material Due to General, Pitting, and Microbiologically Influenced Corrosion

3.2.2.2.4.1 Loss of Material Due to General, Pitting, and Microbiologically Influenced Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.2.2.2.4.1 against the criteria in SRP-LR Section 3.2.2.2.4.1.

SRP-LR Section 3.2.2.2.4.1 states that the reduction of heat transfer due to fouling could occur for steel, SS, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing AMP relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. However, control of lube oil chemistry may not always have been adequate to preclude fouling. Therefore, the effectiveness of lube oil chemistry control should be verified to ensure that fouling is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of lube oil chemistry control. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.4.1, the applicant states that the reduction of heat transfer due to fouling for SS and copper alloy heat exchanger tubes exposed to lubricating oil in ESF systems is managed by the Oil Analysis Program at PNPS. This program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to fouling. Operating experience at PNPS has

confirmed the effectiveness of this program in maintaining contaminants within limits such that fouling has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as fouling in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as fouling in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.4.1 for further evaluation. The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.2.2.2.4.2 Loss of Material Due to General, Pitting, and Microbiologically Influenced Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.2.2.2.4.2 against the criteria in SRP-LR Section 3.2.2.2.4.2.

SRP-LR Section 3.2.2.2.4.2 states that the reduction of heat transfer due to fouling could occur for SS heat exchanger tubes exposed to treated water. The existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of

water chemistry may have been inadequate. Therefore, the GALL Report recommends that the effectiveness of the chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. An OTI is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.4.2, the applicant states that the reduction of heat transfer due to fouling for SS heat exchanger tubes exposed to treated water in ESF systems at PNPS is managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow.

The project team reviewed PNPS LRA Appendix B, Sections B.1.23, "One-Time Inspection," and B.1.32.2, "Water Chemistry Control – BWR Program," and determined that these programs will provide for inspection of select components exposed to treated water at susceptible locations, such as stagnant areas for loss of material due to pitting and crevice corrosion and reduction of heat transfer due to fouling in applicable ESF systems.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.4.2 for further evaluation.

3.2.2.2.5 <u>Hardening and Loss of Strength Due to Elastomer Degradation</u>

The project team reviewed PNPS LRA Section 3.2.2.2.5 against the criteria in SRP-LR Section 3.2.2.2.5.

SRP-LR Section 3.2.2.2.5 states that hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components associated with the BWR SGT system ductwork and filters exposed to air-indoor uncontrolled. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.5, the applicant states that the Periodic Surveillance and Preventive Maintenance Program manages aging in elastomer components of the SGT system exposed to air. The program includes periodic visual or other nondestructive inspections and manipulations to manage cracking and changes in material properties.

The project team reviewed PNPS LRA Appendix B, Section B.1.24, "Periodic Surveillance and Preventive Maintenance Program," and determined that this program will provide for visual inspection and manipulation of elastomer components exposed to air at 5-year intervals to detect elastomer degradation in the SGT system.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.5 for further evaluation.

3.2.2.2.6 Loss of Material Due to Erosion

The project team reviewed PNPS LRA Section 3.2.2.2.6 against the criteria in SRP-LR Section 3.2.2.2.6.

SRP-LR Section 3.2.2.2.6 states that the loss of material due to erosion could occur in the SS high-pressure safety injection (HPSI) pump miniflow recirculation orifice exposed to treated borated water. The GALL Report recommends a plant-specific AMP be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. The GALL Report references Licensee Event Report 50-275/94-023 for evidence of erosion. Further evaluation is recommended to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.6, the applicant states that the discussion refers to the SS HPSI pump miniflow recirculation orifice exposed to treated borated water. PNPS is a BWR and has no HPSI pump miniflow orifice, and therefore this item is not applicable.

The project team found that this item is not applicable to PNPS.

3.2.2.2.7 General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

The project team reviewed PNPS LRA Section 3.2.2.2.7 against the criteria in SRP-LR Section 3.2.2.2.7.

SRP-LR Section 3.2.2.2.7 states that the loss of material due to general corrosion and fouling can occur for steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to uncontrolled indoor air. This could result in plugging of the spray nozzles and flow orifices. 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 accelerate corrosion and fouling. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.7, the applicant states that this item refers to loss of material due to general corrosion and fouling occurring for steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to uncontrolled indoor air. At PNPS, the spray nozzles are copper alloy and SS and are not subject to loss of material due to general corrosion in an indoor air environment. There are also no orifices in ECCS systems exposed to an indoor air environment (internal). This item is therefore not applicable.

3.2.2.2.8 Loss of Material Due to General, Pitting, and Crevice Corrosion

3.2.2.2.8.1 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.2.2.2.8.1 against the criteria in SRP-LR Section 3.2.2.2.8.1.

SRP-LR Section 3.2.2.2.8.1 states that the loss of material due to general, pitting, and crevice corrosion could occur for BWR steel piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.8.1, the applicant states that the loss of material due to general, pitting, and crevice corrosion for BWR steel piping and components in ESF systems exposed to treated water is managed at PNPS by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow. The Periodic Surveillance and Preventive Maintenance Program will also be used to manage loss of material for ADS piping wetted in the waterline region of the torus.

The project team reviewed PNPS LRA Appendix B, Sections B.1.23, "One-Time Inspection Program," and B.1.32.2, "Water Chemistry Control – BWR Program," and determined that these programs will provide for inspection of select steel components exposed to treated water at susceptible locations, such as stagnant areas for loss of material due to general, pitting, and crevice corrosion in the ADS.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.8.1 for further evaluation.

3.2.2.2.8.2 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.2.2.2.8.2 against the criteria in SRP-LR Section 3.2.2.2.8.2.

SRP-LR Section 3.2.2.2.8.2 states that the loss of material due to general, pitting, and crevice corrosion could occur for the internal surfaces of steel containment isolation piping, piping components, and piping elements exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to mitigate degradation. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at

locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.8.2, the applicant stated that steel containment isolation components exposed to treated water are all part of other safety systems that are evaluated separately. Section 3.2.2.2.8.1 above describes the detection of aging effects in these components. As stated above, the loss of material due to general, pitting, and crevice corrosion for internal surfaces of PCP steel piping and components exposed to treated water is managed at PNPS by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.8.2 for further evaluation.

3.2.2.2.8.3 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 3]

The project team reviewed PNPS LRA Section 3.2.2.2.8.3 against the criteria in SRP-LR Section 3.2.2.2.8.3.

SRP-LR Section 3.2.2.2.8.3 states that the loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation to verify the effectiveness of the lubricating oil program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.2.2.2.8.3, the applicant stated that the loss of material due to general, pitting, and crevice corrosion for steel piping and components in ESF systems exposed to lubricating oil is managed by the Oil Analysis Program. This program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the

performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.8.3 for further evaluation.

3.2.2.2.9 Loss of Material Due to General Corrosion and Fouling

The project team reviewed PNPS LRA Section 3.2.2.2.9 against the criteria in SRP-LR Section 3.2.2.2.9.

SRP-LR Section 3.2.2.2.9 states that the loss of material due to general, pitting, crevice, and microbiologically influenced corrosion could occur for steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The 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 effectiveness of the Buried Piping and Tanks Inspection Program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

In PNPS LRA Section 3.2.2.2.9, the applicant stated that the loss of material due to general, pitting, and crevice corrosion and MIC for steel (with or without coating or wrapping) piping and piping components buried in soil in ESF systems at PNPS is managed by the Buried Piping and

Tanks Inspection Program. This program will include (a) preventive measures to mitigate corrosion, and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel components. Buried components will be inspected when excavated during maintenance. An inspection will be performed within 10 years of entering the PEO, unless an opportunistic inspection occurred within this 10-year period.

The project team reviewed PNPS LRA Appendix B, Section B.1.2, "Buried Piping and Tanks Inspection Program," and determined that this program will provide for inspection of select steel components exposed to soil that are excavated during maintenance for loss of material due to general, pitting, and crevice corrosion in ESF systems.

Therefore, the project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.9 for further evaluation.

3.2.2.2.10 QA for Aging Management of NSR Components

SRP-LR Section 3.2.2.2.10 states that the acceptance criteria for the QA program, procedures, and administrative controls are described in Branch Technical Position IQMB-1 (Appendix A.2 of the SRP-LR).

In PNPS LRA Section 3.2.2.2.10, the applicant stated that the quality assurance program, procedures, and administrative controls are discussed in Appendix B, Section B.0.3. The project team's evaluation of Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

Conclusion

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were further evaluated.

3.2.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.2.1, "Summary of Aging Management Evaluations for the Engineered Safety Features Evaluated in Chapter V of GALL Report," the applicant provided information regarding components or material/environment combinations in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Tables 3.2.2-1 through 3.2.2-7, the applicant provided additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicated, via Notes F through J, that neither the identified component nor the material and/or environment combination is evaluated in the GALL Report and provided information concerning how the AERM will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

AEMs in Table 3.2.1 That Are Not Applicable to PNPS

The project team reviewed PNPS LRA Table 3.2.1, which provides a summary of aging management evaluations for the ESF evaluated in the GALL Report.

In PNPS LRA Table 3.2.1, Item 3.2.1-20 discussion column, the applicant states that the loss of fracture toughness due to thermal aging embrittlement of CASS piping, piping components, and piping elements exposed to treated water (borated or unborated) in excess of 482°F is not applicable because there are no CASS components in the ESF systems. On the basis that there are no CASS components in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-21 discussion column, the applicant states that cracking due to cycling loading, stress corrosion, and cracking for high-strength steel closure bolting exposed to air with steam or water leakage is not applicable to PNPS because high-strength steel closure bolting is not used in ESF systems at PNPS. On the basis that there is no high-strength bolting in the ESF at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-22 discussion column, the applicant states that the loss of material due to general, pitting, and crevice corrosion of steel bolting and closure bolting exposed to uncontrolled indoor or outdoor air is not applicable to PNPS because all steel closure bolting exposed to external air is conservatively assumed to be exposed to uncontrolled indoor air. On the basis that there is no steel bolting assigned to the external air environment in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-24 discussion column, the applicant states that the loss of preload due to thermal effects, gasket creep, and self-loosening of steel closure bolting exposed to uncontrolled internal or external air is not applicable to PNPS for the following reasons:

- The loss of preload is a design-driven effect and not an AERM.
- Bolting at PNPS is standard ASTM grade B7 carbon steel, or similar material, except in rare specialized applications such as applications where SS bolting is utilized.
- Loss of preload due to stress relaxation (creep) would only be a concern in very high-temperature applications (greater than 700°F), as stated in the ASME Code, Section II, Part D, Table 4.

- No PNPS bolting operates at greater than700°F. Therefore, loss of preload due to stress relaxation (creep) is not an applicable aging effect for ESF systems.
- Other issues that may result in pressure boundary joint leakage are improper design or maintenance issues.
- Improper bolting application (design) and maintenance issues are current plant operational concerns and not related to aging effects or mechanisms that require management during the PEO.
- To address these bolting operational concerns, PNPS has taken actions to address NUREG-1339.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The Bolting Integrity Program will be implemented before the PEO in accordance with Commitment No. 32. The LRA will be supplemented to include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included AMP B.1.33, "Bolting Integrity Program." This program is consistent with GALL AMP XI.M18, "Bolting Integrity." This program covers bolting within the scope of license renewal, including (1) safety-related bolting; (2) bolting for NSSS component supports; (3) bolting for other pressure-retaining components, including NSR bolting; and (4) structural bolting (actual measured yield strength greater than 150 ksi). The aging management of reactor head closure studs is addressed by GALL AMP XI.M3 and is not included in this program. Therefore, the aging effects of component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program instead of any other programs identified in the LRA Table 3.2.2-2s. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

In PNPS LRA Table 3.2.1, Item 3.2.1-26 discussion column, the applicant stated that the loss of material due to general, pitting, and crevice corrosion of steel piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because steel containment isolation components exposed to CCW are all part of other safety systems that are evaluated separately. On the basis that there are no steel piping components and steel piping elements exposed to CCW in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-33 discussion column, the applicant stated that the loss of material due to general, pitting, and crevice corrosion of steel encapsulation components exposed to uncontrolled indoor air is not applicable to PNPS because the ESF systems include no steel encapsulation components. On the basis that there are no steel encapsulation components in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-36 discussion column, the applicant stated that the loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and fouling of steel heat exchanger components exposed to raw water is not applicable to PNPS because there are no steel heat exchanger components exposed to raw water in the ESF systems. On the basis that there are no steel heat exchanger components exposed to raw water in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-37 discussion column, the applicant stated that the loss of material due to pitting, crevice, and microbiologically influenced corrosion of SS piping, piping components, and piping elements exposed to raw water is not applicable to PNPS because there are no SS components exposed to raw water in the ESF systems.

On the basis that there are no SS piping, piping components, and piping elements exposed to raw water in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-38 discussion column, the applicant states that the loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling of SS component internal surfaces exposed to raw water is not applicable to PNPS because there are no SS components exposed to raw water in the ESF systems.

On the basis that there are no SS component internal surfaces exposed to raw water of applicable components in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-39 discussion column, the applicant stated that the loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling of SS heat exchanger components exposed to raw water is not applicable to PNPS because there are no SS heat exchanger components exposed to raw water in the ESF systems. On the basis that there are no SS heat exchanger components exposed to raw water in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-40 discussion column, the applicant states that the reduction of heat transfer due to fouling of steel and SS heat exchanger tubes (serviced by open-cycle cooling water) exposed to raw water is not applicable to PNPS because there are no steel or SS heat exchanger tubes exposed to raw water in the ESF systems. On the basis that there are no steel or SS heat exchanger tubes exposed to raw water in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-42 discussion column, the applicant stated that the loss of material due to selective leaching of gray cast iron piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because there are no gray cast iron components exposed to CCW in the ESF systems. On the basis that there are no gray cast

iron components exposed to CCW in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-43 discussion column, the applicant states that the loss of material due to selective leaching of gray cast iron piping, piping components, and piping elements exposed to soil is not applicable to PNPS because there are no gray cast iron components exposed to soil in the ESF systems. On the basis that there are no gray cast iron components exposed to soil in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-50 discussion column, the applicant states that the aging of aluminum piping, piping components, and piping elements exposed to uncontrolled internal or external air is not applicable to PNPS because there are no aluminum components in the ESF systems. On the basis that there are no aluminum components in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-51 discussion column, the applicant states that aging of galvanized steel ducting exposed to controlled indoor air is not applicable to PNPS because galvanized steel surfaces are evaluated as steel for the ESF systems. The applicant takes no credit for the corrosion-resistant coating for galvanized steel. On the basis that no credit is taken for the corrosion-resistant coating and that galvanized steel is evaluated as steel in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-54 discussion column, the applicant stated that aging of steel piping, piping components, and piping elements exposed to indoor controlled air is not applicable to PNPS because there are no steel components of the ESF systems in indoor controlled air environments. All indoor air environments are conservatively considered to be uncontrolled. On the basis that all indoor air environments are conservatively considered to be uncontrolled for the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.2.1, Item 3.2.1-55 discussion column, the applicant stated that aging of steel and SS piping, piping components, and piping elements in concrete is not applicable to PNPS because there are no steel or SS components of the ESF systems embedded in concrete. On the basis that there are no steel or SS components embedded in concrete in the ESF systems at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

<u>ESF AMR Line Items That Have No Aging Effect (PNPS LRA Tables 3.2.2-1 through 3.2.2-7, 3.3.2-14-7, 3.3.2-14-16, 3.3.2-14-25, and 3.3.2-14-28)</u>

In LRA Tables 3.2.2-1 through 3.2.2-7, 3.3.2-14-7, 3.3.2-14-16, 3.3.2-14-25, and 3.3.2-14-28, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specific instances in which the applicant states that no aging effects were identified occurred for the following components, fabrication materials, and environments.

SS in an Air-Indoor Internal Environment

SSs are highly resistant to corrosion in dry atmospheres in the absence of corrosive species (which would be reflective of indoor uncontrolled air) as cited in Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555) (Ninth Edition, American Society for Metals International, 1980 and 1987). Components are not subject to moisture in a dry air environment (and indoor uncontrolled air would have limited humidity and condensation). Therefore, SS in an indoor, uncontrolled air environment exhibits no aging effect, and the component or structure will remain capable of performing its intended functions consistent with the CLB for the PEO.

Copper Alloy Less Than 15-Percent Zinc in an Air-Indoor Internal Environment

Copper alloy less than 15-percent zinc in an air-indoor internal environment does not have any aging effect. This conclusion is based on the fact that comprehensive tests conducted over a 20-year period under the supervision of ASTM have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in *Metals Handbook*, Volume 13, "Corrosion" (American Society for Metals International, 1987).

On the basis of its review of current industry research and operating experience, the project team found that an air indoor internal environment on copper alloy less than 15-percent zinc will not result in aging that will be of concern during the PEO. Therefore, the project team concluded that there are no applicable AERMs for copper alloy less than 15-percent zinc components exposed to an air indoor internal environment.

On the basis of its audit and review of the applicant's program, the project team found that this item is not applicable to PNPS.

3.2.2.3.1 RHR System – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-1

The project team reviewed PNPS LRA Table 3.2.2-1, which summarizes the results of AMR evaluations for the RHR system component groups.

In LRA Table 3.2.2-1, the applicant proposed to manage "loss of material – wear" of SS (tubing) of heat exchangers exposed to treated water greater than 270°F using the Heat Exchanger Monitoring Program (AMP B.1.15). The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program will provide inspection of heat exchangers for degradation using visual examination and eddy current testing. Heat exchanger tubes will be subjected to eddy current inspection to determine wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets for Loss of material. On the basis of its review of the applicant's operating experience, the project team found the aging effect of loss of material of SS tubing exposed to treated water greater than 270°F is effectively managed using the Heat Exchanger Monitoring Program. On this basis, the project team found that management of loss of material in Table 3.2.2-1 is acceptable.

3.2.2.3.2 Core Spray System – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-2

The project team reviewed PNPS LRA Table 3.2.2-2, which summarizes the results of AMR evaluations for the core spray system component groups.

In LRA Table 3.2.2-2, the applicant proposed to manage loss of material (wear or erosion) of copper alloy greater than 15-percent zinc for cooling coils exposed to treated water (interior) or lube oil (exterior) environments using the Heat Exchanger Monitoring Program (AMP B.1.15). The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program will provide inspection of heat exchangers for degradation using visual examination and eddy current testing. Cooling coils will be subjected to eddy current inspection to determine wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets for loss of material. On the basis of its review of the applicant's operating experience, the project team found the aging effect of loss of material of copper alloy greater than 15-percent zinc cooling coils exposed to lube oil or treated water is effectively managed using the Heat Exchanger Monitoring Program. On this basis, the project team found that management of loss of material in Table 3.2.2-2 is acceptable.

3.2.2.3.3 ADS – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-3

The project team reviewed PNPS LRA Table 3.2.2-3, which summarizes the results of AMR evaluations for the ADS component groups.

In LRA Table 3.2.2-3, the applicant proposed to manage cracking fatigue of SS for component types of tee-quenchers exposed to steam greater than 270°F (internal) using metal fatigue TLAA.

In PNPS LRA Table 3.2.2-3, the applicant indicated that fatigue is a TLAA as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). The project team's evaluation of this TLAA is addressed separately in Section 4 of the SER related to the PNPS LRA. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking fatigue of SS exposed to steam greater than 270°F (internal) is effectively managed using metal fatigue TLAA. On this basis, the project team found that management of cracking fatigue in Table 3.2.2-3 is acceptable.

3.2.2.3.4 High Pressure Coolant Injection (HPCI) System – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-4

The project team reviewed PNPS LRA Table 3.2.2-4, which summarizes the results of AMR evaluations for the HPCI system component groups.

In LRA Table 3.2.2-4, the applicant proposed to manage cracking fatigue of SS and nickel alloy for component types of orifice, rupture disc, strainer, strainer housing, and tubing exposed to steam greater than 270°F using metal fatigue TLAA. In PNPS LRA Table 3.2.2-4, the applicant

indicates that fatigue is a TLAA as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). The project team's evaluation of this TLAA is addressed separately in Section 4 of the SER related to the PNPS LRA. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking fatigue of SS and nickel alloy exposed to steam greater than 270°F is effectively managed using metal fatigue TLAA. On this basis, the project team found that management of cracking fatigue in Table 3.2.2-4 is acceptable.

In LRA Table 3.2.2-4, the applicant proposed to manage loss of material due to wear of copper alloy greater than 15-percent zinc of heat exchanger tubes exposed to treated water (interior) or lube oil (exterior) environments using the Heat Exchanger Monitoring Program (AMP B.1.15). The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program will provide inspection of heat exchangers for degradation using visual examination and eddy current testing. Heat exchanger tubes will be subjected to eddy current inspection to determine wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets for loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of copper alloy greater than 15-percent zinc cooling coils exposed to lube oil or treated water is effectively managed using the Heat Exchanger Monitoring Program. On this basis, the project team found that management of loss of material in Table 3.2.2-4 is acceptable.

In LRA Table 3.2.2-4, the applicant proposed to manage cracking of SS (tubing) of heat exchangers exposed to lubricating oil using the Oil Analysis Program (AMP B.1.22). The project team reviewed the Oil Analysis Program, and its evaluation is documented in Section 3.0.3.2.13 of this audit and review report. The Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. The Oil Analysis Program does not provide for inspection or other means to verify its effectiveness; rather, the applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. Review of PNPS and industry operating experience and maintenance activities indicate that maintenance of the oil environment alone is effective in managing cracking of SS. This evaluation is documented in Section 3.2.2.2.8.3 of this audit and review report. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of SS tubing exposed to lubricating oil is effectively managed using the Oil Analysis Program. On this basis, the project team found that management of loss of material in Table 3.2.2-4 is acceptable.

In LRA Table 3.2.2-4, the applicant proposed to manage cracking and loss of material of nickel alloy strainers exposed to steam greater than 270°F using the Water Chemistry Control – BWR Program (AMP B.1.32.2). The project team reviewed the Water Chemistry Control – BWR Program, and its evaluation is documented in Section 3.0.3.1.13 of this audit and review report. The Water Chemistry Control – BWR Program optimizes the primary water chemistry to minimize the potential for loss of material and cracking. This is accomplished by limiting the levels of contaminants in the RCS that could cause loss of material and cracking. In Table 3.2.1, the applicant stated in the discussion column that the One-Time Inspection Program will

be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.2.2-4 where these Table 3.2.1 line items are referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where GALL recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking and loss of material of nickel alloy exposed to steam greater than 270°F is effectively managed using the Water Chemistry Control – BWR Program. On this basis, the project team found that management of cracking in Table 3.2.2-4 is acceptable.

3.2.2.3.5 Reactor Core Isolation Cooling (RCIC) System – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-5

The project team reviewed PNPS LRA Table 3.2.2-5, which summarizes the results of AMR evaluations for the RCIC system component groups.

In LRA Table 3.2.2-5, the applicant proposed to manage loss of material from wear of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to lube oil (exterior) using the Heat Exchanger Monitoring Program (AMP B.1.15). The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program will provide inspection of heat exchangers for degradation using visual examination and eddy current testing. Heat exchanger tubes will be subjected to eddy current inspection to determine wall thickness. Visual inspections will be performed on heat exchanger heads, covers, and tube sheets for loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of copper alloy greater than 15-percent zinc cooling heat exchanger tubes exposed to lube oil is effectively managed

using the Heat Exchanger Monitoring Program. On this basis, the project team found that management of loss of material in Table 3.2.2-5 is acceptable.

In LRA Table 3.2.2-5, the applicant proposed to manage cracking due to fatigue of SS for component types of strainer, orifice, and tubing exposed to steam greater than 270°F using metal fatigue TLAA. In PNPS LRA Table 3.2.2-5, the applicant indicated that fatigue is a TLAA as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). The project team's evaluation of this TLAA is addressed separately in Section 4 of the SER related to the PNPS LRA. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking due to fatigue of SS exposed to steam greater than 270°F is effectively managed using metal fatigue TLAA. On this basis, the project team found that management of cracking due to fatigue in Table 3.2.2-5 is acceptable.

3.2.2.3.6 Standby Gas Treatment (SGT) System – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-6

The project team reviewed PNPS LRA Table 3.2.2-6, which summarizes the results of AMR evaluations for the SGT system component groups. The results of these evaluations are all consistent with the GALL Report.

3.2.2.3.7 PCP – Summary of Aging Management Evaluation – PNPS LRA Table 3.2.2-7

The project team reviewed PNPS LRA Table 3.2.2-7, which summarizes the results of AMR evaluations for the PCP component groups. The results of these evaluations are all consistent with the GALL Report.

3.2.2.3.8 Core Spray System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-7

The project team reviewed PNPS LRA Table 3.3.2-14-7, which summarizes the results of AMR evaluations for the core spray system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.2.2.3.9 HPCI System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-16

The project team reviewed PNPS LRA Table 3.3.2-14-16, which summarizes the results of AMR evaluations for the HPCI system NSR component groups affecting safety-related systems.

In LRA Table 3.3.2-14-16, the applicant proposed to manage cracking due to fatigue of SS and for component types of orifice and rupture disc exposed to steam greater than 270°F using metal fatigue TLAA. In PNPS LRA Table 3.2.2-4, the applicant indicated that fatigue is a TLAA as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). The project team's evaluation of this TLAA is addressed separately in Section 4 of the SER related to the PNPS LRA. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of cracking due to fatigue of SS and for components exposed to steam greater than 270°F is effectively managed using metal fatigue TLAA. On this basis, the project team found that management of cracking fatigue in Table 3.2.2-4 is acceptable.

3.2.2.3.10 RCIC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-25

The project team reviewed PNPS LRA Table 3.3.2-14-25, which summarizes the results of AMR evaluations for the RCIC system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.2.2.3.11 Residual Heat Removal (RHR) System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-28

The project team reviewed PNPS LRA Table 3.3.2-14-28, which summarizes the results of AMR evaluations for the RHR system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

Conclusion

The project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.2.3 Conclusion

On the basis of its review, the project team concluded that the applicant has demonstrated that the aging effects associated with the ESF components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the ESF components, as required by 10 CFR 54.21(d).

3.3 Aging Management of Auxiliary Systems

This section of the audit and review report documents the project team's review and evaluation of PNPS AMR results for those components in the auxiliary systems. The following systems are addressed in this section:

- SLC system
- SSW system
- RBCCW system
- EDG system
- SBO diesel generator system.
- security diesel system
- fuel oil system
- IA system
- fire protection – water system
- fire protection – halon system
- HVAC systems
- primary containment atmosphere control (PCAC) system
- fuel pool cooling (FPC) and fuel handling and storage systems
- miscellaneous systems in scope for 10 CFR 54.4(a)(2)

3.3.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.3, the applicant provided the results of its AMRs for the auxiliary systems components and component groups.

In PNPS LRA Table 3.3.1, "Summary of Aging Management Evaluations for the Auxiliary Systems Evaluated in Chapter VII of NUREG-1801," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the auxiliary systems components and component groups. The applicant also identified for each component type in PNPS LRA Table 3.3.1 those components that are consistent with the GALL Report, those for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In PNPS LRA Tables 3.3.2-1 through 3.3.2-14-35, the applicant provided a summary of the AMR results for component types associated with the following auxiliary systems:

- SLC system
- SSW systems
- RBCCW system
- EDG system
- SBO diesel system
- security diesel system
- fuel oil system
- IA system
- fire protection – water system
- fire protection – halon system
- HVAC systems
- PCAC systems
- FPC and fuel handling and storage systems

Miscellaneous systems in scope for 10 CFR 54.4(a)(2) (Tables 3.3.2-14-1 to 3.3.2-14-35)

- circulating water system (CWS), NSR components affecting safety-related systems
- compressed air system (CAS), NSR components affecting safety-related systems
- condensate system, NSR components affecting safety-related systems
- condensate demineralizer system (CDS), NSR components affecting safety-related systems
- condensate storage and transfer (CST) system, NSR components affecting safety-related systems
- CRD system, NSR components affecting safety-related systems
- core spray system, NSR components affecting safety-related systems
- EDG system, NSR components affecting safety-related systems
- extraction steam system, NSR components affecting safety-related systems
- feedwater system, NSR components affecting safety-related systems
- feedwater heater drains and vents system, NSR components affecting safety-related systems
- fire protection system, NSR components affecting safety-related systems
- fuel oil storage and transfer system, NSR components affecting safety-related systems.
- FPC and demineralizer system, NSR components affecting safety-related systems
- HVAC systems, NSR components affecting safety-related systems
- HPCI system, NSR components affecting safety-related systems
- main condenser, NSR components affecting safety-related systems
- MS system, NSR components affecting safety-related systems
- offgas and augmented offgas (AOG) system, NSR components affecting safety-related systems
- post-accident sampling system (PASS), NSR components affecting safety-related systems
- potable and sanitary water system, NSR components affecting safety-related systems

- PCAC system, NSR components affecting safety-related systems
- radioactive waste system, NSR components affecting safety-related systems
- RBCCW system, NSR components affecting safety-related systems
- RCIC system, NSR components affecting safety-related systems
- RCS system, NSR components affecting safety-related systems
- RWCU system, NSR components affecting safety-related systems
- RHR system, NSR components affecting safety-related systems
- SSW system, NSR components affecting safety-related systems
- sampling systems, NSR components affecting safety-related systems
- sanitary soiled waste and vent; plumbing and drains, NSR components affecting safety-related systems
- screen wash system, NSR components affecting safety-related systems
- SLC system, NSR components affecting safety-related systems
- TBCCW system, NSR components affecting safety-related systems
- turbine generator and auxiliaries, NSR components affecting safety-related systems

Specifically, the information for each component type includes intended function, material, environment, AERM, AMPs, the GALL Report Volume 2 item, cross-reference to PNPS LRA Table 3.3.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporate applicable operating experience in the determination of AERMs. These reviews include evaluation of plant-specific and industry operating experience. The plant-specific evaluations include reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience includes a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.3.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.3 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the auxiliary systems components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.3.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further

evaluations were in accordance with the acceptance criteria in SRP-LR. The project team's audit evaluation is documented in Section 3.3.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.3.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the auxiliary systems.

The project team noted that the applicant has included all the 35 miscellaneous systems in scope for 10 CFR 54.4(a)(2) in Section 3.3, "Auxiliary Systems," Tables 3.3.2-14-1 through 3.3.2-14-35. However, four of these systems are ESF systems and should have been included in Section 3.2, and 10 of these systems are in steam and power conversion (S&PC) systems and should have been included in Section 3.4. The Table 2 line items that apply to these 14 systems do reference Table 3.2.1 and Table 3.4.1 line items in the Table 1 line item reference column. This audit report and the SER preparation are based on systems as defined in SRP-LR, Section 3.2, "ESF Systems," Section 3.3, "Auxiliary Systems," and Section 3.4, "S&PC Systems." The project team asked the applicant to justify why the NSR systems associated with ESF and S&PC systems were included in the auxiliary systems section.

In its response, the applicant stated that the AMR of the systems that have functions that met 10 CFR 54.4(a)(2) criterion for physical interaction was done separately from the review of systems with intended functions that met 10 CFR 54.4(a)(1) or (a)(3). The results of the review were presented separately so that they could be reviewed separately on the basis of physical proximity rather than system function. This allows a reviewer to see which component types in a system were included in 10 CFR 54.4(a)(2) for physical interaction. Since most of these systems are auxiliary systems, they were added as part of the auxiliary system section.

The project team reviewed the response and discussed it further with the applicant. The project team agreed that it made sense to have these systems identified in their own specific table; however, only 60 percent of these systems were auxiliary systems and since each system was identified in its own table, these tables should have been numbered and included in ESF, auxiliary, or S&PC system sections as appropriate for ease of preparation of the audit report and SER and to make these documents easier to understand. The audit report and the SER will split these tables and include them in their respective sections as follows:

Section 3.2 – Tables 3.3.2-14-7, 3.3.2-14-16, 3.3.2-14-25, and 3.3.2-14-28

Section 3.3 – Tables 3.3.2-14-2, 3.3.2-14-6, 3.3.2-14-8, 3.3.2-14-12 to -15, 3.3.2-14-19 to -24, 3.3.2-14-26, 3.3.2-14-27, and 3.3.2-14-29 to -34

Section 3.4 – Tables 3.3.2-14-1, 3.3.2-14-3, 3.3.2-14-4, 3.3.2-14-5, 3.3.2-14-9, 3.3.2-14-10, 3.3.2-14-11, 3.3.2-14-17, 3.3.2-14-18, and 3.3.2-14-35

Table 3.3-1 below provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in LRA Section 3.3 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.3-1 Project Team Evaluation for Auxiliary Systems Components in the GALL Report

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-1	Steel cranes – structural girders exposed to air-indoor uncontrolled (external)	Cumulative fatigue damage	TLAA to be evaluated for structural girders of cranes. See SRP-LR Section 4.7 for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	Not used	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.1.
3.3.1-2	Steel and SS piping, piping components, piping elements, and heat exchanger components exposed to air-indoor uncontrolled, treated borated water or treated water	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.1.
3.3.1-3	SS heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.3.2.2.2.
3.3.1-4	SS piping, piping components, and piping elements exposed to sodium pentaborate solution > 140°F	Cracking due to SCC	Water Chemistry and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.3.2.2.3, Item 1.
3.3.1-5	SS and SS clad heat exchanger components exposed to treated water > 140°F	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.3, Item 2.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-6	SS diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.3, item 3.
3.3.1-10	High-strength steel closure bolting exposed to air with steam or water leakage.	Cracking due to SCC, cyclic loading	Bolting Integrity The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	None	Not applicable to PNPS. PWR only.
3.3.1-11	Elastomer seals and components exposed to air-indoor uncontrolled (internal/external)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.5, Item 1.
3.3.1-12	Elastomer lining exposed to treated water or treated borated water	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	None	Not applicable to PNPS. See audit report Section 3.3.2.2.5, Item 2.
3.3.1-13	Boral, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	A plant-specific AMP is to be evaluated.	Water Chemistry Control – BWR Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.6.
3.3.1-14	Steel piping, piping component, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.7, Item 1.
3.3.1-15	Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.3.2.2.7, Item 1.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-16	Steel reactor coolant pump oil collection system tank exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	None	Not applicable to PNPS. See audit report Section 3.3.2.2.7, Item 1.
3.3.1-17	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.7, item 2. Also, see Section 3.3.2.1.2 for bolting integrity program.
3.3.1-18	SS and steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust	Loss of material/general (steel only), pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.7, Item 3.
3.3.1-19	Steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to soil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.8. Also, see Section 3.3.2.1.1 for Bolting Integrity Program.
3.3.1-20	Steel piping, piping components, piping elements, and tanks exposed to fuel oil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling	Fuel Oil Chemistry and One-Time Inspection	Diesel Fuel Monitoring Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.9, Item 1.
3.3.1-21	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.9, Item 2.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-22	Steel with elastomer lining or SS clad piping, piping components, and piping elements exposed to treated water and treated borated water	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Water Chemistry and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.3.2.2.10, Item 1.
3.3.1-23	SS and steel with SS clad heat exchanger components exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 2.
3.3.1-24	SS and aluminum piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 2.
3.3.1-25	Copper alloy HVAC piping, piping components, piping elements exposed to condensation (external)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	System Walkdown Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 3.
3.3.1-26	Copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 4.
3.3.1-27	SS HVAC ducting and aluminum HVAC piping, piping components, and piping elements exposed to condensation	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	System Walkdown Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 5. Also, see Section 3.3.2.1.1 for Bolting Integrity Program.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-28	Copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Periodic Surveillance and Preventive Maintenance Program One-Time Inspection Program Instrument Air Quality Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 6.
3.3.1-29	SS piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	None	Not applicable to PNPS. See audit report Section 3.3.2.2.10, Item 7.
3.3.1-30	SS piping, piping components, and piping elements exposed to sodium pentaborate solution	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.10, Item 8.
3.3.1-31	Copper alloy piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.11.
3.3.1-32	SS, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Fuel Oil Chemistry and One-Time Inspection	Diesel Fuel Monitoring Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.12, Item 1.
3.3.1-33	SS piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.3.2.2.12, Item 2.
3.3.1-34	Elastomer seals and components exposed to air-indoor uncontrolled (internal or external)	Loss of material due to wear	A plant-specific AMP is to be evaluated.	None	Not applicable to PNPS. See audit report Section 3.3.2.2.13.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-36	Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated water	Reduction of neutron-absorbing capacity due to Boraflex degradation	Boraflex Monitoring	Boraflex Monitoring Program	Consistent with the GALL Report.
3.3.1-37	SS piping, piping components, and piping elements exposed to treated water > 140°F	Cracking due to SCC, IGSCC	BWR Reactor Water Cleanup System	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.2 for further discussion.
3.3.1-38	SS piping, piping components, and piping elements exposed to treated water > 140°F	Cracking due to SCC	BWR Stress Corrosion Cracking and Water Chemistry	Water Chemistry Control – BWR Program One-Time Inspection Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.16 for further discussion.
3.3.1-39	SS BWR spent fuel storage racks exposed to treated water > 140°F	Cracking due to SCC	Water Chemistry	None	Not applicable to PNPS. See audit report Section 3.3.2.3.
3.3.1-40	Steel tanks in diesel fuel oil system exposed to air-outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	System Walkdown Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.3 for further discussion.
3.3.1-41	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, SCC	Bolting Integrity	None	Not applicable to PNPS. See audit report Section 3.3.2.3.
3.3.1-42	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	Bolting Integrity	Not used	See audit report Section 3.3.2.1.1 for further discussion.
3.3.1-43	Steel bolting and closure bolting exposed to air-indoor uncontrolled (external) or air-outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	System Walkdown Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.1 for further discussion.
3.3.1-44	Steel CAS closure bolting exposed to condensation	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	Not used	See audit report Section 3.3.2.1.1 for further discussion.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-45	Steel closure bolting exposed to air-indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	None	See audit report Section 3.3.2.1.1 for further discussion.
3.3.1-46	SS and SS clad piping, piping components, piping elements, and heat exchanger components exposed to CCW > 140°F	Cracking due to SCC	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-47	Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to CCW	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-48	Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to CCW	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-49	SS; steel with SS clad heat exchanger components exposed to CCW	Loss of material due to MIC	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-50	SS piping, piping components, and piping elements exposed to CCW	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-51	Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to CCW	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.
3.3.1-52	Steel, SS, and copper alloy heat exchanger tubes exposed to CCW	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	Water Chemistry Control – Closed Cooling Water Program	Consistent with the GALL Report.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-53	Steel CAS piping, piping components, and piping elements exposed to condensation (internal)	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	Instrument Air Quality Program One-Time Inspection Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.8 for further discussion.
3.3.1-54	SS CAS piping, piping components, and piping elements exposed to internal condensation	Loss of material due to pitting and crevice corrosion	Compressed Air Monitoring	Instrument Air Quality Program One-Time Inspection Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.8 for further discussion.
3.3.1-55	Steel ducting closure bolting exposed to air-indoor uncontrolled (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.1 for further discussion.
3.3.1-56	Steel HVAC ducting and components external surfaces exposed to air-indoor uncontrolled (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program	Consistent with the GALL Report.
3.3.1-57	Steel piping and components external surfaces exposed to air-indoor uncontrolled (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program	Consistent with the GALL Report.
3.3.1-58	Steel external surfaces exposed to air-indoor uncontrolled (external), air-outdoor (external), and condensation (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program	Consistent with the GALL Report. See audit report Sections 3.3.2.1.1 and 3.3.2.1.4 for further discussion.
3.3.1-59	Steel heat exchanger components exposed to air-indoor uncontrolled (external) or air-outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	System Walkdown Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.9 for further discussion.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-60	Steel piping, piping components, and piping elements exposed to air-outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	System Walkdown Program	Consistent with the GALL Report.
3.3.1-61	Elastomer fire barrier penetration seals exposed to air-outdoor or air-indoor uncontrolled	Increased hardness, shrinkage and loss of strength due to weathering	Fire Protection	Not used	See audit report Section 3.3.2.1.5 for further discussion.
3.3.1-62	Aluminum piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion	Fire Protection	None	Not applicable to PNPS. See audit report Section 3.3.2.3.
3.3.1-63	Steel fire-rated doors exposed to air-outdoor or air-indoor uncontrolled	Loss of material due to wear	Fire Protection	Not used	Evaluated in Section 3.5.
3.3.1-64	Steel piping, piping components, and piping elements exposed to fuel oil	Loss of material due to general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	Not used	See audit report Section 3.3.2.1.6 for further discussion.
3.3.1-65	Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-indoor uncontrolled	Concrete cracking and spalling due to aggressive chemical attack and reaction with aggregates	Fire Protection and Structures Monitoring Program	Not used	Evaluated in Section 3.5.
3.3.1-66	Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-outdoor	Concrete cracking and spalling due to freeze thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	Not used	Evaluated in Section 3.5.
3.3.1-67	Reinforced concrete structural fire barriers – walls, ceilings, and floors exposed to air-outdoor or air-indoor uncontrolled	Loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring Program	Not used	Evaluated in Section 3.5.
3.3.1-68	Steel piping, piping components, and piping elements exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling	Fire Water System	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.10 for further discussion.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-69	SS piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion and fouling	Fire Water System	Not used	Not consistent with the GALL Report. Fire Water System at PNPS is considered to be treated water rather than raw water. See audit report Section 3.3.2.3.9 for further discussion.
3.3.1-70	Copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling	Fire Water System	Not used	Not consistent with the GALL Report. Fire Water System at PNPS is considered to be treated water rather than raw water. See audit report Section 3.3.2.3.9 for further discussion.
3.3.1-71	Steel piping, piping components, and piping elements exposed to moist air or condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report.
3.3.1-72	Steel HVAC ducting and components internal surfaces exposed to condensation (internal)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically influenced corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	System Walkdown Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.7 for further discussion.
3.3.1-73	Steel crane structural girders in load handling system exposed to air-indoor uncontrolled (external)	Loss of material due to general corrosion	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Not used	Evaluated in Section 3.5.
3.3.1-74	Steel cranes – rails exposed to air-indoor uncontrolled (external)	Loss of material due to wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Not used	Evaluated in Section 3.5.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-75	Elastomer seals and components exposed to raw water	Hardening and loss of strength due to elastomer degradation; loss of material due to erosion	Open-Cycle Cooling Water System	Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.11 for further discussion.
3.3.1-76	Steel piping, piping components, and piping elements (without lining/ coating or with degraded lining/coating) exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation	Open-Cycle Cooling Water System	Service Water Integrity Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.12 for further discussion.
3.3.1-77	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.3.2.3.
3.3.1-78	SS, nickel alloy, and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion	Open-Cycle Cooling Water System	Service Water Integrity Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.13 for further discussion. Also, see Section 3.3.2.1.1 for Bolting Integrity Program.
3.3.1-79	SS piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion and fouling	Open-Cycle Cooling Water System	Service Water Integrity Program Periodic Surveillance and Preventive Maintenance Program One-Time Inspection Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.14 for further discussion.
3.3.1-80	SS and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.3.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-81	Copper alloy piping, piping components, and piping elements, exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	Service Water Integrity Program Periodic Surveillance and Preventive Maintenance Program	Consistent with the GALL Report. See audit report Section 3.3.2.1.15 for further discussion.
3.3.1-82	Copper alloy heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, galvanic, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	Service Water Integrity Program	Consistent with the GALL Report.
3.3.1-83	SS and copper alloy heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	Service Water Integrity Program	Consistent with the GALL Report.
3.3.1-84	Copper alloy > 15% zinc piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or CCW	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching Program	Consistent with the GALL Report.
3.3.1-85	Gray cast iron piping, piping components, and piping elements exposed to soil, raw water, treated water, or CCW	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching Program	Consistent with the GALL Report.
3.3.1-86	Structural steel (new fuel storage rack assembly) exposed to air-indoor uncontrolled (external)	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring Program	Not used	Evaluated in Section 3.5.
3.3.1-92	Galvanized steel piping, piping components, and piping elements exposed to air-indoor uncontrolled	None	None	None	Not applicable to PNPS. See audit report Section 3.3.2.3,.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.3.1-93	Glass piping elements exposed to air, air-indoor uncontrolled (external), fuel oil, lubricating oil, raw water, treated water, and treated borated water	None	None	No AEM or AMP	Consistent with the GALL Report.
3.3.1-94	SS and nickel alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external)	None	None	No AEM or AMP	Consistent with the GALL Report.
3.3.1-95	Steel and aluminum piping, piping components, and piping elements exposed to air-indoor controlled (external)	None	None	No AEM or AMP	Consistent with the GALL Report.
3.3.1-96	Steel and SS piping, piping components, and piping elements in concrete	None	None	No AEM or AMP	Consistent with the GALL Report.
3.3.1-97	Steel, SS, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	No AEM or AMP	Consistent with the GALL Report.
3.3.1-98	Steel, SS, and copper alloy piping, piping components, and piping elements exposed to dried air	None	None	No AEM or AMP	Not applicable to PNPS. See audit report Section 3.3.2.3.

3.3.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Section 3.3.2.1, the applicant identified the materials, environments, AERMs, and AMPs for the following auxiliary systems:

- SLC system
- SSW system
- RBCCW system
- EDG system
- SBO diesel system
- security diesel system
- fuel oil system
- IA system
- fire protection – water system
- fire protection – halon system
- HVAC systems
- PCAC system.
- FPC and fuel handling and storage systems
- miscellaneous systems in scope for 10 CFR 54.4(a)(2)

The AMPs identified by the applicant for the above auxiliary systems are as follows:

- Boraflex Monitoring (B.1.1)
- Buried Piping and Tanks Inspection (B.1.2)
- Diesel Fuel Monitoring (B.1.10)
- Fire Protection (B.1.13.1)
- Fire Water System (B.1.13.2)
- Flow-Accelerated Corrosion (B.1.14)
- Heat Exchanger Monitoring (B.1.15)
- Instrument Air Quality (B.1.17)
- Oil Analysis (B.1.22)
- One-Time Inspection (B.1.23)
- Periodic Surveillance and Preventive Maintenance (B.1.24)
- Selective Leaching (B.1.27)
- Service Water Integrity (B.1.28)
- System Walkdowns (B.1.30)
- Water Chemistry Control – Auxiliary Systems (B.1.32.1)
- Water Chemistry Control – BWR (B.1.32.2)
- Water Chemistry Control – Closed Cooling Water (B.1.32.3)

Project Team Evaluation

The project team reviewed its assigned PNPS LRA AMR line items to determine that the applicant (1) provides a brief description of the system, components, materials, and environment; (2) states that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the components that are subject to an AMR.

3.3.2.1.1 Loss of Material, Loss of Preload, and Cracking of Carbon Steel and SS Bolting in Various External Environments

The applicant does not include a Bolting Integrity Program in the PNPS LRA. Instead, the applicant credits alternate programs such as the System Walkdown, Service Water Integrity, and Buried Piping and Tanks Inspection Programs. GALL AMP XI.M18, "Bolting Integrity," provides several recommendations in the 10-element evaluation, such as selection of bolting materials, use of lubricants and sealants, and additional recommendations of NUREG-1339. The alternate programs may be acceptable for inspection; however, they do not address the preventive actions. For Section 3.3, this applies to Table 3.3.1, Items 19, 27, 42, 43, 44, 55, 58, 78, and 94. The project team asked the applicant to clarify how PNPS meets these recommendations or provide justification why a Bolting Integrity Program should not be provided.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The Bolting Integrity Program will be implemented before the PEO in accordance with Commitment No. 32. The LRA will be supplemented to include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant included B.1.33, "Bolting Integrity Program." This program is consistent with GALL AMP XI.M18, "Bolting Integrity." This program covers bolting within the scope of license renewal, including (1) safety-related bolting; (2) bolting for NSSS component supports; (3) bolting for other pressure-retaining components, including NSR bolting; and (4) structural bolting (actual measured yield strength greater than 150 ksi). The aging management of reactor head closure studs is addressed by GALL AMP XI.M3 and is not included in this program. Therefore, the aging effects of component type of bolting in all mechanical systems, except reactor head closure studs, are managed by the Bolting Integrity Program instead of any other programs identified in the LRA Table 3.x.2-2s. The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report. The project team reviewed the program and found it to be acceptable.

3.3.2.1.2 Cracking Due to SCC, IGSCC

In the discussion section of Table 3.3.1, Item 3.3.1-37, of the PNPS LRA, the applicant stated that cracking of SS components of the RWCU system exposed to treated water greater than 140°F is managed by the Water Chemistry Control – BWR and One-Time Inspection

Programs. During the audit and review, the project team noted that for 10 AMR results lines that point to Table 3.1.1, Item 3.1.1-37, the applicant included a reference to Note E. The only components to which this GALL Report line item applies are included in scope only under 10 CFR 54.4(a)(2) criterion.

The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M25, "Reactor Water Cleanup System," the applicant proposed using the Water Chemistry Control – BWR and One-Time Inspection Programs. The applicant stated in the LRA that Supplement 1 to NRC GL 88-01 states that IGSCC inspection of RWCU piping outside of the containment isolation valves is recommended only until actions associated with NRC GL 89-10 on motor-operated valves are completed. Since PNPS has satisfactorily completed all actions requested in NRC GL 89-10, the Water Chemistry Control – BWR Program is used in lieu of the BWR Reactor Water Cleanup System Program to manage this potential aging effect. However, the GALL AMP also states that in addition to meeting this supplement criterion, piping is made of material that is resistant to IGSCC. The project team asked the applicant to confirm the grade of SS material used and justify that it is resistant to IGSCC.

In its response, the applicant stated that the original type 304 SS piping and fittings between drywell penetration X-14 and the 6-by-4 inch reducer downstream of MO-1201-5 were replaced with type 316L SS. The project team reviewed the response and determined that type 316L is low-carbon grade (less than .035% carbon) SS that is resistant to IGSCC. Furthermore, Supplement 1 to NRC GL 88-01 does indicate that low-grade carbon SS, such as 304L or 316L, is resistant to IGSCC. On this basis, the project team found the applicant's use of the Water Chemistry Control – BWR and One-Time Inspection Programs for aging management of these RWCU components to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the Aging Effect, Environment, Aging Mechanism (AEM) combination, as recommended by the GALL Report.

3.3.2.1.3 <u>Loss of Material Due to General, Pitting, and Crevice Corrosion</u>

In the discussion section of Table 3.3.1, Item 3.3.1-40, of the PNPS LRA, the applicant stated that loss of material of steel tanks in diesel fuel oil system exposed to air-outdoor external environment is managed by the System Walkdown Program. During the audit and review, the project team noted that for the AMR results line in Table 3.3.2-7, "Fuel Oil System," that points to Table 3.1.1, Item 3.1.1-40, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M29, "Aboveground Steel Tanks Program," the applicant proposed using the System Walkdown Program. The project team reviewed the System Walkdown Program and determined that while this program may be an acceptable alternate for the Aboveground Steel Tanks Program

for inspection, the Aboveground Steel Tanks Program has some preventive actions associated with it that are not addressed in the System Walkdown Program. Furthermore, the GALL AMP specifies wall thickness measurement of tank bottom if it is supported on earthen or concrete foundations.

The project team asked the applicant to clarify if the steel tanks are coated with protective paint or coating in accordance with industry practice, and whether sealant or caulking is applied at the interface edge between the tank and the foundation as per GALL AMP XI.M29. The project team asked the applicant to confirm how the tank is supported.

In its response, the applicant stated that no carbon steel tanks in the fuel oil system exposed to air-outdoor are included in the scope of license renewal. The LRA will be amended to remove the line item in Table 3.3.2-7 for carbon steel tanks exposed to air-outdoor. The discussion for Item 3.3.1-40 will be amended to state that the line item is not used.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.3.1, Item 3.3.1-40, is revised to remove reference to the System Walkdown Program as follows:

> Not applicable. There are no steel tanks in the diesel fuel oil system exposed to air-outdoor (external).
>
> LRA Table 3.3.2-7 line item with component type of tank exposed to air- outdoor (ext) is removed.

On the basis that the carbon steel tank is not in scope of license renewal and Item 3.3.1-40 is not used, the project team found the response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.4 <u>Loss of Material Due to General Corrosion</u>

In the discussion section of Table 3.3.1, Item 3.3.1-58, of the PNPS LRA, the applicant stated that loss of material of steel external surfaces exposed to air-indoor uncontrolled, air-outdoor, and condensation environments is managed by the System Walkdown Program. During the audit and review, the project team noted that for the AMR results lines that point to Table 3.1.1, Item 3.1.1-58, the applicant has credited the Fire Protection Program to manage loss of material for the tank in the halon system. The applicant was asked to justify why the Fire Protection Program was not identified in the discussion column of Table 3.3.1, Item 3.3.1-58.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the LRA Table 3.3.1, Item 3.3.1-58, discussion is revised to read as follows:

> The System Walkdown Program manages loss of material for external surfaces of steel components. For some fire protection system components, the Fire Protection Program will manage loss of material.
>
> In LRA Table 3.3.2-10, the note for the line item with component type of tank exposed to air – indoor (ext) is changed from "B" to "E."

On the basis that the applicant is revising the discussion for Item 3.3.1-58 to include the Fire Protection Program, the project team found the response acceptable. However, the applicant is crediting the Fire Protection Program as an alternate to GALL AMP XI.M36, "External Surfaces Monitoring." The project team reviewed the Fire Protection Program and determined that this program is an acceptable alternate to GALL AMP XI.M36 because it provides for periodic inspection of the halon fire suppression system, which is similar to the visual inspection of external surfaces as recommended by GALL AMP XI.M36.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.5 Increased Hardness, Shrinkage, and Loss of Strength Due to Weathering

In the discussion section of Table 3.3.1, Item 3.3.1-61, of the PNPS LRA, the applicant stated that this line item was not used in the auxiliary systems tables. Fire barrier seals are evaluated as structural components in Section 3.5. Cracking and the change in material properties of elastomer seals are managed by the Fire Protection Program. In Section 3.5, Table 3.5.2-6, "Bulk Commodities," on pages 3.5-82 and 3.5-83, where Item 3.3.1-61 is referenced, PNPS credits the Fire Protection Program and the Structures Monitoring Program. However, Item 3.3.1-61 does not credit the Structures Monitoring Program.

The project team asked the applicant to clarify if both programs are credited for managing aging effects for penetration seals as stated in Table 3.5.2-6.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Table 3.5.2-6, pages 3.5-82 and 3.5-83, as follows:

> Delete line items:
>
> - Penetration sealant (fire rated, flood, radiation) // EN, FB, FLB, PB, SNS // Elastomer //Protected from weather // Cracking Change in material properties // Fire protection/Structures Monitoring // III.A6-12 (TP-7) // 3.5.1-44 // CSeismic joint filler // FB, SNS // Elastomer // Protected from weather // Cracking Change In material properties // Structures Monitoring, Fire Protection // VII.G-1 (A-19) //3.3.1-61// C

Add line items:

- Penetration sealant (fire rated) // EN, FB, PB, SNS // Elastomer // Protected from weather // Cracking Change in material properties // Fire Protection // VII.G-1(A-19) //3.3.1-61 // B

- Penetration sealant (flood, radiation) // EN, FLB, PB, SNS // Elastomer // Protected from weather// Cracking Change in material properties // Structures Monitoring // III.A6-12 (TP-7) // 3.5.1-44 // C

- Seismic isolation joint // FB, SNS // Elastomer // Protected from weather // Cracking Change in material properties // Fire protection // VII.G-1 (A-19) // 3.3.1-61 // D

- Seismic isolation joint // SNS // Elastomer // Protected from weather // Cracking Change in material properties // Structures monitoring // III.A6-12 (TP-7) // 3.5.1-44 // C

On the basis that the applicant has clarified the use of the Structures Monitoring Program and Fire Protection Program and referenced different Table 1 line items, the project team found the response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.6 Loss of Material Due to General, Pitting, and Crevice Corrosion

In the discussion section of Table 3.3.1, Item 3.3.1-64, of the PNPS LRA, the applicant stated that this line item was not used. Loss of material of steel components exposed to fuel oil was addressed by other items, including Items 3.3.1-20 and 3.3.1-32. However, the intent of this line is to address the diesel-driven fire pump, which is why the GALL Report recommended the Fire Protection Program. Neither Item 20 nor Item 32 credits the Fire Protection Program, only the Diesel Fuel Monitoring Program is credited. The project team asked the applicant to clarify if PNPS has a diesel-driven fire pump, and if so, where in LRA Section 3.3 it is addressed and if the Fire Protection Program is credited.

In its response, the applicant stated that PNPS has a diesel-driven fire pump with components addressed in Table 3.3.2-7. The fuel oil supply to the diesel-driven fire pump is included in Table 3.3.2-7. The line item for carbon steel piping with a fuel oil internal environment in Table 3.3.2-7 for the fuel supply line does not credit the Fire Protection Program. Although the programs credited in Table 3.3.2-7 for the fuel supply line provide an acceptable alternative approach to manage the effects of aging, in order to achieve consistency with NUREG-1801, the LRA will be revised to credit the Fire Protection Program. LRA Table 3.3.2-7 will be revised to add an additional line item to credit the Fire Protection Program to manage the fuel supply

line in addition to the Diesel Fuel Monitoring Program. This will also require a change to Item 3.3.1-64 since the new line item will specify 3.3.1-64 as the Table 1 item.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised Table 3.3.2-7 to add a line item crediting the Fire Protection Program as follows:

> Piping // Pressure boundary // Carbon steel // Fuel oil (int) // Loss of material // Fire Protection and Diesel Fuel Monitoring// VII.G-21 (A-28) // 3.3.1-64 // B

LRA Table 3.3.1, Item 3.3.1-64, discussion is revised as follows:

> Consistent with NUREG-1801. The Fire Protection Program and Diesel Fuel Monitoring Program manage loss of material for internal surfaces of steel piping (fire pump diesel fuel supply line) components exposed to fuel oil.

On the basis that the applicant credits the Fire Protection Program to manage aging effects of the fire pump diesel fuel supply line, the project team found the applicant's response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.7 <u>Loss of Material Due to General, Pitting, Crevice, and (for Drip Pans and Drain Lines) Microbiologically Influenced Corrosion</u>

In the discussion section of Table 3.3.1, Item 3.3.1-72, of the PNPS LRA, the applicant stated that loss of material of steel component internal surfaces exposed to condensation environment is managed by the System Walkdown Program. During the audit and review, the project team noted that for the AMR results line in Table 3.3.2-3, RBCCW system, that points to Table 3.1.1, Item 3.1.1-72, the applicant included a reference to Note E. The only components to which this GALL Report line item applies is heat exchanger housing.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the applicant proposed using the System Walkdown Program. The applicant stated that the System Walkdown Program manages loss of material for external carbon steel components by visual inspection of external surfaces. For systems where internal carbon steel surfaces are exposed to the same environment as external surfaces, external surfaces condition will be representative of internal surfaces. Thus, loss of material on internal carbon steel surfaces is also managed by the System Walkdown Program.

The project team asked the applicant to clarify how PNPS concluded that the internal surface of the heat exchanger is the same as the external surface in the RBCCW system.

In its response, the applicant stated that the internal components of the heat exchanger housing have the potential for being exposed to a combination of low-temperature CCW and high-dewpoint indoor drywell air, which could result (though it is not expected to) in condensation on the cooling coil that would be collected in the bottom of the housing. Condensation was also identified on the uninsulated external surfaces of the heat exchanger housing due to the potential of the housing surface temperature downstream of the cooling coil being less than or equal to the dewpoint of the surrounding air in the drywell. These environments were conservatively identified even though the expected environment would be indoor air with no condensation since the cooling water temperature is normally maintained at approximately 80°F. The System Walkdown Program was credited because the expected environment for both the internal and external surfaces would be the same in either case.

On the basis that the internal environment is the same as the external environment, and since the System Walkdown Program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring," which states that the program may also be credited with managing loss of material from internal surfaces for situations in which material and environmental conditions are the same for internal and external surfaces such that external surface condition is representative of internal surface condition, the project team found the applicant's use of the System Walkdown Program for aging management of this heat exchanger housing to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.8 Loss of Material Due to General and Pitting Corrosion; and Loss of Material Due to General, Pitting, and Crevice Corrosion

In the discussion section of Table 3.3.1, Items 3.3.1-53 and 3.3.1-54, of the PNPS LRA, the applicant stated that loss of material of steel and SS component internal surfaces exposed to a condensation environment in an IA system is managed by the Instrument Air Quality and One-Time Inspection Programs. During the audit and review, the project team noted that for the AMR results line in Table 3.3.2-8, "instrument air system," that points to Table 3.1.1, Items 3.1.1-53 and 3.3.1-54, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M24, "Compressed Air Monitoring," the applicant proposed using the Instrument Air Quality and One-Time Inspection Programs. GALL AMP XI.M24 recommends periodic monitoring of air quality for the presence of contaminants and visual inspection. The project team reviewed the Instrument Air Quality Program, which is a plant-specific program, and determined that the applicant performs periodic sampling at various locations in the system. Furthermore, the applicant has proposed an OTI at susceptible locations to confirm that aging degradation is not occurring. On this basis, the project team found the applicant's use of the Instrument Air Quality and One-Time Inspection Programs to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.9 Loss of Material Due to General, Pitting, and Crevice Corrosion

In the discussion section of Table 3.3.1, Item 3.3.1-59, of the PNPS LRA, the applicant stated that loss of material of steel heat exchanger tubes external surfaces exposed to an air-indoor uncontrolled environment in the security diesel system is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR results line in Table 3.3.2-6, "security diesel system," that points to Table 3.1.1, Item 3.1.1-59, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M36, "External Surface Monitoring," the applicant proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL AMP recommends periodic visual inspections of external surfaces during system walkdowns for evidence of material loss. Since the surface of heat exchanger tubes are not easily accessible during system walkdowns, the applicant is crediting the Periodic Surveillance and Preventive Maintenance Program, which uses visual or other NDE techniques to inspect a representative sample of security diesel oil cooler, aftercooler, and radiator tubes to manage loss of material. On the basis that periodic visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.10 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

In the discussion section of Table 3.3.1, Item 3.3.1-68, of the PNPS LRA, the applicant stated that loss of material of steel piping, piping components, and piping elements exposed to a raw water environment is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.1.1, Item 3.1.1-68, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M27, "Fire Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL Report line item referenced is in the fire protection water system, and, therefore, the GALL Report recommends AMP XI.M27. At PNPS, the fire

protection water system does not use raw water, but instead uses treated water. The AMR results lines that point to Table 3.1.1, Item 3.3.1-68, are listed only in those systems that are in scope for 10 CFR 54.4(a)(2) criterion and are not in the fire protection water system. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of NSR components affecting safety-related systems, which include the AMR results lines that point to Item 3.3.1-68. On the basis that periodic visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.11 Hardening and Loss of Strength Due to Elastomer Degradation; Loss of Material Due to Erosion

In the discussion section of Table 3.3.1, Item 3.3.1-75, of the PNPS LRA, the applicant stated that degradation of elastomer components exposed to a raw or untreated water environment is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.1.1, Item 3.1.1-75, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL Report line item referenced is in the open-cycle cooling water system, and therefore, the GALL Report recommends AMP XI.M20. However, the AMR results lines that point to Table 3.1.1, Item 3.3.1-75, are listed only in the radwaste system that is in scope for 10 CFR 54.4(a)(2) criterion and are not in the open-cycle cooling water system. The Periodic Surveillance and Preventive Maintenance Program visually inspects and manually flexes a representative sample of the flex/expansion joints in the radwaste system to manage cracking and change in material properties. On the basis that periodic visual inspections and manual flexing are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.12 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion, Fouling, and Lining/Coating Degradation

In the discussion section of Table 3.3.1, Item 3.3.1-76, of the PNPS LRA, the applicant stated that loss of material of steel components exposed to a raw water environment in the screen wash system is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.1.1, Item 3.1.1-76, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL Report line item referenced is in the open-cycle cooling water system, and therefore, the GALL Report recommends AMP XI.M20. However, the AMR results lines that point to Table 3.1.1, Item 3.3.1-76, are listed only in the screen wash system that is in scope for 10 CFR 54.4(a)(2) criterion and are not in the open-cycle cooling water system. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of NSR components affecting safety related systems, which include the AMR results lines that point to Item 3.3.1-76. On the basis that periodic visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.13 Loss of Material Due to Pitting and Crevice Corrosion

In the discussion section of Table 3.3.1, Item 3.3.1-78, of the PNPS LRA, the applicant stated that loss of material of nickel alloy components exposed to a raw water environment in the screen wash system is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.1.1, Item 3.1.1-78, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL Report line item referenced is in the open-cycle cooling water system, and therefore, the GALL Report recommends AMP XI.M20. However, the AMR results lines that point to Table 3.1.1, Item 3.3.1-78, are listed only in the screen wash system that is in scope for 10 CFR 54.4(a)(2) criterion and are not in the open-cycle cooling water system. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of NSR components affecting safety-related systems, which include the AMR results lines that point to Item 3.3.1-78. On the basis

that periodic visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.14 Loss of Material Due to Pitting and Crevice Corrosion and Fouling

In the discussion section of Table 3.3.1, Item 3.3.1-79, of the PNPS LRA, the applicant stated that loss of material of SS components exposed to a raw or untreated water environment in the screen wash, sanitary soiled waste, and vent; plumbing and drains; and radwaste systems is managed by the Periodic Surveillance and Preventive Maintenance and One-Time Inspection Programs. During the audit and review, the project team noted that for the AMR results line that points to Table 3.1.1, Item 3.1.1-79, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program for the screen wash system and the One-Time Inspection Program for the other systems. The GALL Report line item referenced is in the open-cycle cooling water system, and therefore, the GALL Report recommends AMP XI.M20. However, the AMR results lines that point to Table 3.1.1, Item 3.3.1-79, of the PNPS LRA are listed only in systems that are in scope for 10 CFR 54.4(a)(2) criterion and are not in the open-cycle cooling water system. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of NSR components affecting safety-related systems, which include the AMR results lines that point to Item 3.3.1-79. The One-Time Inspection Program includes an OTI activity that will confirm that loss of material is not occurring or is so insignificant that an AMP is not warranted. On the basis that periodic or one-time visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program and One-Time Inspection Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.15 Loss of Material Due to Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

In the discussion section of Table 3.3.1, Item 3.3.1-81, of the PNPS LRA, the applicant stated that loss of material of copper alloy components exposed to a raw or untreated water environment in the NSR systems is managed by the Periodic Surveillance and Preventive Maintenance Program. During the audit and review, the project team noted that for the AMR

results line that points to Table 3.1.1, Item 3.1.1-81, of the PNPS LRA, the applicant included a reference to Note E.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant has proposed using the Periodic Surveillance and Preventive Maintenance Program. The GALL Report line item referenced is in the open-cycle cooling water system, and therefore, the GALL Report recommends AMP XI.M20. However, the AMR results lines that point to Table 3.1.1, Item 3.3.1-81, of the PNPS LRA are listed only in NSR systems that are in scope for 10 CFR 54.4(a)(2) criterion and are not in the open-cycle cooling water system. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of NSR components affecting safety-related systems, which include the AMR results lines that point to Item 3.3.1-81. On the basis that periodic visual inspections are performed, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.16 Cracking Due to SCC

In the discussion section of Table 3.3.1, Item 3.3.1-38, of the PNPS LRA, the applicant stated that cracking of SS components of the RWCU system exposed to treated water greater than 140°F is managed by the Water Chemistry Control – BWR and One-Time Inspection Programs. During the audit and review, the project team noted that for the AMR results lines that point to Table 3.1.1, Item 3.1.1-38, of the PNPS LRA, the applicant included a reference to Note E. The only components to which this GALL Report line item applies are included in scope only under 10 CFR 54.4(a)(2) criterion.

The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry," the applicant proposed using the Water Chemistry Control – BWR and One-Time Inspection Programs. In the discussion column, the applicant stated that none of these components are within the scope of the BWR Stress Corrosion Cracking Program. The Water Chemistry Control – BWR Program provides for periodic sampling to maintain contaminants within prescribed levels, and the One-Time Inspection Program verifies the effectiveness of the Water Chemistry Program. On this basis, the project team found the applicant's use of the Water Chemistry Control – BWR and One-Time Inspection Programs for aging management of these NSR components to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report,

the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.17 Loss of Material Due to General Corrosion

During the audit and review, the project team noted that some AMR results lines pointed to Section 3.2, "ESF Systems," Table 3.2.1, Item 3.2.1-32, of the PNPS LRA. For these line items, the applicant included a reference to Note E. This line item applies to steel piping and ducting components and internal surfaces exposed to an air-indoor uncontrolled environment. This line item was referenced on 26 component types.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the applicant has proposed using the System Walkdown Program for 15 component types, the Fire Protection Program for 3 component types, and the Periodic Surveillance and Preventive Maintenance Program for 8 component types.

GALL AMP XI.M38 states that this program consists of inspections of the internal surfaces of steel components that are not covered by other AMPs and consists of periodic visual inspections. The applicant stated that the System Walkdown Program manages loss of material for external carbon steel components by visual inspection of external surfaces. For systems where internal carbon steel surfaces are exposed to the same environment as external surfaces, external surfaces condition will be representative of internal surfaces. Thus, loss of material on internal carbon steel surfaces is also managed by the System Walkdown Program. Since the applicant is using an existing AMP that performs periodic visual inspections, the project team found the System Walkdown Program acceptable.

For the three component types where the applicant credited the Fire Protection Program, the project team found that this program was not credited in Table 3.2.1, Item 3.2.1-32 discussion column. The project team asked the applicant to clarify the discrepancy between the AMR results line items in Table 3.3.2-x and Table 3.2.1, Item 3.2.1-32, where the Fire Protection Program is credited in one table but not in the other table.

In its response, the applicant stated that the System Walkdown Program is the more appropriate program for two of these component types, which are in the fire protection water system, and the LRA will be supplemented to revise the Table 3.3.2-x items. However, one component type is in the halon fire protection system, and the Fire Protection Program will be used to inspect piping internal surfaces. The LRA will be supplemented to add the Fire Protection Program to the discussion column of Table 3.2.1, Item 3.2.1-32.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.2.1, Item 3.2.1-32, is revised to add the Fire Protection Program to the list of programs managing internal surfaces of steel components exposed to air-indoor.

The project team reviewed the Fire Protection Program, which includes periodic inspection and testing of the halon fire protection system. Since the applicant is using an existing AMP that performs visual inspection of internal surfaces, the project team found the applicant's use of the Fire Protection Program to be acceptable.

For the eight component types in the emergency diesel, SBO diesel, and security diesel systems, the applicant credited the Periodic Surveillance and Preventive Maintenance Program. The Periodic Surveillance and Preventive Maintenance Program uses visual or other NDE techniques to inspect a representative sample of the identified system components. Since the applicant is using an existing AMP that performs visual inspection of internal surfaces, the project team found the applicant's use of the Periodic Surveillance and Preventive Maintenance Program to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.18 Reduction of Heat Transfer Due to Fouling

During the audit and review, the project team noted that some AMR results lines pointed to Section 3.2, "ESF Systems," Table 3.2.1, Item 3.2.1-9. For these line items, the applicant included a reference to Note E. This line item applies to copper alloy heat exchanger tubes exposed to a lubricating oil environment. This line item was referenced on two component types.

During the audit and review, the project team noted that some AMR results lines pointed to Section 3.4, "Steam and Power Conversion Systems," Table 3.4.1, Item 3.4.1-10. For these line items, the applicant included a reference to Note E. This line item applies to steel heat exchanger tubes exposed to a lubricating oil environment. This line item was referenced on one component type.

The project team reviewed the AMR results lines referenced to Note E and determined that the material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.M39, "Lubricating Oil Analysis," and XI.M32, "One-Time Inspection," to verify the effectiveness of the lubricating oil analysis program, the applicant has only credited the Oil Analysis Program.

The project team reviewed the Oil Analysis Program. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any

CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.1.19 Loss of Material Due to General Pitting and Crevice Corrosion

In Table 3.3.2-14-27, "RWCU System," page 3.3-234 of the LRA, for steel heat exchanger shell in treated water internal environment, the applicant has credited the Water Chemistry Control – Closed Cooling Water Program and references Table 3.3.1, Item 3.3.1-17. However, Item 3.3.1-17 addresses the Water Chemistry Control – BWR Program. The project team asked the applicant to clarify this discrepancy.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.3.2-14-27, last three columns for the carbon steel component type heat exchanger shell in treated water environment with an aging effect of loss of material, is revised to list VII.C2-14 (A-25), 3.3.1-47, and D.

The project team reviewed Table 3.3.1, Item 3.3.1-47, and found the applicant's response to be acceptable.

In Table 3.3.2-14-27, "RWCU System," page 3.3-235 of the LRA, for SS orifice in treated water internal environment, the applicant has the credited Water Chemistry Control –- Closed Cooling Water Program and references Table 3.3.1, Item 3.3.1-17. However, Item 3.3.1-17 addresses steel components, not SS. The project team asked the applicant to clarify this discrepancy.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.3.2-14-27, SS component type orifice in treated water environment with an aging effect of loss of material, is revised to list Table 1, Item 3.3.1-24.

The project team reviewed Line 3.3.1-24 and confirmed that it does address SS components and found the applicant's response to be acceptable.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.3.2.2 AMR Results for Which Further Evaluation Is Recommended

Summary of Information in the Application

In PNPS LRA Section 3.3.2.2, the applicant provides further evaluation of aging management as recommended by the GALL Report for the auxiliary systems subject to an AMR. The applicant also provides information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in PNPS LRA Table 3.3.1, the GALL Report recommends further evaluation. When further evaluation is recommended, the project team reviewed these further evaluations provided in PNPS LRA Section 3.3.2.2 against the criteria provided in the SRP-LR Section 3.3.2.2. The project team's assessments of these evaluations is documented in this section. These assessments are applicable to each Table 2 AMR line item in Section 3.3 citing the item in Table 1.

3.3.2.2.1 Cumulative Fatigue Damage

The project team reviewed the AMR line items in the Type 2 AMR Tables for the Auxiliary Systems in which fatigue-induced damage (which is referred to as "fatigue - cracking" in the AMR line items) was identified as an AERM and in which the "TLAA - Metal Fatigue" was credited as the basis for management of the aging effect. Henceforth, these AMR line items in the Type 2 AMR tables for the auxiliary systems will be referred in this audit and review report as the "AMRs on Non-Class 1 Fatigue," and the relevant TLAA will be referred to as the "TLAA on Metal Fatigue of Non-Class 1 Components."

The project team reviewed the applicant's TLAA on Metal Fatigue of Non-Class 1 Components, as provided in Section 4.3.2 of the application. The project team determined that the applicant had indicated that all of the AMRs on Non-Class 1 Fatigue were within the scope of the B31.1 fatigue analysis discussion in Section 4.3.2 of the LRA. However, the project team determined that the AMRs on Non-Class 1 Fatigue did not clearly indicate which of the commodity groups for the auxiliary systems were designed to the ANSI B31.1 design code (B31.1) and which commodity groups for these systems were designed to a design code other than B31.1. Thus, the project team was unable to conclude that the TLAA on Metal Fatigue was an appropriate

means of aging management for those Non-Class 1 commodity groups that were designed to a design code other than B31.1. The project team asked the applicant to respond to the following requests:

(1) Identify which design codes were applied to the non-piping commodity groups in the AMRs on Non-Class 1 Fatigue for the auxiliary systems

(2) Clarify whether the design codes required a metal fatigue analysis, and summarize what type of metal fatigue analysis calculation was required by the design code, if applicable

(3) Discuss how the metal fatigue analysis was acceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii), if applicable

(4) Propose an acceptable AMP to manage fatigue-induced damage for the PEO if the design code for the particular Non-Class 1 commodity group did not require a metal fatigue analysis

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant clarified that the following Auxiliary System components were not designed in accordance with B31.1:

- RBCCW heat exchanger tubes
- all non-piping components in the Nonsafety-Related Components Affecting Safety-Related Systems AMR tables for the auxiliary systems (i.e., those components in LRA Tables 3.3.2-14-1 through 3.3.2-14-35)

The applicant clarified that the design codes for these components do not require metal fatigue analyses for the components and, therefore, proposed to credit the One-Time Inspection Program to manage fatigue-induced damage in these components in lieu of the TLAA on Metal Fatigue on Non-Class 1 Components.

The applicant's One-Time Inspection Program is used, in part, to determine whether a specific aging effect of concern is occurring in components in which there has been no plant-specific operating experience with the aging effect. The applicant has not indicated any relevant operating experience with respect to the occurrence of fatigue-induced damage in the non-piping components for the auxiliary systems in LRA Tables 3.3.2-14-1 through 3.3.2-14-35. GALL Program XI.M32, "One Time Inspection," states that either an enhanced VT-1 (EVT-1) visual examination or volumetric examination techniques (i.e., either ultrasonic or radiographic techniques) are to be used to detect cracking in plant components.

The project team reviewed the One-Time Inspection Program, and its evaluation is documented in Section 3.0.3.1.8 of this audit and review report. In its evaluation of the AMP, the project team concluded that the applicant's One-time Inspection Program (LRA AMP B.1.23) is consistent with GALL AMP XI.M32 without exception and acceptable for implementation. Therefore, staff concludes that it will be appropriate to credit a one-time inspection of these components using either an EVT-1 or volumetric examination technique to determine whether

fatigue-induced damage is an AERM for the PEO. This issue is closed with respect to confirming that a valid AMP is credited to manage fatigue-induced damage in these auxiliary system components (i.e., in the RBCCW heat exchanger tubes or in the non-piping components for non-safety related systems in LRA Tables 3.3.2-14-1 through 3.3.2-14-35).

For the remaining AMRs on Non-Class 1 Fatigue of the auxiliary feature systems, the applicant confirmed that the design code for the components in the AMRs is B31.1, and that the TLAA on Metal Fatigue is credited to manage fatigue-induced damage in these components. Therefore, the project team concludes that it is valid and acceptable to use the TLAA on Metal Fatigue of Non-Class 1 Components as the basis for managing fatigue-induced damage in these components because (1) these components are designed to B31.1, (2) B31.1 includes a metal fatigue analysis methodology for B31.1-designed components, and (3) Section 4.3.2 of the LRA includes a B31.1-based fatigue assessment for these components. The project team reviewed the ability of the TLAA on Metal Fatigue of Non-Class 1 Components to manage fatigue-induced damage in these components and its evaluation is provided in Section 4.3.2.2.2 of this audit and review report. This issue is closed.

3.3.2.2.2 Reduction of Heat Transfer Due to Fouling

The project team reviewed PNPS LRA Section 3.3.2.2.2 against the criteria in SRP-LR Section 3.3.2.2.2.

SRP-LR Section 3.3.2.2.2 states that the reduction of heat transfer due to fouling could occur for SS heat exchanger tubes exposed to treated water. The existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, control of water chemistry may have been inadequate. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. OTI is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.2, the applicant states that reduction of heat transfer due to fouling could occur for SS heat exchanger tubes exposed to treated water. However, heat transfer is not a license renewal intended function for any of the auxiliary system heat exchangers with SS tubes exposed to treated water. Therefore, this item is not applicable to PNPS.

On the basis that there are no SS heat exchangers in the auxiliary systems with intended functions of heat transfer, the project team found that, for this component type, this aging effect is not applicable to PNPS.

3.3.2.2.3 Cracking Due to SCC

3.3.2.2.3.1 Cracking Due to SCC [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.3.1 against the criteria in SRP-LR Section 3.3.2.2.3.1.

SRP-LR Section 3.3.2.2.3.1 states that cracking due to SCC could occur in the SS piping, piping components, and piping elements of the BWR SLC system that are exposed to sodium pentaborate solution greater than 140°F. The existing AMP relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring. An OTI of select components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.3.1, the applicant states that cracking due to SCC can occur in the SS piping, piping components, and piping elements of the BWR SLC system that are exposed to sodium pentaborate solution greater than 140°F. At PNPS the sodium pentaborate solution in the SLC system does not exceed 140°F. Therefore, cracking due to SCC is not an AERM for the SLC system. This item is not applicable to PNPS.

On the basis that there are no SS SLC system components with intended functions exposed to treated water greater than 140°F, the project team found that, for this component type, this aging effect is not applicable to PNPS.

3.3.2.2.3.2 <u>Cracking Due to SCC [Item 2]</u>

The project team reviewed PNPS LRA Section 3.3.2.2.3.2 against the criteria in SRP-LR Section 3.3.2.2.3.2.

SRP-LR Section 3.3.2.2.3.2 states that cracking due to SCC could occur in SS and SS clad heat exchanger components exposed to treated water greater than 140°F. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1

In PNPS LRA Section 3.3.2.2.3.2, the applicant states that cracking due to SCC in SS heat exchanger components exposed to treated water greater than 140°F is an AERM at PNPS. There are no auxiliary system components at PNPS with SS cladding. For PNPS auxiliary systems these SS heat exchanger components are managed by the Water Chemistry Control – BWR Program. This program monitors parameters and contaminants to ensure they remain within the limits specified by the EPRI guidelines. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program for managing cracking using visual and ultrasonic inspection techniques.

The project team reviewed the program and determined that the applicant's plant chemistry program exceptions were nontechnical; the program is based on a more recent EPRI document for BWR water chemistry, versus the EPRI document BWRVIP-29 (TR-103515) recommended by the GALL Report. The project team determined that the use of a more recent issue of the BWRVIP chemistry program document was acceptable. In the discussion column of Table 3.3.1, Item 5, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in

Table 3.3.2-X where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy of why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence, The effectiveness of the program will be confirmed by the One-Time Inspection Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.3.2 for further evaluation.

3.3.2.2.3.3 Cracking Due to SCC [Item 3]

The project team reviewed PNPS LRA Section 3.3.2.2.3.3 against the criteria in SRP-LR Section 3.3.2.2.3.3.

SRP-LR Section 3.3.2.2.3.3 states that cracking due to SCC could occur in SS diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.3.3, the applicant states that cracking due to SCC in SS diesel engine exhaust piping exposed to diesel exhaust is an AERM at PNPS. At PNPS, cracking of SS exhaust piping in the SBO diesel generator system is managed by the Periodic Surveillance and Preventive Maintenance Program. This program uses visual and other NDE techniques to manage cracking of the piping. These inspections will manage the aging effect of cracking such that the intended function of the component will not be affected.

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program and determined that since visual or other NDE techniques are used to inspect a representative sample of SBO diesel exhaust components, the aging effect of cracking will be effectively managed.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.3.3 for further evaluation.

3.3.2.2.4 Cracking Due to SCC and Cyclic Loading

3.3.2.2.4.1 Cracking Due to SCC and Cyclic Loading [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.4.1 against the criteria in SRP-LR Section 3.3.2.2.4.1.

SRP-LR Section 3.3.2.2.4.1 states that cracking due to SCC and cyclic loading could occur in SS PWR nonregenerative heat exchanger components exposed to treated borated water greater than 140°F in the chemical and volume control system. The existing AMP relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. An acceptable verification program is to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes.

PNPS is a BWR and does not have a SS nonregenerative heat exchanger exposed to treated borated water. This item is not applicable to PNPS.

3.3.2.2.4.2 Cracking Due to SCC and Cyclic Loading [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.4.2 against the criteria in SRP-LR Section 3.3.2.2.4.2.

SRP-LR Section 3.3.2.2.4.2 states that cracking due to SCC and cyclic loading could occur in SS PWR regenerative heat exchanger components exposed to treated borated water greater than 140°F. The existing AMP relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1.

PNPS is a BWR and does not have a SS regenerative heat exchanger exposed to treated borated water. This item is not applicable to PNPS.

3.3.2.2.4.3 Cracking Due to SCC and Cyclic Loading [Item 3]
The project team reviewed PNPS LRA Section 3.3.2.2.4.3 against the criteria in SRP-LR Section 3.3.2.2.4.3.

SRP-LR Section 3.3.2.2.4.3 states that cracking due to SCC and cyclic loading could occur for the SS pump casing for the PWR high-pressure pumps in the chemical and volume control system. The existing AMP relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1

PNPS is a BWR and does not have a chemical and volume control system. This item is not applicable to PNPS.

3.3.2.2.5 Hardening and Loss of Strength Due to Elastomer Degradation

3.3.2.2.5.1 Hardening and Loss of Strength Due to Elastomer Degradation [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.5.1 against the criteria in SRP-LR Section 3.3.2.2.5.1.

SRP-LR Section 3.3.2.2.5.1 states that hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air-indoor uncontrolled (internal/external). The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.5.1, the applicant states that cracking and change in material properties due to elastomer degradation in elastomer duct flexible connections of the HVAC systems exposed to air-indoor are AERMs at PNPS. These aging effects are managed by the Periodic Surveillance and Preventive Maintenance Program. The Periodic Surveillance and Preventive Maintenance Program includes visual inspections and physical manipulation of the flexible connections to confirm that the components are not experiencing any aging that would affect accomplishing their intended functions.

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program and determined that since visual inspections and manipulation of the flexible connections are performed at periodic intervals, the aging effect of hardening and loss of strength of elastomer components will be effectively managed.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.5.1 for further evaluation.

3.3.2.2.5.2 Hardening and Loss of Strength Due to Elastomer Degradation [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.5.2 against the criteria in SRP-LR Section 3.3.2.2.5.2.

SRP-LR Section 3.3.2.2.5.2 states that hardening and loss of strength due to elastomer degradation could occur in elastomer linings of the filters, valves, and ion exchangers in spent FPC and cleanup systems (BWR and PWR) exposed to treated water or to treated borated water. The GALL Report recommends that a plant-specific AMP be evaluated to determine and assess the qualified life of the linings in the environment to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.5.2, the applicant states that for the auxiliary systems at PNPS, no credit is taken for any elastomer linings to prevent loss of material from the underlying carbon steel material such that the material is identified as carbon steel for the AMR. This item is not applicable to PNPS.

Since no credit is taken for elastomer linings to prevent loss of material from the underlying carbon steel material, the project team determined that this line item is not applicable to PNPS.

3.3.2.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

The project team reviewed PNPS LRA Section 3.3.2.2.6 against the criteria in SRP-LR Section 3.3.2.2.6.

SRP-LR Section 3.3.2.2.6 states that a reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or to treated borated water. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.6, the applicant states that the loss of material and cracking are AERMs for boral spent fuel storage racks exposed to a treated water environment. These aging effects are managed by the Water Chemistry Control – BWR Program.

Reduction of neutron-absorbing capacity is insignificant and requires no aging management. The potential for aging effects due to sustained irradiation of boral was previously evaluated by the staff (BNL-NUREG-25582, dated January 1979; NUREG-1787, VC Summer SER, Paragraph 3.5.2.4.2, p. 3-408) and determined to be insignificant. Plant operating experience with the boral coupon inspected in 2000 is consistent with the staff's conclusion, and an AMP is not required.

The project team reviewed the Water Chemistry Control – BWR Program, which monitors chlorides, sulfates, and dissolved oxygen to limit the contaminants. The project team determined that loss of material due to general corrosion will be managed by the plant chemistry program. The applicant has stated that water chemistry control programs will be verified for effectiveness by the One-Time Inspection Program. The OTI of boral coupon test specimens is performed to confirm that no significant aging degradation will occur. The One-Time Inspection Program has provisions to increase frequency of inspections based on the results of the first inspection.

These AMPs are appropriate for the AEMs identified and provide assurance that the AEMs will be effectively managed through the PEO. The plant chemistry program and the One-Time Inspection Program were evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.6 for further evaluation.

3.3.2.2.7 Loss of Material Due to General, Pitting, and Crevice Corrosion

3.3.2.2.7.1 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.7.1 against the criteria in SRP-LR Section 3.3.2.2.7.1.

SRP-LR Section 3.3.2.2.7.1 states that a loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements, including the tubing, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil (as part of the fire protection system). The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In addition, corrosion may occur at locations in the reactor coolant pump oil collection tank where water from wash downs may accumulate. Therefore, the effectiveness of the program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion, to include determining the thickness of the lower portion of the tank. An OTI is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.7.1, the applicant states that steel piping and components in auxiliary systems at PNPS that are exposed to lubricating oil are managed by the Oil Analysis Program, which includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components. PNPS is a BWR with an inert containment atmosphere and as a result has no reactor coolant pump oil collection system.

The project team reviewed the Oil Analysis Program. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team

asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the program identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.7.1 for further evaluation.

3.3.2.2.7.2 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.7.2 against the criteria in SRP-LR Section 3.3.2.2.7.2.

SRP-LR Section 3.3.2.2.7.2 states that the loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements in the BWR RWCU and shutdown cooling systems exposed to treated water. The existing AMP relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from general, pitting, and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry control program. An OTI of select

components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.7.2, the applicant states that PNPS does not have a separate shutdown cooling system. Loss of material due to general, pitting, and crevice corrosion in carbon steel piping and components in other auxiliary systems exposed to treated water are managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including areas of stagnant flow.

The project team reviewed the program and determined that the applicant's plant chemistry program exceptions were nontechnical and the program is based on a more recent EPRI document for BWR water chemistry, versus the EPRI document BWRVIP-29 (TR-103515) recommended by the GALL Report. The project team determined that the use of a more recent issue of the BWRVIP chemistry program document was acceptable. In the discussion column of Table 3.3.1, Item 17, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.3.2-X where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where GALL recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.7.2 for further evaluation.

3.3.2.2.7.3 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 3]

The project team reviewed PNPS LRA Section 3.3.2.2.7.3 against the criteria in SRP-LR Section 3.3.2.2.7.3.

SRP-LR Section 3.3.2.2.7.3 states that a loss of material due to general (steel only) pitting and crevice corrosion could occur for steel and SS diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.7.3, the applicant states that the loss of material due to general (steel only) pitting and crevice corrosion for carbon steel and SS diesel exhaust piping and components exposed to diesel exhaust in the EDG, SBO diesel generator, and security diesel generator systems is managed by the Periodic Surveillance and Preventive Maintenance Program. This program uses visual and other NDE techniques to manage loss of material for these components. The carbon steel diesel exhaust piping and components in the fire protection system are managed by the Fire Protection Program. The Fire Protection Program uses visual inspections of diesel exhaust piping and components to manage loss of material. These inspections in the Periodic Surveillance and Preventive Maintenance and Fire Protection Programs will manage the aging effect of loss of material such that the intended function of the components will not be affected.

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program and determined that since visual or other NDE techniques are used to inspect a representative sample of EDG, SBO diesel generator, and security diesel generator exhaust components, the aging effect of loss of material will be effectively managed.

The project team reviewed the Fire Protection Program and determined that the program description does not include these components nor has the program been enhanced to include these components. The project team asked the applicant to clarify how the Fire Protection Program will manage the aging effects for these components. In its response, the applicant stated that per AMP B.1.13.1, procedures will be enhanced to verify that the diesel engine does not exhibit signs of degradation while running, such as exhaust gas leakage. Through monitoring and trending of performance data under the Fire Protection Program, loss of material for the diesel fire pump exhaust subsystem components will be identified and corrected through the corrective action program. As described in Section B.1.13.1, observation of degraded performance produced corrective actions, including engine replacement in 2002, before loss of intended function. Consequently, continued implementation of the Fire Protection Program provides assurance that aging effects will be managed for the diesel fire pump exhaust subsystem. In addition, PNPS performs fire pump inspection, testing, and maintenance in accordance with NFPA 25, which would also detect the presence of aging effects in the exhaust system before loss of intended function.

The project team reviewed the response and found that the applicant was managing the aging effects by verifying that there is no leakage. The project team determined that verifying for leakage is not an adequate AMP, since it implies a through-wall leakage. The project team

asked the applicant to justify how the aging is managed if it is a through-wall leakage. In its response, the applicant stated that enhancements will be made to the Fire Protection Program to credit existing or implement new PM tasks for the fire pump diesel to ensure that all aging effects identified in Table 3.3.2-9 line items that apply to the fire pump diesel components are adequately managed and intended functions are maintained without crediting the detection of leakage as managing an aging effect.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that this is License Renewal Commitment No. 7. LRA Section A.2.1.13 is revised to clarify inspection of the diesel-driven fire pump as follows:

> The diesel-driven fire pump inspection requires that the pump be periodically tested and system components internally inspected to ensure that the fuel supply line and engine support systems can perform their intended function.

LRA Section B.1.13.1 is revised with the following enhancement:

Attributes Affected	Enhancements
3. Parameters Monitored/Inspected 6. Acceptance Criteria	Procedures will be enhanced to clarify that at least once every five years, the diesel-driven fire pump engine is inspected for evidence of corrosion to manage loss of material in carbon steel and gray cast iron components including the intake air, exhaust, jacket water, and lube oil subsystems. The jacket water heat exchanger is inspected for evidence of fouling on the tubes. Also, the engine exhaust piping and silencer are inspected for evidence of cracking.

On the basis that the applicant is crediting periodic visual inspection to manage aging effects in lieu of monitoring for leakage, the project team found the enhancement to be acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.7.3 for further evaluation.

3.3.2.2.8 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

The project team reviewed PNPS LRA Section 3.3.2.2.8 against the criteria in SRP-LR Section 3.3.2.2.8.

SRP-LR Section 3.3.2.2.8 states that a loss of material due to general, pitting, and crevice corrosion and MIC could occur for steel (with or without coating or wrapping) piping, piping

components, and piping elements buried in soil. The Buried Piping and Tanks Inspection Program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the Buried Piping and Tanks Inspection Program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

In PNPS LRA Section 3.3.2.2.8, the applicant states that the loss of material due to general, pitting, and crevice corrosion and MIC for carbon steel (with or without coating or wrapping) piping and components buried in soil in the SSW, fuel oil, and fire protection-water systems at PNPS is managed by the Buried Piping and Tanks Inspection Program. This program will include (a) preventive measures to mitigate corrosion, and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel components. Buried components will be inspected when excavated during maintenance. An inspection will be performed within 10 years of entering the PEO, unless an opportunistic inspection occurs within this 10-year period. This program will manage the aging effect of loss of material such that the intended function of the components will not be affected.

The project team reviewed the Buried Piping and Tanks Inspection Program, which is consistent with GALL AMP XI.M34. On the basis that periodic inspections, including opportunistic inspections, will be performed on buried piping, the project team determined that the Buried Piping and Tanks inspection Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.8 for further evaluation.

3.3.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

3.3.2.2.9.1 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling [Item1]

The project team reviewed PNPS LRA Section 3.3.2.2.9.1 against the criteria in SRP-LR Section 3.3.2.2.9.1.

SRP-LR Section 3.3.2.2.9.1 states that a loss of material due to general, pitting, and crevice corrosion, MIC, and fouling could occur for steel piping, piping components, piping elements, and tanks exposed to fuel oil. The existing AMP relies on the Fuel Oil Chemistry Program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion or fouling. Corrosion or fouling may occur at locations where contaminants accumulate. The effectiveness of the fuel oil chemistry control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling to verify the effectiveness of the Fuel Oil Chemistry Program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.9.1, the applicant states that fouling is not an AERM for the fuel oil system at PNPS. loss of material due to general, pitting, crevice, and microbiologically influenced corrosion for carbon steel piping and components exposed to fuel oil is an AERM at PNPS, and these components are managed by the Diesel Fuel Monitoring Program. This program includes sampling and monitoring of fuel oil quality to ensure it remains within the limits specified by the ASTM standards. Maintaining parameters within limits ensures that significant loss of material will not occur. Ultrasonic inspections of storage tank bottoms where water and contaminants accumulate will be performed to confirm the effectiveness of the Diesel Fuel Monitoring Program. In addition, operating experience at PNPS has confirmed the effectiveness of this program in maintaining fuel oil quality within limits such that loss of material will not affect the intended functions of these components.

The project team reviewed the Diesel Fuel Monitoring Program, which includes sampling and monitoring of fuel oil quality. In lieu of using the One-Time Inspection Program to verify effectiveness, the applicant performs UT inspections of tank bottoms, which is where corrosion is likely to occur due to any water accumulation. Since the most susceptible location will be inspected for loss of material, the project team determined that the performance of UT inspection of storage tank bottoms is an acceptable method of verifying the effectiveness of the Diesel Fuel Monitoring Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.9.1 for further evaluation.

3.3.2.2.9.2 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.9.2 against the criteria in SRP-LR Section 3.3.2.2.9.2.

SRP-LR Section 3.3.2.2.9.2 states that a loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling could occur for steel heat exchanger components exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.9.2, the applicant states that the loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling for carbon steel heat exchanger components exposed to lubricating oil is an AERM in the auxiliary systems at PNPS, and is managed by the Oil Analysis Program. This program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion or fouling. Operating experience at PNPS

has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion and fouling has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.9.2 for further evaluation.

3.3.2.2.10 Loss of Material Due to Pitting and Crevice Corrosion

3.3.2.2.10.1 Loss of Material Due to Pitting and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.10.1 against the criteria in SRP-LR Section 3.3.2.2.10.1.

SRP-LR Section 3.3.2.2.10.1 states that a loss of material due to pitting and crevice corrosion could occur in BWR and PWR steel piping with elastomer lining or SS cladding that is exposed to treated water and treated borated water if the cladding or lining is degraded. The existing

AMP relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified 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. An OTI of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.10.1, the applicant states that the loss of material due to pitting and crevice corrosion could occur in BWR and PWR steel piping with elastomer lining or SS cladding that is exposed to treated water and treated borated water if the cladding or lining is degraded. For the auxiliary systems at PNPS, no credit is taken for any elastomer linings or SS cladding to prevent loss of material from the underlying carbon steel material such that the material is identified as carbon steel for the AMR. This item is not applicable to PNPS.

Since no credit is taken for elastomer linings or SS cladding to prevent loss of material from the underlying carbon steel material, the project team determined that this line item is not applicable to PNPS.

3.3.2.2.10.2 Loss of Material Due to Pitting and Crevice Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.10.2 against the criteria in SRP-LR Section 3.3.2.2.10.2.

SRP-LR Section 3.3.2.2.10.2 states that a loss of material due to pitting and crevice corrosion could occur for SS and aluminum piping, piping components, piping elements, and for SS and steel with SS clad heat exchanger components exposed to treated water. The existing AMP relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause pitting or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified 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. An OTI of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.10.2, the applicant states that there are no aluminum components exposed to treated water in the auxiliary systems at PNPS. The loss of material due to pitting and crevice corrosion for SS piping and components and for SS heat exchanger components exposed to treated water in the auxiliary systems at PNPS is managed by the Water Chemistry Control – BWR Program. The effectiveness of the program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

The project team reviewed the program and determined that the applicant's plant chemistry program exceptions were nontechnical; the program is based on a more recent EPRI document for BWR water chemistry versus the EPRI document BWRVIP-29 (TR-103515) recommended by the GALL Report. The project team determined that the use of a more recent issue of the BWRVIP chemistry program document was acceptable. In the discussion column of Table 3.3.1, Items 23 and 24, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.3.2-X where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where GALL recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.2 for further evaluation.

3.3.2.2.10.3 <u>Loss of Material Due to Pitting and Crevice Corrosion [Item 3]</u>

The project team reviewed PNPS LRA Section 3.3.2.2.10.3 against the criteria in SRP-LR Section 3.3.2.2.10.3.

SRP-LR Section 3.3.2.2.10.3 states that a loss of material due to pitting and crevice corrosion could occur for copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external). The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.10.3, the applicant states that the loss of material due to pitting and crevice corrosion for copper alloy components exposed to condensation (external) in the HVAC and other auxiliary systems is managed by the System Walkdown and Periodic Surveillance and Preventive Maintenance Programs. These programs include a periodic visual

inspection, and the Periodic Surveillance and Preventive Maintenance Program includes other NDE techniques to manage loss of material of the components. These inspections will manage the aging effect of loss of material such that the intended function of the components will not be affected.

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, which states that for the reactor building CCW system, visual or other NDE techniques are used to inspect a representative sample of the in scope RBCCW copper alloy cooling coils to manage loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the heat exchanger tubes will be periodically inspected, the aging effect of loss of material of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of condensation is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

The project team reviewed the System Walkdown Program, which states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of copper alloy components exposed to an external environment of condensation is effectively managed using the System Walkdown Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.3 for further evaluation.

3.3.2.2.10.4 Loss of Material Due to Pitting and Crevice Corrosion [Item 4]

The project team reviewed PNPS LRA Section 3.3.2.2.10.4 against the criteria in SRP-LR Section 3.3.2.2.10.4.

SRP-LR Section 3.3.2.2.10.4 states that a loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.10.4, the applicant states that a loss of material due to pitting and crevice corrosion for copper alloy components exposed to lubricating oil in auxiliary systems at PNPS is managed by the Oil Analysis Program, which includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed

the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.4 for further evaluation.

3.3.2.2.10.5 Loss of Material Due to Pitting and Crevice Corrosion [Item 5]

The project team reviewed PNPS LRA Section 3.3.2.2.10.5 against the criteria in SRP-LR Section 3.3.2.2.10.5.

SRP-LR Section 3.3.2.2.10.5 states that a loss of material due to pitting and crevice corrosion could occur for HVAC aluminum piping, piping components, and piping elements and SS ducting and components exposed to condensation. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.10.5, the applicant states that the loss of material due to pitting and crevice corrosion could occur for HVAC aluminum piping, piping components, and piping elements and SS ducting and components exposed to condensation. At PNPS, there are no aluminum components or SS ducting exposed to condensation in the HVAC systems. However, this item can be applied to SS components exposed to condensation, both internal and external, in other systems. The System Walkdown Program will manage loss of material in SS components exposed externally to condensation. The Periodic Surveillance and Preventive Maintenance Program will manage loss of material in SS components exposed internally to condensation. These programs include a periodic visual inspection, and the Periodic Surveillance and Preventive Maintenance Program includes other NDE techniques to manage loss of material of the components.

The SS component types to which Section 3.3.2.2.10.5 applies are identified in Table 3.3.2-X, which references Table 3.3.1, Item 27. Two of these component types are in the EDG system in an internal environment of untreated air. Footnote 303 is applied to these components, and it states that the untreated air environment is the equivalent of the GALL Report environment of condensation. The Periodic Surveillance and Preventive Maintenance Program will manage the aging effect of these two component types. The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, which states that for the EDG system, visual or other NDE techniques are used to inspect a representative sample of the in scope EDG components to manage loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of loss of material of SS components exposed to an internal environment of condensation is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

The other SS component types are in various systems in an external environment of condensation. The aging effect of loss of material of these components is managed by the System Walkdown Program. The project team reviewed the System Walkdown Program, which states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of SS components exposed to an external environment of condensation is effectively managed using the System Walkdown Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.5 for further evaluation.

3.3.2.2.10.6 <u>Loss of Material Due to Pitting and Crevice Corrosion [Item 6]</u>

The project team reviewed PNPS LRA Section 3.3.2.2.10.6 against the criteria in SRP-LR Section 3.3.2.2.10.6.

SRP-LR Section 3.3.2.2.10.6 states that a loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation. The GALL Report recommends further evaluation

of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.10.6, the applicant states that the loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation. At PNPS, there are no copper alloy components exposed to condensation in the fire protection systems. However, this item can be applied to copper alloy components exposed to internal condensation in other systems. The Periodic Surveillance and Preventive Maintenance and One-Time Inspection Programs will manage loss of material in copper alloy components exposed internally to untreated air, which is equivalent to condensation, through the use of visual inspections or other NDE techniques.

The PNPS Instrument Air Quality Program will manage loss of material in copper alloy components exposed internally to treated air. The Instrument Air Quality Program maintains humidity and particulate within acceptable limits, thereby preserving the environment of treated air that is not conducive to corrosion. This is equivalent to the management of loss of material in steel and SS components addressed in Items 3.3.1-53 and -54, respectively.

The component types to which Section 3.3.2.2.10.6 applies are identified in Table 3.3.2-X, which references Table 3.3.1, Item 28. One of these component types is in the EDG system in an internal environment of untreated air. Footnote 303, which is applied to this component, states that the untreated air environment is the equivalent of the GALL Report environment of condensation. The Periodic Surveillance and Preventive Maintenance Program will manage the aging effect of this component type. The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, which states that for the EDG system, visual or other NDE techniques are used to inspect a representative sample of the in scope EDG components to manage loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of loss of material of copper alloy components exposed to an internal environment of condensation is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

Four component types are in the IA system in an internal environment of condensation. The Instrument Air Quality Program will manage the aging effects of these components. The project team reviewed the Instrument Air Quality Program, which is a plant-specific program that ensures that IA supplied to components is maintained free of water and significant contaminants, thereby preserving an environment that is not conducive to loss of material. Dewpoint, particulate contamination, and hydrocarbon concentration are periodically checked to verify the IA quality is maintained. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since IA quality will be periodically checked, the aging effect of loss of material of copper alloy components exposed to an internal environment of condensation is effectively managed using the Instrument Air Quality Program.

Three component types are in the CAS. These components are in scope per the requirements of 10 CFR 54.4(a)(2) criteria on NSR components affecting safety-related systems. The One-

Time Inspection Program will manage the aging effects of these components. The project team reviewed the One-Time Inspection Program, which is a new program consistent with the recommendations of GALL AMP XI.M32, "One-Time Inspection." This program provides confirmation for the potential long incubation period for certain aging effects on SCs. The applicant has noted in the LRA, Section B.1.23, that for internal surfaces of CASs, an OTI activity will confirm that loss of material in a CAS is not occurring or is so insignificant that an AMP is not warranted. The applicant also stated that when evidence of an aging effect is revealed by an OTI, routine evaluation of the inspection results will identify appropriate corrective actions. The project team determined that use of the One-Time Inspection Program alone in certain cases is acceptable. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the One-Time Inspection Program will visually inspect the internal surfaces before entering the PEO, the aging effect of loss of material of these components in a CAS exposed to an internal environment of condensation is effectively managed using the One-Time Inspection Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.6 for further evaluation.

3.3.2.2.10.7 Loss of Material Due to Pitting and Crevice Corrosion [Item 7]

The project team reviewed PNPS LRA Section 3.3.2.2.10.7 against the criteria in SRP-LR Section 3.3.2.2.10.7.

SRP-LR Section 3.3.2.2.10.7 states that a loss of material due to pitting and crevice corrosion could occur for SS piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.10.7, the applicant states that the loss of material due to pitting and crevice corrosion could occur for SS piping, piping components, and piping elements exposed to soil. At PNPS, there are no SS components exposed to soil in the auxiliary systems. This item is not applicable to PNPS auxiliary systems.

Since there are no SS components exposed to soil in the auxiliary systems, the project team determined that this line item is not applicable to PNPS.

3.3.2.2.10.8 Loss of Material Due to Pitting and Crevice Corrosion [Item 8]

The project team reviewed PNPS LRA Section 3.3.2.2.10.8 against the criteria in SRP-LR Section 3.3.2.2.10.8.

SRP-LR Section 3.3.2.2.10.8 states that a loss of material due to pitting and crevice corrosion could occur for SS piping, piping components, and piping elements of the BWR SLC system that are exposed to sodium pentaborate solution. The existing AMP relies on monitoring and control of water chemistry to manage the aging effects of loss of material due to pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of

stagnant flow conditions could cause loss of material due to pitting and crevice corrosion. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure this aging is not occurring. An OTI of select components at susceptible locations is an acceptable method to ensure that loss of material due to pitting and crevice corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.10.8, the applicant states that the loss of material due to pitting and crevice corrosion for SS piping and components of the SLC system exposed to sodium pentaborate solution is managed at PNPS by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

The project team reviewed the program and determined that the applicant's plant chemistry program exceptions were nontechnical; the program is based on a more recent EPRI document for BWR water chemistry versus the EPRI document BWRVIP-29 (TR-103515) recommended by the GALL Report. The project team determined that the use of a more recent issue of the BWRVIP chemistry program document was acceptable. In the discussion column of Table 3.3.1, Item 30, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.3.2-X where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where GALL recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.8 for further evaluation.

3.3.2.2.11 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion

The project team reviewed PNPS LRA Section 3.3.2.2.11 against the criteria in SRP-LR Section 3.3.2.2.11.

SRP-LR Section 3.3.2.2.11 states that a loss of material due to pitting, crevice, and galvanic corrosion could occur for copper alloy piping, piping components, and piping elements exposed to treated water. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure this aging is not occurring. An OTI of select components at susceptible locations is an acceptable method to ensure that loss of material due to pitting and crevice corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.11, the applicant states that the loss of material due to pitting, crevice, and galvanic corrosion could occur for copper alloy piping and components exposed to treated water. At PNPS, there are no copper alloy components exposed to treated water in the auxiliary systems. However, this item can be applied to copper alloy components exposed to treated water in the HPCI and RCIC systems. The Water Chemistry Control – BWR Program will manage loss of material for these components. The effectiveness of the program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

This line item is not used for any components in the auxiliary systems. However, it is used in Section 3.2, "ESF Systems." In the discussion column of Table 3.3.1, Item 31, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.2.2-X where this Table 3.3.1 line item is referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference this Table 1 line item.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.3.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Table 2 credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program. For further clarification, LRA Appendix A is revised for these three water chemistry control programs to

include the sentence "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.11 for further evaluation.

3.3.2.2.12 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

3.3.2.2.12.1 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.3.2.2.12.1 against the criteria in SRP-LR Section 3.3.2.2.12.1.

SRP-LR Section 3.3.2.2.12.1 states that a loss of material due to pitting, crevice, and microbiologically influenced corrosion could occur in SS, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. The existing AMP relies on the Fuel Oil Chemistry Program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion. However, corrosion may occur at locations where contaminants accumulate, and the effectiveness of fuel oil chemistry control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the Fuel Oil Chemistry Program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.12.1, the applicant states that there are no aluminum components exposed to fuel oil in the auxiliary systems at PNPS. The loss of material due to pitting, crevice, and microbiologically influenced corrosion in SS and copper alloy piping and components exposed to fuel oil is an AERM at PNPS, and these components are managed by the Diesel Fuel Monitoring Program. This program includes sampling and monitoring of fuel oil quality to ensure it remains within the limits specified by the ASTM standards. Maintaining parameters within limits ensures that significant loss of material will not occur. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining fuel oil quality within limits such that loss of material will not affect the intended functions of these SS and copper alloy components.

The project team reviewed the Diesel Fuel Monitoring Program, which includes sampling and monitoring of fuel oil quality. In lieu of using the One-Time Inspection Program to verify effectiveness, the applicant performs UT inspections of tank bottoms, which is where corrosion is likely to occur due to any water accumulation. Since the most susceptible location will be inspected for loss of material, the project team determined that the performance of UT inspection of storage tank bottoms is an acceptable method of verifying the effectiveness of the Diesel Fuel Monitoring Program.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.12.1 for further evaluation.

3.3.2.2.12.2 Loss of Material Due to Pitting, Crevice, and Microbiologically Influenced Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.3.2.2.12.2 against the criteria in SRP-LR Section 3.3.2.2.12.2.

SRP-LR Section 3.3.2.2.12.2 states that a loss of material due to pitting, crevice, and microbiologically influenced corrosion could occur in SS piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the Lubricating Oil Program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.3.2.2.12.2, the applicant states that a loss of material due to pitting, crevice, and microbiologically influenced corrosion in SS piping and components exposed to lubricating oil is managed by the Oil Analysis Program, which includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.12.2 for further evaluation.

3.3.2.2.13 Loss of Material Due to Wear

The project team reviewed PNPS LRA Section 3.3.2.2.13 against the criteria in SRP-LR Section 3.3.2.2.13.

SRP-LR Section 3.3.2.2.13 states that a loss of material due to wear could occur in the elastomer seals and components exposed to air-indoor uncontrolled (internal or external). The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.3.2.2.13, the applicant states that a loss of material due to wear could occur in the elastomer seals and components exposed to air-indoor uncontrolled (internal or external). Wear is the removal of surface layers due to relative motion between two surfaces. At PNPS, in the auxiliary systems, this specific aging effect for elastomers is not applicable based on operating experience. Where the aging effects of change in material properties and cracking are identified for elastomer components, they are managed by the Periodic Surveillance and Preventive Maintenance Program. This item is not applicable to PNPS auxiliary systems.

Since there are no elastomer components with wear as an aging effect, the project team determined that this line item is not applicable to PNPS.

3.3.2.2.15 QA for Aging Management of NSR Components

The applicant referenced LRA Section B.0.3. The project team's evaluation of LRA Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

Conclusion

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were further evaluated.

3.3.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.3.1, "Summary of Aging Management Evaluations for the Auxiliary Systems," the applicant provided information regarding components or material/environment combination in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Tables 3.3.2-1 through 3.3.2-13, 3.3.2-14- 2, 3.3.2-14-6, 3.3.2.14-8, 3.3.2.1-14-12 through 3.3.2-14-15, 3.3.2-14-19 through 3.3.2-14-24, 3.3.2-14-26, 3.3.2-14-27, and 3.3.2-14-29 through 3.3.2-14-34, the applicant provided additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicated, via Notes F through J, that neither the identified component nor the material/environment combination is evaluated in the GALL Report and provided information concerning how the AERM will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

AEMs in Table 3.3.1 That Are Not Applicable to PNPS

The project team reviewed PNPS LRA Table 3.3.1, which provides a summary of aging management evaluations for the auxiliary systems evaluated in the GALL Report.

In PNPS LRA Table 3.1.1, Item 39 discussion column, the applicant stated that cracking of SS BWR spent fuel storage racks exposed to treated water greater than 140°F due to SCC is not applicable because there are no SS spent fuel storage components with intended functions exposed to treated water greater than 140°F.

On the basis that there are no SS spent fuel storage components with intended functions exposed to treated water greater than 140°F, the project team found that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 41 discussion column, the applicant stated that cracking of high-strength steel closure bolting exposed to air with steam or water leakage due to cyclic loading and SCC is not applicable because high-strength steel closure bolting is not used in auxiliary systems.

On the basis that high-strength steel closure bolting is not used in auxiliary systems, the project team found that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 62 discussion column, the applicant stated that loss of material of aluminum piping, piping components, and piping elements exposed to raw water due to pitting and crevice corrosion is not applicable because there are no aluminum components with intended functions exposed to raw water in the auxiliary systems.

On the basis that there are no aluminum components with intended functions exposed to raw water in the auxiliary systems, the project team found that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 77 discussion column, the applicant stated that loss of material of steel heat exchanger components exposed to raw water due to crevice, galvanic, and microbiologically influenced corrosion and fouling is not applicable because steel heat exchanger components are not exposed to raw water in the auxiliary systems.

On the basis that steel heat exchanger components are not exposed to raw water in the auxiliary systems, the project team found that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 80 discussion column, the applicant stated that loss of material of SS and copper alloy piping, piping components, and piping elements exposed to raw water due to pitting, crevice, and microbiologically influenced corrosion is not applicable because this line applies to EDG system components. At PNPS, these components are not exposed to raw water.

On the basis that these components are not exposed to raw water at PNPS, the project team found that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.1.1, Item 98 discussion column, the applicant stated that AE/AMP combination “None-None” for steel, SS, and copper alloy piping, piping components, and piping elements exposed to dried air is not applicable because at PNPS dried (treated) air is maintained as an environment as a result of using the Instrument Air Quality Program, so it is possible that aging effects may occur without that program.

On the basis that PNPS assumes that steel, SS, and copper alloy piping, piping components, and piping elements exposed to dried air could have aging effects, the project team found that, for this component type, this aging effect is not applicable to PNPS.

<u>Auxiliary Systems AMR Line Items That Have No Aging Effect (PNPS LRA Tables 3.3.2-1 through 3.3.2-13, 3.3.2-14- 2, 3.3.2-14-6, 3.3.2.14-8, 3.3.2.1-14-12 through 3.3.2-14-15, 3.3.2-14-19 through 3.3.2-14-24, 3.3.2-14-26, 3.3.2-14-27, and 3.3.2-14-29 through 3.3.2-14-34)</u>

In PNPS LRA Tables 3.3.2-1 through 3.3.2-13, 3.3.2-14- 2, 3.3.2-14-6, 3.3.2.14-8, 3.3.2.1-14-12 through 3.3.2-14-15, 3.3.2-14-19 through 3.3.2-14-24, 3.3.2-14-26, 3.3.2-14-27, and 3.3.2-

14-29 through 3.3.2-14-34, the applicant identified line items where no aging effects were identified as a result of its aging review process.

Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from aluminum, glass, titanium, copper alloy greater than 15-percent zinc, copper alloy less than 15-percent zinc, plastic, fiberglass, and SS material exposed to condensation external, air-indoor internal, fuel oil, and various other environments.

Aluminum in air-outdoor, internal and external environment

Aluminum has an excellent resistance to corrosion when exposed to a humid air (outdoor environment). The aluminum oxide film is bonded strongly to its surface and, if damaged, reforms immediately in most environments. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometers thick but is highly effective in protecting the aluminum from corrosion. Therefore, aluminum exposed to an outdoor air environment does not have any applicable aging effect.

Glass in condensation external environment

Glass as a material is impervious to normal plant environments. This conclusion is based on the fact that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at the temperatures or during the time periods of concern for extended operation.

Titanium in condensation external environment

The corrosion resistance of titanium is a result of formation of a continuous, stable, highly adherent protective oxide layer on the metal surface. The metal itself is very reactive, with a high affinity for oxygen, and reforms damage to this layer instantaneously. Therefore, titanium exposed to a condensation environment does not have any applicable aging effect.

Copper alloy greater than 15-percent zinc in air-indoor internal environment

Copper alloy greater than 15-percent zinc in air-indoor internal environment does not have any aging effect. This conclusion is based on the fact that comprehensive tests conducted over a 20-year period under the supervision of ASTM have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in *Metals Handbook*, Volume 13, “Corrosion” (American Society for Metals International, 1987).

Copper alloy less than 15-percent zinc in air-indoor internal environment

Copper alloy less than 15-percent zinc in air-indoor internal environment does not have any aging effect. This conclusion is based on the fact that comprehensive tests conducted over a 20-year period under the supervision of ASTM have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in *Metals Handbook*, Volume 13, “Corrosion,” (American Society for Metals International, 1987).

Plastic in various environments

In the LRA, the applicant has used “plastics” as a generic term. The project team asked the applicant to identify what kind of plastic materials are used at PNPS. In its response, the applicant stated that at PNPS piping codes JE, JF, JG, and HT are plastic or fiberglass. As identified in the PNPS specification for piping M-300, pipe class JE is fiberglass reinforced plastic, piping code JF allows the use of polyvinyl chloride (PVC) piping, and class HT piping is PVC. Per Note 3 on Drawing M211, M212 Sheet 1, M273 Sheet 3, some of the pipe code JG is PVC.

Some specific components are also identified as plastics that are not included in the piping class summary sheets and which required component-specific reviews to identify the material. For instance, some components such as the tank shown on M212 Sheet 1 is identified on the drawing as a 55-gallon PVC drum, and some piping, like the piping on M273 Sheet 3, is identified on the drawing as chlorinated polyvinyl chloride (CPVC).

The fuel oil system Table 3.3.2-7 also identifies a plastic filter housing used on the SBO diesel fuel oil filter X-176. These are plastic bowls at the bottom of the filter housing that collect water and sediment. The exact type of plastic is not known but was selected for use by the original manufacturer in this application. In addition, similar to all the plastic materials described above, it is not exposed to direct sunlight and was designed to be used with fuel oil. Therefore, as stated in the EPRI mechanical tools, none of these components is expected to experience aging effects that require management in the environments to which they are exposed.

PVC is unaffected by water, concentrated alkalies, and nonoxidizing acids, oils, and ozone. PVC is also unaffected by sunlight and humidity changes.

Unlike metals, thermoplastics do not display corrosion rates. Rather than depending on an oxide layer for protection, they depend on chemical resistance to the environment to which they are exposed. The use of thermoplastics in a water environment is a design-driven criteria.

Fiberglass reinforced plastic is similarly impervious to normal plant environments. Chlorinated PVC is a stronger version of PVC and is not susceptible to age degradation in normal plant environments.

Therefore, based on industry experience review and the assumption of proper design and application of the material, aging of thermoplastics in treated water, raw water, and fuel oil environment is not an applicable aging effect.

Fiberglass in fuel oil and soil environment

Fiberglass is used in a fuel oil and soil environment due to its corrosive resistance. Fuel oil does not contain hydrofluoric acids or caustics. Therefore, fiberglass in a fuel oil environment does not have any aging effect.

SS in an air-indoor internal environment

SSs are highly resistant to corrosion in dry atmospheres in the absence of corrosive species (which would be reflective of indoor uncontrolled air), as cited in *Metals Handbook*, Volumes 3 (p. 65) and 13 (p. 555) (Ninth Edition, American Society for Metals International, 1980 and 1987). Components are not subject to moisture in a dry air environment (and indoor uncontrolled air would have limited humidity and condensation). Therefore, SS in an indoor, uncontrolled air environment exhibits no aging effect, and the component or structure will remain capable of performing its intended functions consistent with the CLB for the PEO.

Fluoropolymer (teflon) in treated air internal environment

Unlike metals, fluoropolymer (teflon) does not display corrosion rates. Rather than depending on an oxide layer for protection, it depends on chemical resistance to the environment to which it is exposed. Teflon is highly resistant to normal environments and degrades in a radiation environment; however, in a treated air internal environment such as IA, teflon is impervious to aging effect. Therefore, fluoropolymer (teflon) in a treated air internal environment exhibits no aging effect, and the component or structure will remain capable of performing its intended functions consistent with the CLB for the PEO.

SS braid/teflon liner in air-indoor internal environment

Unlike metals, teflon does not display corrosion rates. Rather than depending on an oxide layer for protection, it depends on chemical resistance to the environment to which it is exposed. It degrades in a radiation environment; however, in an air-indoor internal environment, teflon is impervious to aging effect. Therefore, teflon in an air-indoor internal environment exhibits no aging effect, and the component or structure will remain capable of performing its intended functions consistent with the CLB for the PEO.

SS braid/teflon liner in halon internal environment

Unlike metals, teflon does not display corrosion rates. Rather than depending on an oxide layer for protection, it depends on chemical resistance to the environment to which it is exposed. It degrades in a radiation environment; however, in an inert gas environment such as halon, teflon is impervious to aging effect. Therefore, teflon in a halon internal environment exhibits no aging effect, and the component or structure will remain capable of performing its intended functions consistent with the CLB for the PEO.

SS in an air-outdoor environment

In some Table 2's, PNPS has stated "None-None" for AERM/AMP combination for SS bolting in an air-outdoor environment; however, in Tables 3.3.2-5 and 3.3.2-9, PNPS identified loss of material as an aging effect for the same material/environment combination and credited the System Walkdown Program to manage this aging effect. The applicant was asked to clarify this discrepancy.

In its response**,** the applicant stated that the only table that did not identify loss of material for SS bolting in an air-outdoor environment was Table 3.3.2-7 for the fuel oil system. Loss of material is an AERM that should have been identified for the SS bolting with an environment of air-outdoor.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the LRA Table 3.3.2-7 line item for component bolting, material SS, environment air-outdoor is revised as follows:

> Bolting// Pressure boundary//stainless steel//air – outdoor (ext) // Loss of material //Bolting Integrity // // // G

The letter also included a writeup of PNPS AMP B.1.33, "Bolting Integrity Program." The evaluation of this program is documented in Section 3.0.3.2.20 of this audit and review report.

On the basis of its review of current industry research and operating experience, the project team found that condensation external, air-indoor internal, fuel oil, and various other environments on aluminum, glass, titanium, copper alloy greater than 15-percent zinc, copper alloy less than 15-percent zinc, plastic, fiberglass, and SS material will not result in aging that will be of concern during the PEO. Therefore, the project team concluded that there are no applicable AERMs for aluminum, glass, titanium, copper alloy greater than 15-percent zinc, copper alloy less than 15-percent zinc, plastic, fiberglass, and SS material components exposed to condensation external, air-indoor internal, fuel oil, and various other environments.

On the basis of its audit and review of the applicant's program, the project team found that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.3.2.3.1 SLC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-1

The project team reviewed PNPS LRA Table 3.3.2-1, which summarizes the results of AMR evaluations for the SLC system component groups.

In LRA Table 3.3.2-1, the applicant proposed to manage loss of material of carbon steel coated materials for tanks exposed to a sodium pentaborate internal environment using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that SLC system UT or other NDE techniques are used to verify remaining wall thickness to manage loss of material from internal surfaces of the carbon steel discharge accumulators (component group – tank). On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the wall thickness will be periodically measured, the aging effect of loss of material of carbon steel coated tank exposed to a sodium pentaborate internal environment is effectively managed using the Periodic Surveillance and Preventive Maintenance Program. On this basis, the project team found that management of loss of material in the SLC system is acceptable.

3.3.2.3.2 SSW System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-2

The project team reviewed PNPS LRA Table 3.3.2-2, which summarizes the results of AMR evaluations for the SSW system component groups.

In Table 3.3.2-2, the applicant proposed to manage loss of material for nickel alloy material for component types of bolting and valve body exposed to an external environment of condensation using PNPS AMP B.1.30, "System Walkdown Program."

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of nickel alloy bolting and valve body exposed to an external environment of condensation is effectively managed using the Service Water Integrity Program.

In Table 3.3.2-2, the applicant proposed to manage loss of material for titanium material for component types of piping and thermowells exposed to an environment of raw water using PNPS AMP B.1.28, "Service Water Integrity Program."

The project team reviewed the Service Water Integrity Program, and its evaluation is documented in Section 3.0.3.2.16 of this audit and review report. The Service Water Integrity Program includes surveillance and control techniques such as visual inspection, eddy current testing, and other NDE techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the SSW system or SCs serviced by the SSW system. The project team reviewed the applicant's plant-specific operating experience and found that a number of components in 2004 had revealed areas of erosion and corrosion on the internal and external surfaces. The inspections also found that the lining in original carbon steel rubber lined piping had deteriorated. The applicant has since replaced the components using corrosion-resistant materials such as titanium. Identification of the degradation and appropriate corrective action provide adequate assurance that the program is effective. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team

found that the aging effect of loss of material of titanium piping and thermowells exposed to an environment of raw water is effectively managed using the Service Water Integrity Program.

In Table 3.3.2-2, the applicant proposed to manage loss of material for copper alloy less than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of treated water using PNPS AMP B.1.28, "Service Water Integrity Program."

The project team reviewed the Service Water Integrity Program, and its evaluation is documented in Section 3.0.3.2.16 of this audit and review report. The Service Water Integrity Program includes surveillance and control techniques such as visual inspection, eddy current testing, and other NDE techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the SSW system or SCs serviced by the SSW system. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of copper alloy less than 15-percent zinc heat exchanger tubes exposed to an external environment of treated water is effectively managed using the Service Water Integrity Program.

In Table 3.3.2-2, the applicant proposed to manage loss of material for titanium material for component types of piping exposed to an external environment of soil using PNPS AMP B.1.2, "Buried Piping and Tanks Inspection Program."

The project team reviewed the Buried Piping and Tanks Inspection Program, and its evaluation is documented in Section 3.0.3.2.1 of this audit and review report. The Buried Piping and Tanks Inspection Program is a new program that includes inspections of buried titanium components to manage the effects of loss of material due to corrosion. Buried components are inspected when excavated during maintenance. Although this is a new program, it will be consistent with GALL AMP XI.M34, "Buried Piping and Tanks Inspection," with an exception where the applicant may use methods such as phased array UT technology for wall thickness measurement of buried piping without excavation. If an opportunistic inspection cannot occur within a 10-year period, focused inspection will be performed. On this basis, the project team found that the aging effect of loss of material of titanium piping exposed to an external environment of soil is effectively managed using the Buried Piping and Tanks Inspection Program.

3.3.2.3.3 RBCCW System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-3

The project team reviewed PNPS LRA Table 3.3.2-3, which summarizes the results of AMR evaluations for the RBCCW system component groups.

In Table 3.3.2-3, the applicant proposed to manage loss of material for copper alloy less than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of treated water using PNPS AMP B.1.28, "Service Water Integrity Program."

The project team reviewed the Service Water Integrity Program, and its evaluation is documented in Section 3.0.3.2.16 of this audit and review report. The Service Water Integrity Program includes surveillance and control techniques such as visual inspection, eddy current

testing, and other NDE techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the SSW system or SCs serviced by the SSW system. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of copper alloy less than 15-percent zinc heat exchanger tubes exposed to an external environment of treated water is effectively managed using the Service Water Integrity Program.

In Table 3.3.2-3, the applicant proposed to manage loss of material for copper alloy greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of air-indoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for reactor building CCW system, visual or other NDE techniques are used to inspect a representative sample of the in scope RBCCW copper alloy cooling coils to manage loss of material. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the heat exchanger tubes will be periodically inspected, the aging effect of loss of material of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of indoor air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-3, the applicant proposed to manage loss of material for copper alloy greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environments of treated water and lube oil using PNPS AMP B.1.15, "Heat Exchanger Monitoring Program."

The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program is a new plant-specific program that will inspect heat exchangers for degradation. Representative tubes within the sample population of heat exchangers will be eddy current tested at a frequency determined by internal and external operating experience to ensure that effects of aging are identified before loss of intended function. Along with each eddy current test, visual inspections will be performed on accessible heat exchanger heads, covers, and tube sheets to monitor surface condition for indications of loss of material. On the basis that the EDG lube oil coolers and the HPCI gland seal condenser that are included in the sample population have the same material and environment as the heat exchangers in the reactor building cooling water system, the project team found that the aging effect of loss of material of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of treated water and lube oil is effectively managed using the Heat Exchanger Monitoring Program.

3.3.2.3.4 EDG System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-4

The project team reviewed PNPS LRA Table 3.3.2-4, which summarizes the results of AMR evaluations for the EDG system component groups.

In Table 3.3.2-4, the applicant proposed to manage loss of material for copper alloy greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of treated water and lube oil using PNPS AMP B.1.15, "Heat Exchanger Monitoring Program."

The project team reviewed the Heat Exchanger Monitoring Program, and its evaluation is documented in Section 3.0.3.3.1 of this audit and review report. The Heat Exchanger Monitoring Program is a new plant-specific program that will inspect heat exchangers for degradation. Representative tubes within the sample population of heat exchangers will be eddy current tested at a frequency determined by internal and external operating experience to ensure that effects of aging are identified before loss of intended function. Along with each eddy current test, visual inspections will be performed on accessible heat exchanger heads, covers, and tube sheets to monitor surface condition for indications of loss of material. On the basis that the EDG lube oil coolers are included in the sample population, the project team found that the aging effect of loss of material of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of treated water and lube oil is effectively managed using the Heat Exchanger Monitoring Program.

In Table 3.3.2-4, the applicant proposed to manage loss of material for copper alloy greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of air-indoor and air-outdoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for the EDG system, PNPS visually inspects A/B EDG jacket water radiators to manage loss of material and fouling. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the heat exchanger tubes will be periodically inspected, the aging effect of loss of material of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of indoor air and outdoor air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-4, the applicant proposed to manage fouling of copper alloy greater than15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of air-indoor and air-outdoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for EDG system,

PNPS performs EDG surveillance test (loaded) to manage fouling for heat exchanger tubes. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the heat exchanger tubes will be periodically tested, the aging effect of fouling of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of indoor air and outdoor air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-4, the applicant proposed to manage cracking of SS material for component types of strainers and valve body exposed to an internal and external environment of lube oil using PNPS AMP B.1.22, "Oil Analysis Program."

The project team reviewed the Oil Analysis Program, and its evaluation is documented in Section 3.0.3.2.13 of this audit and review report. The Oil Analysis Program description states that the program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. The applicant's response and its evaluation are documented in Section 3.3.2.1.17 of this audit and review report.

In Table 3.3.2-4, the applicant proposed to manage cracking due to fatigue of SS and carbon steel material for component types of expansion joint, turbocharger housing, piping, and silencer exposed to an internal environment of exhaust gas and air-untreated using metal fatigue TLAA.

The project team reviewed TLAA Section 4.3.2, "Non-Class 1 Fatigue," and its evaluation is documented in Section 4.3.2 of the SER. However, it is not clear if expansion joints and turbocharger housing are included in this section. The project team asked the applicant to clarify if these components were included in TLAA Section 4.3.2. The project team also asked the applicant to justify why PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program," is not credited for inspection of these components. The program description does include visual or NDE inspection of EDG exhaust components.

In its response, the applicant stated that the expansion joints and turbocharger were designed per the requirements of ANSI B31.1 for a limited number of thermal cycles. The evaluation of fatigue is therefore discussed in Section 4.3.2. The applicant further stated that the exhaust systems of SBO and security diesel generators are not designed to a code or standard where thermal cycles are a consideration. Therefore, the Periodic Surveillance and Preventive Maintenance Program will manage the aging effect of cracking due to thermal fatigue. On this basis, the project team found the applicant's response to be acceptable.

3.3.2.3.5 SBO Diesel Generator System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-5

The project team reviewed PNPS LRA Table 3.3.2-5, which summarizes the results of AMR evaluations for the SBO diesel generator system component groups.

In Table 3.3.2-5, the applicant proposed to manage loss of material of SS material for component types of bolts exposed to an external environment of air-outdoor using PNPS AMP B.1.30, "System Walkdown Program."

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of SS bolting exposed to an external environment of air-outdoor is effectively managed using the System Walkdown Program.

In Table 3.3.2-5, the applicant proposed to manage fouling of copper alloy greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of air-indoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for the SBO diesel generator system, PNPS performs SBD generator surveillance test (loaded) to manage fouling for heat exchanger tubes. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the heat exchanger tubes will be periodically tested, the aging effect of fouling of copper alloy greater than 15-percent zinc heat exchanger tubes exposed to an external environment of indoor air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-5, the applicant proposed to manage fouling of aluminum material for component types of heat exchanger fins and loss of material for SS radiator tubes exposed to an external environment of air-indoor or air-outdoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for the SBO diesel generator system, PNPS visually inspects SBO jacket water radiators to manage loss of material and fouling. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of fouling of aluminum heat exchanger fins and loss of material of radiator tubes exposed to an external environment of air-indoor and air-outdoor is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-5, the applicant proposed to manage loss of material of carbon steel, SS, copper alloys less than and greater than 15-percent zinc for component types of filter housing, lubricator housing, motor housing, piping, strainer housing, tank, tubing and valve body exposed to an internal environment of treated air using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that visual or other NDE techniques are used to inspect a representative sample of SBO diesel intake air, air start, and exhaust components to manage loss of material, cracking, and fouling.

On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of loss of material of carbon steel, SS, copper alloys less than and greater than 15-percent zinc components exposed to an internal environment of treated air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-5, the applicant proposed to manage cracking due to fatigue of SS and carbon steel material for component types of turbocharger housing, piping, and silencer exposed to an internal environment of exhaust gas using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that visual or other NDE techniques are used to inspect a representative sample of SBO diesel intake air, air start, and exhaust components to manage loss of material, cracking, and fouling.

On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of cracking of carbon steel, SS, copper alloys less than and greater than 15-percent zinc components exposed to an internal environment of exhaust gas is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-5, the applicant proposed to manage cracking of SS material for component types of strainers and tubing exposed to an internal environment of lube oil using PNPS AMP B.1.22, "Oil Analysis Program."

The project team reviewed the Oil Analysis Program, and its evaluation is documented in Section 3.0.3.2.13 of this audit and review report. The Oil Analysis Program description states that the program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection

has not been performed. The applicant's response and its evaluation are documented in Section 3.3.2.1.17 of this audit and review report.

3.3.2.3.6 Security Diesel Generator System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-6

The project team reviewed PNPS LRA Table 3.3.2-6, which summarizes the results of AMR evaluations for the security diesel generator system component groups.

In Table 3.3.2-6, the applicant proposed to manage fouling of copper alloy greater than 15-percent zinc and carbon steel material for component types of heat exchanger radiator and tubes exposed to an external environment of air-indoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for the security diesel generator system, PNPS performs security diesel generator surveillance tests (loaded) to manage fouling for heat exchanger tubes. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically tested, the aging effect of fouling of copper alloy greater than 15-percent zinc and carbon steel heat exchanger radiator and tubes exposed to an external environment of indoor air is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-6, the applicant proposed to manage loss of material for carbon steel and copper alloy greater than 15-percent zinc heat exchanger radiator and tubes exposed to an external environment of air-indoor using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that for the security diesel generator system, PNPS visually inspects security diesel jacket water radiators to manage loss of material and fouling. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of loss of material of heat exchanger radiator and tubes exposed to an external environment of air-indoor and air-outdoor is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

In Table 3.3.2-6, the applicant proposed to manage loss of material of carbon steel material for component types of heat exchanger tubes exposed to an external environment of lube oil using PNPS AMP B.1.22, "Oil Analysis Program."

The project team reviewed the Oil Analysis Program, and its evaluation is documented in Section 3.0.3.2.13 of this audit and review report. The Oil Analysis Program description states that the program maintains oil systems free of contaminants (primarily water and particulates),

thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. The applicant's response and its evaluation are documented in Section 3.3.2.1.17 of this audit and review report.

In Table 3.3.2-6, the applicant proposed to manage cracking due to fatigue of carbon steel and gray cast iron material for component types of turbocharger housing, piping, and silencer exposed to an internal environment of exhaust gas using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that visual or other NDE techniques are used to inspect a representative sample of SBO diesel intake air, air start, and exhaust components to manage loss of material, cracking, and fouling.

On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of cracking of carbon steel and gray cast iron components exposed to an internal environment of exhaust gas is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

3.3.2.3.7 Fuel Oil System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-7

The project team reviewed PNPS LRA Table 3.3.2-7, which summarizes the results of AMR evaluations for the fuel oil system component groups. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.8 IA System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-8

The project team reviewed PNPS LRA Table 3.3.2-8, which summarizes the results of AMR evaluations for the IA system component groups. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.9 Fire Protection – Water System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-9

The project team reviewed PNPS LRA Table 3.3.2-9, which summarizes the results of AMR evaluations for the fire protection – water system component groups.

In Table 3.3.2-9, the applicant proposed to manage loss of material and fouling of gray cast iron and copper alloy greater than15-percent zinc material for component types of heat exchanger

shell and tubes; and piping, pump casing, and tanks exposed to an internal environment of treated water using PNPS AMP B.1.13.1, “Fire Protection Program.”

The project team reviewed the Fire Protection Program, and its review is documented in Section 3.0.3.2.10 of this audit and review report. However, the Fire Protection Program description does not include these components nor has the program been enhanced to include these components. The applicant was asked to clarify how the Fire Protection Program will manage these aging effects for these components. In its response, the applicant stated that as identified in LRA Appendix B.1.13.1, procedures will be enhanced to verify that the diesel engine does not exhibit signs of degradation while running. Included in the scope of this test are components that have an environment of lube oil, fuel oil, treated water, and exhaust gas. Through monitoring and trending of performance data, specifically jacket cooling water, fouling and loss of material for the fire pump diesel jacket water heat exchanger will be identified and corrected through the corrective action program. On the basis that the applicant has appropriately identified these components in the program writeup, the project team found the response to be acceptable.

In Table 3.3.2-9, the applicant proposed to manage cracking due to fatigue of carbon steel material for component types of piping, silencer, and turbocharger exposed to an internal environment of exhaust gas using PNPS AMP B.1.13.1, “Fire Protection Program.”

The project team reviewed the Fire Protection Program, and its review is documented in Section 3.0.3.2.10 of this audit and review report. Program Element 6, “acceptance criteria,” is enhanced to verify that the diesel engine did not exhibit signs of degradation, such as exhaust gas leakage, while it was running. The project team did not consider verifying for leakage an adequate AMP for managing cracking. If there is leakage, it implies a through-wall crack has occurred. The applicant was asked to justify how the aging effect of cracking is managed by verifying for exhaust gas leakage. The applicant’s response and its evaluation are documented in Section 3.3.2.2.7.3 of this audit and review report.

In Table 3.3.2.9, the applicant proposed to manage loss of material of carbon steel, gray cast iron, SS, copper alloy greater than 15-percent zinc and copper alloy less than 15-percent zinc material for component types of hydrants, nozzle, orifice, piping, pump casing, strainer, strainer housing, tank, tubing, and valve body exposed to an internal environment of treated water using PNPS AMP B.1.13.2, “Fire Water System Program.”

The project team reviewed the Fire Water System Program, and its review is documented in Section 3.0.3.2.11 of this audit and review report. This program is consistent with GALL AMP XI.M27, “Fire Water System,” with enhancements and an exception. On the basis of its review of the applicant’s plant-specific and industry operating experience, the project team found that since these components will be periodically inspected and tested, the aging effect of loss of material of carbon steel, gray cast iron, SS, copper alloy greater than 15-percent zinc, and copper alloy less than 15-percent zinc components exposed to an internal environment of treated water is effectively managed using the Fire Water System Program.

In Table 3.3.2-9, the applicant proposed to manage cracking of SS material for component types of strainer exposed to an external environment of lube oil using PNPS AMP B.1.22, "Oil Analysis Program."

The project team reviewed the Oil Analysis Program, and its evaluation is documented in Section 3.0.3.2.13 of this audit and review report. The Oil Analysis Program description states that the program maintains oil systems free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results. The applicant depends on operating experience at PNPS to verify the effectiveness of the Oil Analysis Program. The project team asked the applicant how it can make this statement if inspection has not been performed. The applicant's response and its evaluation are documented in Section 3.3.2.1.17 of this audit and review report.

In Table 3.3.2-9, the applicant proposed to manage loss of material of SS material for component types of bolts exposed to an external environment of air-outdoor using PNPS AMP B.1.30, "System Walkdown Program."

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that the aging effect of loss of material of SS bolting exposed to an external environment of air-outdoor is effectively managed using the System Walkdown Program.

3.3.2.10 Fire Protection – Halon System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-10

The project team reviewed PNPS LRA Table 3.3.2-10, which summarizes the results of AMR evaluations for the fire protection – water system component groups. The results of these evaluations are all consistent with the GALL Report.

3.3.2.11 HVAC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-11

The project team reviewed PNPS LRA Table 3.3.2-11, which summarizes the results of AMR evaluations for the HVAC system component groups.

In Table 3.3.2-11, the applicant proposed to manage fouling of copper alloy with greater than 15-percent zinc material for component types of heat exchanger tubes exposed to an external environment of condensation using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic

Surveillance and Preventive Maintenance Program description states that visual or other NDE techniques are used to inspect the air side of copper alloy tubes of heat exchangers to manage loss of material and fouling. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected, the aging effect of fouling of copper alloy with greater than 15-percent zinc components exposed to an external environment of condensation is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

3.3.2.12 PCAC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-12

The project team reviewed PNPS LRA Table 3.3.2-12, which summarizes the results of AMR evaluations for the PCAC system component groups. The results of these evaluations are all consistent with the GALL Report.

3.3.2.13 FPC and Fuel Handling and Storage System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-13

The project team reviewed PNPS LRA Table 3.3.2-13, which summarizes the results of AMR evaluations for the FPC and fuel handing and storage system component groups.

In Table 3.3.2-13, the applicant proposed to manage cracking of aluminum/boron carbide material for component types of neutron absorber (boral) exposed to an external environment of treated water using PNPS AMP B.1.32.2, "Water Chemistry Control – BWR Program." Furthermore, in a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that for LRA Table 3.3.2-13, line items for the component type neutron absorber with aging effects "loss of material" and "cracking" are revised to indicate that these aging effects are managed by the Water Chemistry Control – BWR Program. The line items will now use Note H, "Aging effect not in NUREG- 1801 for this component, material and environment combination."

The project team reviewed the Water Chemistry Control – BWR Program, and its evaluation is documented in Section 3.0.3.1.13 of this audit and review report. This program is consistent with GALL AMP XI.M2, "Water Chemistry." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the water chemistry will be periodically monitored and controlled within established levels of contaminants, the aging effect of cracking of aluminum/boron carbide neutron absorber (boral) components exposed to an external environment of treated water is effectively managed using the Water Chemistry Control – BWR Program. However, for those line items in Table 3.3.2-13, where the Water Chemistry Control – BWR Program is credited, the applicant did not indicate how it proposes to verify the effectiveness of the water chemistry control program. The project team asked the applicant to justify why a verification program was not credited. The applicant's response and its evaluation are documented in Section 3.3.2.2.3.2 of this audit and review report.

3.3.2.3.14 CAS – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-2

The project team reviewed PNPS LRA Table 3.3.2-14-2, which summarizes the results of AMR evaluations for the CAS NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.15 CRD System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-6

The project team reviewed PNPS LRA Table 3.3.2-14-6, which summarizes the results of AMR evaluations for the CRD system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.16 EDG System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-8

The project team reviewed PNPS LRA Table 3.3.2-14-8, which summarizes the results of AMR evaluations for the EDG system NSR component groups affecting safety-related systems.

In Table 3.3.2-14-8, the applicant proposed to manage cracking and loss of material of SS material for component types of piping and valve body exposed to an internal environment of untreated air using PNPS AMP B.1.23, "One-Time Inspection Program."

The project team reviewed the One-Time Inspection Program, and its evaluation is documented in Section 3.0.3.1.8 of this audit and review report. The One-Time Inspection Program is a new program, which when implemented will be consistent with GALL AMP XI.M32, "One-Time Inspection." The program description states that for internal surfaces and EDG system components containing untreated air, OTI activity will confirm that cracking and loss of material are not occurring or are so insignificant that an AMP is not warranted. Normally an OTI by itself may not be adequate for managing aging effects. However, SS in an untreated air environment may exhibit an insignificant loss of material due to the moisture present in the air, and the OTI would confirm if any aging is occurring. Similarly, for cracking to occur in SS, a corrosive atmosphere in the presence of moisture needs to occur and a temperature greater than 140°F needs to be present. Neither of these conditions are present in an untreated air environment, but the applicant has conservatively assumed that cracking could occur. Again, an OTI would confirm if there is any cracking. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be inspected one time before the PEO to confirm if any aging has occurred, the aging effect of cracking and loss of material of SS components exposed to an internal environment of untreated air is effectively managed using the One-Time Inspection Program.

3.3.2.3.17 Fire Protection System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-12

The project team reviewed PNPS LRA Table 3.3.2-14-12, which summarizes the results of AMR evaluations for the fire protection system NSR component groups affecting safety-related systems.

In Table 3.3.2-14-12, the applicant proposed to manage loss of material of SS, carbon steel, gray cast iron, copper alloy with greater than 15-percent zinc, and copper alloy with less than 15-percent zinc material for component types of nozzle, orifice, piping, tubing, and valve body exposed to an internal environment of treated water using PNPS AMP B.1.13.2, "Fire Water System Program."

The project team reviewed the Fire Water System Program, and its review is documented in Section 3.0.3.2.11 of this audit and review report. This program is consistent with GALL AMP XI.M27, "Fire Water System," with enhancements and an exception. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected and tested, the aging effect of loss of material of carbon steel, gray cast iron, SS, copper alloy with greater than 15-percent zinc, and copper alloy with less than 15-percent zinc components exposed to an internal environment of treated water is effectively managed using the Fire Water System Program.

3.3.2.3.18 Fuel Oil Storage and Transfer System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-13

The project team reviewed PNPS LRA Table 3.3.2-14-13, which summarizes the results of AMR evaluations for the fuel oil storage and transfer system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.19 FPC and Demineralizer System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-14

The project team reviewed PNPS LRA Table 3.3.2-14-14, which summarizes the results of AMR evaluations for the FPC and demineralizer system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.20 HVAC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-15

The project team reviewed PNPS LRA Table 3.3.2-14-15, which summarizes the results of AMR evaluations for the HVAC system NSR component groups affecting safety-related systems.

In Table 3.3.2-11, the applicant proposed to manage cracking and change in material properties of elastomer material for component types of expansion joints exposed to an internal

environment of treated water using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program."

The project team reviewed the Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The Periodic Surveillance and Preventive Maintenance Program description states that fan duct flexible connections in HVAC systems are visually inspected and manually flexed to manage cracking and change in material properties. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since these components will be periodically inspected and manually flexed, the aging effect of cracking and change in material properties of elastomer components exposed to an internal environment of treated water is effectively managed using the Periodic Surveillance and Preventive Maintenance Program.

3.3.2.3.21 Offgas and AOG System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-19

The project team reviewed PNPS LRA Table 3.3.2-14-19, which summarizes the results of AMR evaluations for the offgas and AOG system NSR component groups affecting safety-related systems.

In Table 3.3.2-19, the applicant proposed to manage cracking due to fatigue of SS material for component types of thermowells, tubing, and valve body exposed to an internal environment of steam greater than 270°F using metal fatigue TLAA. The evaluation of metal fatigue is documented in Section 4.3.2 of this audit and review report.

3.3.2.3.22 PASS – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-20

The project team reviewed PNPS LRA Table 3.3.2-14-20, which summarizes the results of AMR evaluations for the PASS NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.23 Potable and Sanitary Water System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-21

The project team reviewed PNPS LRA Table 3.3.2-14-21, which summarizes the results of AMR evaluations for the potable and sanitary water system NSR component groups affecting safety-related systems.

In Table 3.3.2-21, the applicant proposed to manage loss of material of carbon steel, SS, copper alloy with greater than 15-percent zinc, and copper alloy with less than 15-percent zinc material for component types of orifice, piping, pump casing, strainer housing, tubing, and valve body exposed to an internal environment of treated water using PNPS AMP B.1.32.1, "Water Chemistry Control – Auxiliary Systems Program."

The project team reviewed the Water Chemistry Control – Auxiliary Systems Program, and its evaluation is documented in Section 3.0.3.3.6 of this audit and review report. The program

monitors conductivity, corrosion products, and dissolved oxygen in accordance with industry recommendations. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the water chemistry will be periodically monitored and controlled within established levels of contaminants, the aging effect of loss of material of carbon steel, SS, copper alloy greater than15-percent zinc, and copper alloy less than 15-percent zinc material for component types of orifice, piping, pump casing, strainer housing, tubing, and valve body exposed to an internal environment of treated water is effectively managed using the Water Chemistry Control – Auxiliary Systems Program.

3.3.2.3.24 PCAC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-22

The project team reviewed PNPS LRA Table 3.3.2-14-22, which summarizes the results of AMR evaluations for the PCAC system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.25 Radioactive Waste System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-23

The project team reviewed PNPS LRA Table 3.3.2-14-23, which summarizes the results of AMR evaluations for the radioactive waste system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.26 RBCCW System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-24

The project team reviewed PNPS LRA Table 3.3.2-14-24, which summarizes the results of AMR evaluations for the RBCCW system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.27 RCS – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-26

The project team reviewed PNPS LRA Table 3.3.2-14-26, which summarizes the results of AMR evaluations for the RCS NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.28 RWCU System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-27

The project team reviewed PNPS LRA Table 3.3.2-14-27, which summarizes the results of AMR evaluations for the RWCU NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.29 SSW System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-29

The project team reviewed PNPS LRA Table 3.3.2-14-29, which summarizes the results of AMR evaluations for the SSW NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.30 Sampling System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-30

The project team reviewed PNPS LRA Table 3.3.2-14-30, which summarizes the results of AMR evaluations for the sampling NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.31 Sanitary Soiled Waste and Vent; Plumbing and Drains System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-31

The project team reviewed PNPS LRA Table 3.3.2-14-31, which summarizes the results of AMR evaluations for the sanitary soiled waste and vent; plumbing and drains NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.32 Screen Wash System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-32

The project team reviewed PNPS LRA Table 3.3.2-14-32, which summarizes the results of AMR evaluations for the screen wash NSR component groups affecting safety-related systems.

In Table 3.3.2-32, the applicant proposed to manage loss of material of nickel alloy material for component types of piping exposed to an external environment of condensation using PNPS AMP B.1.30, “System Walkdown Program.”

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, “External Surfaces Monitoring Program.” On the basis of its review of the applicant’s plant-specific and industry operating experience, the project team found that the aging effect of loss of material of nickel alloy piping exposed to an external environment of condensation is effectively managed using the System Walkdown Program.

3.3.2.3.33 SLC System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-33

The project team reviewed PNPS LRA Table 3.3.2-14-33, which summarizes the results of AMR evaluations for the SLC NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.3.2.3.34 TBCCW System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-34

The project team reviewed PNPS LRA Table 3.3.2-14-34, which summarizes the results of AMR evaluations for the TBCCW NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

Conclusion

On the basis of its review, the project team found that the applicant appropriately evaluated AMR results involving material, environment, AERMs, and AMP combinations that are not addressed in the GALL Report.

3.3.3 Conclusion

On the basis of its review, the project team concluded that the applicant has demonstrated that the aging effects associated with the auxiliary systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the auxiliary systems components, as required by 10 CFR 54.21(d).

3.4 Aging Management of Steam and Power Conversion System

This section of the audit and review report documents the project team's review and evaluation of PNPS AMR results for the aging management of the S&PC system component and component groups associated with the following systems:

- condensate storage system
- MS system, turbine-generator and auxiliaries, and main condenser
- miscellaneous systems within the S&PC system in scope for 10 CFR 54.4(a)(2) (these S&PC subsystems are included by PNPS in LRA Section 3.3, "Auxiliary Systems," but are evaluated in this section)

3.4.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.4, the applicant provided the results of its AMRs for the S&PC system components and component groups.

In PNPS LRA Table 3.4.1, "Summary of Aging Management Program for Steam and Power Conversion System," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the S&PC system components and component groups. The applicant also identified for each component type in PNPS LRA Table 3.4.1 those components that are consistent with the GALL Report, those components for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In PNPS LRA Tables 3.4.2-1 and 3.4.2-2, the applicant provided a summary of the AMR results for component types associated with the (1) condensate storage system, (2) MS system, (3) turbine-generator and auxiliaries, and (4) main condenser system.

In PNPS LRA Tables 3.3.2-14-1, 3.3.2-14-3 through 3.3.2-14-5, 3.3.2-14-9 through 3.3.2-14-11, 3.3.2-14-17, 3.3.2-14-18, and 3.3.2-14-35, the applicant provided results for component types associated with the following S&PC subsystems in scope for 10 CFR 54.4(a)(2):

- CWS, NSR components affecting safety-related systems
- condensate system, NSR components affecting safety-related systems
- CDS, NSR components affecting safety-related systems
- CST system, NSR components affecting safety-related systems
- extraction steam system, NSR components affecting safety-related systems
- feedwater system, NSR components affecting safety-related systems
- feedwater heater drains and vents system, NSR components affecting safety-related systems
- main condenser system, NSR components affecting safety-related systems
- MS system, NSR components affecting safety-related systems
- turbine generator and auxiliary system, NSR components affecting safety-related systems

Specifically, the information for each component type includes intended function, material, environment, AERM, AMPs, the GALL Report Volume 2 item, cross-reference to PNPS LRA Table 3.4.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporated applicable operating experience in the determination of AERMs. These reviews included evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.4.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.4 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the S&PC system components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.4.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further evaluations were in accordance with the acceptance criteria in the SRP-LR. The project team's audit evaluation is documented in Section 3.4.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report to determine whether or not these AMRs are technically acceptable. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.4.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the S&PC system components.

Table 3.4-1 below provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in LRA Section 3.4 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.4-1 Project Team Evaluation for Steam and Power Conversion System Components in the GALL Report

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-1	Steel piping, piping components, and piping elements exposed to steam or treated water	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.1.
3.4.1-2	Steel piping, piping components, and piping elements exposed to steam	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.2.1.
3.4.1-4	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.2.1.
3.4.1-5	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Water Chemistry (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.9.
3.4.1-6	Steel and SS tanks exposed to treated water	Loss of material due to general (steel only) pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry– BWR (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Sections 3.4.2.2.7.1 and 3.4.2.2.2.1 for steel tanks.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-7	Steel piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis (B.1.22)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.2.2.
3.4.1-8	Steel piping, piping components, and piping elements exposed to raw water	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling	Plant-specific	Periodic Surveillance and Preventive Maintenance (B.1.24)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.3.
3.4.1-9	SS and copper alloy heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.4.2.2.4.1.
3.4.1-10	Steel, SS, and copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.4.2.2.4.2.
3.4.1-11	Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	None	Not applicable to PNPS. See audit report Section 3.4.2.2.5.1.
3.4.1-12	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	None	Not applicable to PNPS. See audit report Section 3.4.2.2.5.2.
3.4.1-13	SS piping, piping components, and piping elements exposed to steam	Cracking due to SCC	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.6.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-14	SS piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water> 140°F	Cracking due to SCC	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.6.
3.4.1-15	Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.7.1.
3.4.1-16	SS piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Water Chemistry – BWR (B.1.32.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.7.1.
3.4.1-17	SS piping, piping components, and piping elements exposed to soil	Loss of material due to pitting and crevice corrosion	Plant-specific	Buried Piping and Tanks Inspection (B.1.2)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.7.2.
3.4.1-18	Copper alloy piping, piping components, and piping elements exposed to lubricating oil	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis (B.1.22)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.7.3.
3.4.1-19	SS piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Oil Analysis (B.1.22)	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.4.2.2.8.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-20	Steel tanks exposed to air-outdoor (external)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	System Walkdown Program (B.1.30)	Consistent with GALL Report. See audit report Section 3.4.2.1.1.
3.4.1-21	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, SCC	Bolting Integrity	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-22	Steel bolting and closure bolting exposed to air with steam or water leakage, air-outdoor (external), or air-indoor uncontrolled (external)	Loss of material due to general, pitting, and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	Bolting Integrity Program (B.1.33)	Consistent with GALL Report. See audit report Section 3.4.2.1.2.
3.4.1-23	SS piping, piping components, and piping elements exposed to CCW > 140°F	Cracking due to SCC	Closed-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-24	Steel heat exchanger components exposed to CCW	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-25	SS piping, piping components, piping elements, and heat exchanger components exposed to CCW	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-26	Copper alloy piping, piping components, and piping elements exposed to CCW	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-27	Steel, SS, and copper alloy heat exchanger tubes exposed to CCW	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-28	Steel external surfaces exposed to air-indoor uncontrolled (external), condensation (external), or air-outdoor (external)	Loss of material due to general corrosion	External Surfaces Monitoring	System Walkdown Program (B.1.30)	Consistent with GALL Report. See audit report Section 3.4.2.1.
3.4.1-29	Steel piping, piping components, and piping elements exposed to steam or treated water	Wall thinning due to FAC	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (B.1.11)	Consistent with GALL Report. See audit report Section 3.4.2.1.
3.4.1-30	Steel piping, piping components, and piping elements exposed to air-outdoor (internal) or condensation (internal)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with GALL Report. See audit report Section 3.4.2.1.1.
3.4.1-31	Steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with GALL Report. See audit report Section 3.4.2.1.3.
3.4.1-32	SS and copper alloy piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	Periodic Surveillance and Preventive Maintenance Program (B.1.24)	Consistent with GALL Report. See audit report Section 3.4.2.1.3.
3.4.1-33	SS heat exchanger components exposed to raw water	Loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling	Open-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-34	Steel, SS, and copper alloy heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-35	Copper alloy >15% zinc piping, piping components, and piping elements exposed to CCW, raw water, or treated water	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching of Materials (B.1.25)	Consistent with GALL Report. See audit report Section 3.4.2.1.
3.4.1-36	Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water	Loss of material due to selective leaching	Selective Leaching of Materials	Selective Leaching of Materials (B.1.25)	Consistent with GALL Report. See audit report Section 3.4.2.1.
3.4.1-37	Steel, SS, and nickel-based alloy piping, piping components, and piping elements exposed to steam	Loss of material due to pitting and crevice corrosion	Water Chemistry	Water Chemistry – BWR (B.1.32.2)	Consistent with GALL Report. See audit report Section 3.4.2.1.
3.4.1-40	Glass piping elements exposed to air, lubricating oil, raw water, and treated water	None	None	None	Consistent with GALL Report. See audit report Section 3.4.2.3.2.
3.4.1-41	SS, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external)	None	None	None	Consistent with GALL Report. See audit report Section 3.4.2.3.2.
3.4.1-42	Steel piping, piping components, and piping elements exposed to air-indoor controlled (external)	None	None	None	Not applicable to PNPS. See audit report Section 3.4.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.4.1-43	Steel and SS piping, piping components, and piping elements in concrete	None	None	None	Not applicable to PNPS. See audit report Section 3.4.2.3.
3.4.1-44	Steel, SS, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas	None	None	None	Not applicable to PNPS. See audit report Section 3.4.2.3.

3.4.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Sections 3.4.2.1 and 3.3.2.1.14, the applicant identified the materials, environments, AERMs, and AMPs for the following S&PC systems:

- condensate storage system
- MS system, turbine-generator and auxiliaries, and main condenser
- miscellaneous systems within the S&PC system in scope for 10 CFR 54.4(a)(2)

The applicant identified the following programs that manage the aging effects related to the above S&PC systems:

- Buried Piping and Tanks Inspection Program (B.1.2)
- FAC Program (B.1.14)
- Periodic Surveillance and Preventive Maintenance Program (B.1.24)
- Selective Leaching Program (B.1.27)
- System Walkdown Program (B.1.30)
- Water Chemistry Control – BWR Program (B.1.32.2)
- Water Chemistry Control – Auxiliary Systems Program (B.1.32.1)
- One-Time Inspection Program (B.1.23)
- Oil Analysis Program (B.1.22)
- Bolting Integrity Program (B.1.33)

Project Team Evaluation

The project team reviewed its assigned PNPS LRA AMR line items to determine that the applicant (1) provides a brief description of the system, components, materials, and environment; (2) states that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the condensate system, condensate transfer system, feedwater system, main condenser, main generator and auxiliary system, MS system, and main turbine and auxiliary system components that are subject to an AMR.

3.4.2.1.1 Loss of Material Due to General, Pitting, and Crevice Corrosion

In LRA Table 3.4.2-1, "Condensate Storage System" (page 3.4-29) which cites Table 3.4.1, Items 3.4.1-20 and 3.4.1-30, the applicant proposed to manage loss of material of steel tanks (condensate storage tanks) exposed to an air-outdoor external environment and condensation internal environment using AMP B.1.30, "System Walkdown Program," and AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program," respectively. However, the AMP recommended by the GALL Report for this AERM is GALL AMP XI.M29, "Aboveground Steel Tanks Program." The applicant included a reference to Note E to the associated Table 2 line items indicating that a different AMP is credited.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report. The project team reviewed the applicant's System Walkdown Program and Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Sections 3.0.3.1.11 and 3.0.3.3.5 of this audit and review report, respectively. The project team found the use of the System Walkdown Program and Periodic Surveillance and Preventive Maintenance Program to manage loss of material due to general, pitting, and crevice corrosion for condensate storage tanks to be acceptable because both programs manage material degradation through visual inspections. However, GALL AMP XI.M29, "Aboveground Steel Tanks Program," has some detection of aging effects attributes associated with it that are not addressed in the System Walkdown Program and Periodic Surveillance and Preventive Maintenance Program. For example, the GALL AMP specifies that thickness measurement of the tank bottom is to be taken to ensure that significant degradation is not occurring and the component intended function will be maintained during the PEO. The project team asked the applicant to clarify how this detection of aging effects at the tank bottom surface will be performed.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that to ensure that significant degradation on the bottom of the condensate storage tanks is not occurring, a one-time UT examination in accessible areas on the tank bottom will be performed. The applicant also stated that standard examination and sampling techniques will be utilized. This is identified as License Renewal Commitment No. 36. In addition, the applicant revised LRA Table 3.4.1, Item 3.4.1-20, to specify the One-Time Inspection Program to ensure that significant degradation on the bottom of the condensate storage tanks is not occurring. The applicant also stated that LRA Section B.1.23 program description and LRA

Section A.2.1.25 were revised to include an OTI activity of a UT examination on the bottom of the condensate storage tanks before the PEO.

On the basis of its review, the project team found that by adding a commitment to perform a UT inspection on the condensate storage tank bottom, the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.4.2.1.2 Loss of Material Due to General, Pitting, and Crevice Corrosion; Loss of Preload Due to Thermal Effects, Gasket Creep, and Self-Loosening

The applicant does not include a Bolting Integrity Program in the PNPS LRA. Instead, the applicant credits the System Walkdown Program to manage loss of material for steel bolting. GALL AMP XI.M18, "Bolting Integrity," provides several recommendations in the 10-element evaluation, such as selection of bolting materials, use of lubricants and sealants, and additional recommendations of NUREG-1339. The System Walkdown Program may be acceptable for inspection; however, it does not address the preventive actions. For LRA Section 3.4, this applies to Table 3.4.1, Item 3.4.1-22. The project team asked the applicant to clarify how PNPS meets these recommendations or provide justification why a bolting program should not be provided.

In its response, the applicant stated that a Bolting Integrity Program will be developed that will address the aging management of bolting in the scope of license renewal. Also, a copy of the AMP basis will be provided for review. The LRA will be supplemented to include descriptions of the Bolting Integrity Program in Appendices A and B and to identify where the program is applicable. Subsequently, in a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a 10-element description of its Bolting Integrity Program (LRA Appendix B.1.33) and stated that the program applies to all bolting exposed to air with AERMs except RV closure studs. The project team reviewed the Bolting Integrity Program, and the evaluation is documented in Section 3.0.3.2.9 of this audit and review report. The project team concluded that the applicant's Bolting Integrity Program will adequately manage the aging effects that are identified in the PNPS LRA for which this AMP is credited. On the basis that the applicant's Bolting Integrity Program applies to steel bolting and closure bolting exposed to air where the applicant had previously included a reference to Note E, the project team found that taking credit of Bolting Integrity Program to be acceptable because it brings the component, material, environment, aging effect, and AMP for these components into conformance with what is described in the GALL Report.

On the basis of its review of AMR results lines as described in the preceding paragraphs and its comparison of the applicant's results with corresponding recommendations in the GALL Report, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.4.2.1.3 Loss of Material Due to General, Pitting, and Crevice Corrosion and MIC

In LRA Table 3.3.2-14-1, "condensate storage system," which cites Table 3.4.1, Items 3.4.1-31 and 3.4.1-32, the applicant proposed to manage loss of material of steel heat exchanger (shell) and SS and copper alloy piping, piping components, and piping elements exposed to raw water

using PNPS AMP B.1.24, "Periodic Surveillance and Preventive Maintenance Program." However, the AMP recommended by the GALL Report for this AERM is GALL AMP XI.M20, "Open-Cycle Cooling Water System Program." The applicant included a reference to Note E to the associated Table 2 line items, indicating a different AMP is credited.

The project team reviewed the AMR results lines referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report. The project team reviewed the applicant's Periodic Surveillance and Preventive Maintenance Program, and its evaluation is documented in Section 3.0.3.3.5 of this audit and review report. The project team found the use of the Periodic Surveillance and Preventive Maintenance Program to manage loss of material of steel heat exchanger (shell) and SS and copper alloy piping, piping components, and piping elements exposed to raw water to be acceptable because the Periodic Surveillance and Preventive Maintenance Program detects leakage and manages material degradation through periodic visual inspections. The project team concluded that this AMP addressed the AEM as recommended by the GALL Report.

On the basis of its review, the project team found that the applicant appropriately addressed the loss of material due to general, pitting and crevice corrosion and MIC for steel heat exchanger (shell) and SS and copper alloy piping, piping components, and piping elements exposed to raw water.

Conclusion

The project team evaluated the applicant's claim of consistency with the GALL Report. The project team also reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the project team found that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report.

3.4.2.2 AMR Results for Which Further Evaluation Is Recommended

Summary of Information in the Application

In PNPS LRA Section 3.4.2.2, the applicant provided further evaluation of aging management as recommended by the GALL Report for the condensate system, condensate transfer system, feedwater system, main condenser, main generator and auxiliary system, MS system, and main turbine and auxiliary system components and component groups. The applicant also provided information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in PNPS LRA Table 3.4.1, the GALL Report recommends further evaluation. When further evaluation is recommended, the project team reviewed these further evaluations provided in PNPS LRA Section 3.4.2.2 against the criteria provided in SRP-LR Section 3.4.2.2. The project team's assessments of these

evaluations is documented in this section. These assessments are applicable to each Table 2 AMR line item in Section 3.4 citing the item in Table 1.

3.4.2.2.1 Cumulative Fatigue Damage

The project team reviewed the AMR line items in the Type 2 AMR Tables for the Steam and Power Conversion Systems in which fatigue-induced damage (which is referred to as fatigue - cracking in the AMR line items) was identified as an AERM and in which the "TLAA - Metal Fatigue" was credited as the basis for management of the aging effect. Henceforth, these AMR line items in the Type 2 AMR tables for the steam and power conversion systems will be referred in this audit and review report as the "AMRs on Non-Class 1 Fatigue," and the relevant TLAA will be referred to as the "TLAA on Metal Fatigue of Non-Class 1 Components."

The project team confirmed that LRA Table 3.4.1-1 does not include any AMRs on Non-Class 1 Fatigue for the commodity groups for the condensate storage system. The project team also confirmed that LRA Table 3.4.1-2 does include AMRs on Non-Class 1 Fatigue for the piping, tubing, valve casings, and orifices in the main condenser and main steam isolation valve (MSIV) leakage pathway.

The project team also reviewed the applicant's TLAA on Metal Fatigue of Non-Class 1 Components, as provided in Section 4.3.2 of the application. The project team determined that the applicant had indicated that all of the AMRs on Non-Class 1 Fatigue of the main condenser and MSIV leakage pathway components were within the scope of the B31.1 fatigue analysis discussion in Section 4.3.2 of the LRA. However, the project team determined that the AMRs on Non-Class 1 Fatigue did not clearly indicate which of the commodity groups for the steam and power conversion systems were designed to B31.1 requirements and which commodity groups for these systems were not designed to B31.1 requirements. Thus, the project team was unable to conclude that the TLAA on Metal Fatigue of Non-Class 1 Components was an appropriate means of aging management for those Non-Class 1 commodity groups that were designed to a design code other than B31.1. The project team asked the applicant to respond to the following requests:

(1) identify which design codes were applied to the non-piping commodity groups in the Non-Class 1 Fatigue AMRs for the steam and power conversion systems

(2) clarify whether the design codes required a metal fatigue analysis and summarize what type of metal fatigue analysis calculation was required by the design code, if applicable

(3) discuss how the metal fatigue analysis was acceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii), if applicable

(4) propose an acceptable AMP to manage fatigue-induced damage for the PEO if the design code for the particular Non-Class 1 commodity group did not require a metal fatigue analysis

In its letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant did not identify any main condenser and MSIV leakage pathway components for

which the TLAA on Metal Fatigue was credited with aging management of fatigue-induced damage and for which the components were designed in accordance with a design code other than B31.1.

The project team performed an additional review of the AMRs on Non-Class 1 Fatigue for the main condenser and MSIV leakage pathway components and confirmed that all of the commodity groups in these AMR line items were designed in accordance with B31.1. Therefore, the project team concludes that it is valid and acceptable to use the TLAA on Metal Fatigue of Non-Class 1 Components as the basis for managing fatigue-induced damage in the main condenser and MSIV leakage pathway components because (1) these components are designed to B31.1, (2) B31.1 includes a metal fatigue analysis methodology for B31.1-designed components, and (3) Section 4.3.2 of the LRA includes a B31.1-based fatigue assessment for these components. The project team reviewed the ability of the TLAA on Metal Fatigue to manage fatigue-induced damage in these Non-Class 1 Components, and its evaluation is provided in Section 4.3.2.2.2 of this audit and review report. This issue is closed.

3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

3.4.2.2.2.1 Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.4.2.2.2.1 against the criteria in SRP-LR Section 3.4.2.2.2.1.

SRP-LR Section 3.4.2.2.2.1 states that the loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. An OTI of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.2.1, the applicant states that, at PNPS, there are no heat exchanger components included in the S&PC systems except for components in scope solely based on 10 CFR 54.4(a)(2) criterion. The condensers are included as part of the main condenser and main steam isolation valve (MSIV) leakage pathway but have no AERMs since their intended function is for holdup and plateout of radioactive materials.

The applicant also stated that the loss of material due to general, pitting, and crevice corrosion for carbon steel piping, piping components, and tanks exposed to treated water and for carbon steel piping and components exposed to steam is an AERM in the S&PC systems at PNPS, and is managed by the Water Chemistry Control – BWR and Periodic Surveillance and Preventive Maintenance Programs. The effectiveness of the Water Chemistry Control – BWR

Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow. The Periodic Surveillance and Preventive Maintenance Program uses visual inspections and other NDE techniques to manage loss of material for carbon steel tanks in the condensate storage system.

In the discussion section of Table 3.4.1, Items 3.4.1-2, 3.4.1-4, and 3.4.1-6, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Tables 3.4.2-2, and 3.3.2-14-x where these Table 3.4.1 line items are referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference these Table 1 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.4.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Tables 3.4.2-2 and 3.3.2-14-x credit the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, “The One-Time Inspection Program will confirm the effectiveness of the program.”

The project team’s evaluation of the Water Chemistry Control – BWR Program and One-Time Inspection Program is documented in Sections 3.0.3.1.13 and 3.0.3.1.8, respectively, of this audit and review report. The project team reviewed the applicant’s Water Chemistry Control – BWR Program (AMP B.1.32.2) and verified that this AMP included activities that monitor and control water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. In addition, the project team verified that the One-Time Inspection Program (AMP B.1.23) included inspection activities to verify the effectiveness of the water chemistry control program to manage loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. The project team concluded that these AMPs will adequately manage loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to steam and for steel piping, piping components, and piping elements exposed to treated water.

In the discussion column entry of Table 3.4.1-6, the applicant stated that the Periodic Surveillance and Preventive Maintenance Program applies to the condensate storage tanks. During the audit and review, the project team asked the applicant to clarify whether it is using

the Periodic Surveillance and Preventive Maintenance Program alone to manage the loss of material for the condensate storage tanks. In its response, the applicant stated that it intended to use the Water Chemistry Control – BWR Program in conjunction with the Periodic Surveillance and Preventive Maintenance Program to manage the effects of aging for the condensate storage tanks surfaces exposed to the treated water environment. The applicant also stated that the associated LRA Table 2 items will be supplemented to clarify this point.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that "LRA Table 3.4.2-1 is revised to include Water Chemistry Control – BWR Program in addition to Periodic Surveillance and Preventive Maintenance Program (PSPM) to manage aging effects on internal environments of component type tank (condensate storage tanks)."

The project team found this response acceptable because the applicant's AMPs (Water Chemistry Control – BWR Program and Periodic Surveillance and Preventive Maintenance Program) are consistent with the GALL Report recommendations (water chemistry and OTI), with the Periodic Surveillance and Preventive Maintenance Program providing more frequent inspections than OTI.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.2.1 for further evaluation.

3.4.2.2.2.2 <u>Loss of Material Due to General, Pitting, and Crevice Corrosion [Item 2]</u>

The project team reviewed PNPS LRA Section 3.4.2.2.2.2 against the criteria in SRP-LR Section 3.4.2.2.2.2.

SRP-LR Section 3.4.2.2.2.2 states that a loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.2.2, the applicant states that a loss of material due to general, pitting, and crevice corrosion for steel piping and components in S&PC systems exposed to lubricating oil is managed by the Oil Analysis Program. This aging effect only applies to components in the turbine generator and auxiliary system and is included in the evaluation of systems within the scope of license renewal based on the criterion of 10 CFR 54.4(a)(2) (see Table 3.3.2-14-35). The Oil Analysis Program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed

the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

In the discussion column entry of Table 3.4.1-7, the applicant indicated that it depends on operating experience to verify the effectiveness of the Oil Analysis Program. During the audit and review, the project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation. The project team's evaluation of the Oil Analysis Program is documented in Section 3.0.3.2.13 of this audit and review report.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.2.2 for further evaluation.

3.4.2.2.3 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Fouling

The project team reviewed PNPS LRA Section 3.4.2.2.3 against the criteria in SRP-LR Section 3.4.2.2.3.

SRP-LR Section 3.4.2.2.3 states that a loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling could occur in steel piping, piping components, and piping elements exposed to raw water. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.4.2.2.3, the applicant states that a loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling in steel piping, piping components, and piping elements exposed to raw water is managed by the Periodic Surveillance and Preventive Maintenance Program. The Periodic Surveillance and Preventive Maintenance Program uses visual inspections and other NDE techniques to manage loss of material for carbon steel components.

During the audit and review, the project team asked the applicant to identify the specific components in the CWS that are represented by five line items in Table 3.3.2-14-1, which reference Table 3.4.1, Item 3.4.1-8 and credit the Periodic Surveillance and Preventive Maintenance Program. The project team found that the applicant's Periodic Surveillance and Preventive Maintenance Program includes using visual or other NDE techniques to inspect a representative sample of CWS to manage internal loss of material. The project team's evaluation of the Periodic Surveillance and Preventive Maintenance Program is documented in Section 3.0.3.3.5 of this audit and review report. The project team concluded that this AMP will assure detection of leakage before the loss of its intended function and that this AMP will adequately manage loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling in steel piping, piping components, and piping elements exposed to raw water.

The project team found that, based on the programs identified above, the applicant appropriately addressed loss of material due to general, pitting, crevice, and microbiologically influenced corrosion and fouling for steel piping, piping components, and piping elements exposed to raw water.

3.4.2.2.4 Reduction of Heat Transfer Due to Fouling

3.4.2.2.4.1 Reduction of Heat Transfer Due to Fouling [Item 1]

The project team reviewed PNPS LRA Section 3.4.2.2.4.1 against the criteria in SRP-LR Section 3.4.2.2.4.1.

SRP-LR Section 3.4.2.2.4.1 states that the reduction of heat transfer due to fouling could occur for SS and copper alloy heat exchanger tubes exposed to treated water. The existing AMP relies on control of water chemistry to manage reduction of heat transfer due to fouling.

However, control of water chemistry may not always have been adequate to preclude fouling. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. An OTI is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.4.1, the applicant states that the S&PC system at PNPS has no heat exchanger tubes with an intended function of heat transfer and associated aging effect of fouling. The applicant also stated that regarding Table 3.4.1, Item 3.4.1-9, the only components to which this GALL Report line item applies are in the HPCI and RCIC systems. The project team noted that there are no Table 2 line items in the S&PC system that reference Table 3.4.1, Item 3.4.1-9.

On the basis that PNPS does not have any components from this group in the S&PC system, the project team found that this aging effect is not applicable to PNPS.

3.4.2.2.4.2 Reduction of Heat Transfer Due to Fouling [Item 2]

The project team reviewed PNPS LRA Section 3.4.2.2.4.2 against the criteria in SRP-LR Section 3.4.2.2.4.2.

SRP-LR Section 3.4.2.2.4.2 states that the reduction of heat transfer due to fouling could occur for steel, SS, and copper alloy heat exchanger tubes exposed to lubricating oil. The existing AMP relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that fouling is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the lube oil chemistry control program. An OTI of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.4.2, the applicant states that the S&PC system at PNPS has no heat exchanger tubes with an intended function of heat transfer and associated aging effect of fouling. The applicant also stated that regarding Table 3.4.1, Item 3.4.1-10, the only components to which this GALL Report line item applies are in the SBO diesel generator and security diesel generator systems. The project team noted that there are no Table 2 line items in the S&PC system that reference Table 3.4.1, Item 3.4.1-10.

On the basis that PNPS does not have any components from this group in the S&PC system, the project team found that, for this component type, this aging effect is not applicable to PNPS.

3.4.2.2.5 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

3.4.2.2.5.1 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.4.2.2.5.1 against the criteria in SRP-LR Section 3.4.2.2.5.1.

SRP-LR Section 3.4.2.2.5.1 states that the loss of material due to general, pitting, and crevice corrosion and MIC could occur in steel (with or without coating or wrapping) piping, piping components, piping elements, and tanks exposed to soil. The Buried Piping and Tanks Inspection Program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the Buried Piping and Tanks Inspection Program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

In PNPS LRA Section 3.4.2.2.5.1, the applicant states that the S&PC system at PNPS has no carbon steel components that are exposed to soil. This item is not applicable to PNPS. The project team noted that there are no Table 2 line items in the S&PC system that reference Table 3.4.1, Item 3.4.1-11.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

3.4.2.2.5.2 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion [Item 2]

The project team reviewed PNPS LRA Section 3.4.2.2.5.2 against the criteria in SRP-LR Section 3.4.2.2.5.2.

SRP-LR Section 3.4.2.2.5.2 states that the loss of material due to general, pitting, and crevice corrosion and MIC could occur in steel heat exchanger components exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.5.2, the applicant states that the S&PC system at PNPS has no heat exchanger components that are exposed to lubricating oil. This item is not applicable to

PNPS. The project team noted that there are no Table 2 line items in the S&PC system that reference Table 3.4.1, Item 3.4.1-12.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

3.4.2.2.6 Cracking Due to SCC

The project team reviewed PNPS LRA Section 3.4.2.2.6 against the criteria in SRP-LR Section 3.4.2.2.6

SRP-LR Section 3.4.2.2.6 states that cracking due to SCC could occur in the SS piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 140°F, and for SS piping, piping components, and piping elements exposed to steam. The existing AMP relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring. An OTI of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.6, the applicant stated that cracking due to SCC in SS components exposed to steam is managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

In the discussion section of Table 3.4.1, Items 3.4.1-13 and 3.4.1-14, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Tables 3.4.2-2, 3.3.2-14-9, 3.3.2-14-16, 3.3.2-14-18, and 3.3.2-14-19 where these Table 3.4.1 line items are referenced in the S&PC system, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference these Table 1 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.4.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Tables 3.4.2-2 and 3.3.2-14-x credit the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team's evaluation of the Water Chemistry Control – BWR Program and One-Time Inspection Program is documented in Sections 3.0.3.1.13 and 3.0.3.1.8, respectively, of this audit and review report. The project team reviewed the applicant's Water Chemistry Control – BWR Program (AMP B.1.32.2) and verified that this AMP included activities that monitor and control water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. In addition, the project team verified that the One-Time Inspection Program (AMP B.1.23) included inspection activities to verify the effectiveness of the water chemistry control program to manage loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. The project team concluded that these AMPs will adequately manage loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to steam and for steel piping, piping components, and piping elements exposed to treated water.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.6 for further evaluation.

3.4.2.2.7 Loss of Material Due to Pitting and Crevice Corrosion

3.4.2.2.7.1 Loss of Material Due to Pitting and Crevice Corrosion [Item 1]

The project team reviewed PNPS LRA Section 3.4.2.2.7.1 against the criteria in SRP-LR Section 3.4.2.2.7.1.

SRP-LR Section 3.4.2.2.7.1 states that a loss of material due to pitting and crevice corrosion could occur for SS, aluminum, and copper alloy piping, piping components, and piping elements and for SS tanks and heat exchanger components exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to pitting and crevice corrosion. However, control of water chemistry does not preclude corrosion at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. An OTI of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.7.1, the applicant stated that the loss of material due to pitting and crevice corrosion for SS and copper alloy components exposed to treated water is managed by the Water Chemistry Control – BWR Program. There are no aluminum components in the S&PC systems. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a

representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

In the discussion section of Table 3.4.1, Items 3.4.1-15 and 3.4.1-16, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Tables 3.4.2-1 and various 3.3.2-14-x where these Table 3.4.1 line items are referenced in the S&PC system, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference these Table 1 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.4.1 indicates that the One-Time Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Tables 3.4.2-1 and 3.3.2-14-x credit the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, “The One-Time Inspection Program will confirm the effectiveness of the program.”

The project team’s evaluation of the Water Chemistry Control – BWR Program and One-Time Inspection Program is documented in Sections 3.0.3.1.13 and 3.0.3.1.8, respectively, of this audit and review report. The project team reviewed the applicant’s Water Chemistry Control – BWR Program (AMP B.1.32.2) and verified that this AMP included activities that monitor and control water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. In addition, the project team verified that the One-Time Inspection Program (AMP B.1.23) included inspection activities to verify the effectiveness of the water chemistry control program to manage loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. The project team concluded that these AMPs will adequately manage loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to steam and for steel piping, piping components, and piping elements exposed to treated water.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.7.1 for further evaluation.

3.4.2.2.7.2 <u>Loss of Material Due to Pitting and Crevice Corrosion [Item 2]</u>
The project team reviewed PNPS LRA Section 3.4.2.2.7.2 against the criteria in SRP-LR Section 3.4.2.2.7.2.

SRP-LR Section 3.4.2.2.7.2 states that a loss of material due to pitting and crevice corrosion could occur for SS piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB- 1.

In PNPS LRA Section 3.4.2.2.7.2, the applicant stated that the loss of material due to pitting and crevice corrosion for SS piping and tubing exposed to soil is managed by the Buried Piping and Tanks Inspection Program. This program will include (a) preventive measures to mitigate corrosion, and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried components. Buried components will be inspected when excavated during maintenance. An inspection will be performed within 10 years of entering the PEO unless an opportunistic inspection occurred within this 10-year period. This program will manage the aging effect of loss of material such that the intended function of the components will not be affected.

The project team reviewed the Buried Piping and Tanks Inspection Program, which is consistent with GALL AMP XI.M34. The project team's evaluation of the Buried Piping and Tanks Inspection Program is documented in Section 3.0.3.2.1 of this audit and review report. On the basis that periodic inspections, including opportunistic inspections, will be performed on buried piping, the project team determined that the Buried Piping and Tanks inspection Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.7.2 for further evaluation.

3.4.2.2.7.3 <u>Loss of Material Due to Pitting and Crevice Corrosion [Item 3]</u>

The project team reviewed PNPS LRA Section 3.4.2.2.7.3 against the criteria in SRP-LR Section 3.4.2.2.7.3.

SRP-LR Section 3.4.2.2.7.3 states that the loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.7.3, the applicant states that loss of material due to pitting and crevice corrosion for copper alloy components in S&PC systems exposed to lubricating oil is managed by the Oil Analysis Program. This aging effect only applies to components in the turbine generator and auxiliary system and is included in the evaluation of systems within the

scope of license renewal based on the criterion of 10 CFR 54.4(a)(2) (see Table 3.3.2-14-35). The Oil Analysis Program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

In the discussion column entry of Table 3.4.1-18, which linked to PNPS LRA Section 3.4.2.2.7.3, the applicant indicated that it depends on operating experience to verify the effectiveness of the Oil Analysis Program. During the audit and review, the project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.7.3 for further evaluation.

3.4.2.2.8 Loss of Material Due to Pitting, Crevice, and Microbiologically Influenced Corrosion

The project team reviewed PNPS LRA Section 3.4.2.2.8 against the criteria in SRP-LR Section 3.4.2.2.8.

SRP-LR Section 3.4.2.2.8 states that the loss of material due to pitting, crevice, and microbiologically influenced corrosion could occur in SS piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. The existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. An OTI of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO.

In PNPS LRA Section 3.4.2.2.8, the applicant states that a loss of material due to pitting, crevice, and microbiologically influenced corrosion for SS components in S&PC systems exposed to lubricating oil is managed by the Oil Analysis Program. This aging effect only applies to components in the turbine generator and auxiliary system and is included in the evaluation of systems within the scope of license renewal based on the criterion of 10 CFR 54.4(a)(2) (see Table 3.3.2-14-35). The Oil Analysis Program includes periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. Operating experience at PNPS has confirmed the effectiveness of this program in maintaining contaminants within limits such that corrosion has not and will not affect the intended functions of these components.

In the discussion column entry of Table 3.4.1-19, which linked to PNPS LRA Section 3.4.2.2.8, the applicant indicated that it depends on operating experience to verify the effectiveness of the Oil Analysis Program. During the audit and review, the project team asked the applicant how it can make this statement if inspection has not been performed. In its response, the applicant stated that during the performance of routine maintenance on components that contain lubricating oil, visual inspections of these components would identify degraded conditions that could be attributed to an ineffective Oil Analysis Program. The corrective action program at PNPS has a low threshold for the identification of degraded conditions such that corrosion or cracking of components would be identified as part of this program. The review of operating experience at PNPS for the last 5 years did not identify any CRs that indicated an ineffective Oil Analysis Program or that identified degraded component conditions such as corrosion or cracking in a lubricating oil environment.

During the past 5 years, many visual inspections of components containing lubricating oil have been performed during corrective and PM activities. The visual inspection of these components would identify degraded conditions such as corrosion or cracking that could be attributed to an ineffective Oil Analysis Program. No CRs that identified degraded component conditions, such as corrosion and cracking in a lubricating oil environment, were initiated as a result of these inspections. These past inspections at PNPS serve in lieu of an OTI to provide confirmation of the effectiveness of the Oil Analysis Program.

The project team reviewed the PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, and confirmed that there were no CRs generated for degraded

conditions of components in a lubricating oil environment. On the basis that periodic inspections of components in a lubricating environment are performed during maintenance activities, and that operating experience has shown no degraded conditions, the project team determined that the Oil Analysis Program is appropriate for the AEMs identified and provides assurance that the AEMs will be effectively managed through the PEO. The Oil Analysis Program was evaluated by the project team and found acceptable for managing aging degradation.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.8 for further evaluation.

3.4.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion

The project team reviewed PNPS LRA Section 3.4.2.2.9 against the criteria in SRP-LR Section 3.4.2.2.9.

SRP-LR Section 3.4.2.2.9 states that a loss of material due to general, pitting, crevice, and galvanic corrosion can occur for steel heat exchanger components exposed to treated water. The existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the water chemistry control program. An OTI of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the PEO. Acceptance criteria are described in Branch Technical Position IQMB-1.

In PNPS LRA Section 3.4.2.2.9, the applicant states that a loss of material due to general, pitting, crevice, and galvanic corrosion for steel heat exchanger components exposed to treated water is managed by the Water Chemistry Control – BWR Program. The effectiveness of the Water Chemistry Control – BWR Program will be confirmed by the One-Time Inspection Program through an inspection of a representative sample of components crediting this program, including susceptible locations such as areas of stagnant flow.

In the discussion section of Table 3.4.1, Item 3.4.1-5, the applicant stated that the One-Time Inspection Program will be used to verify the effectiveness of the water chemistry control program. However, for those line items in Table 3.3.2-14-x where these Table 3.4.1 line items are referenced, only the Water Chemistry Control – BWR Program is credited. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items that reference these Table 1 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. LRA Table 3.4.1 indicates that the One-Time

Inspection Program is credited along with the water chemistry control programs for line items where the GALL Report recommends an OTI to confirm water chemistry control. Table 3.3.2-14-x credits the One-Time Inspection Program through reference to the associated Table 1 line item. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

The project team's evaluation of the Water Chemistry Control – BWR Program and One-Time Inspection Program is documented in Sections 3.0.3.1.13 and 3.0.3.1.8, respectively, of this audit and review report. The project team reviewed the applicant's Water Chemistry Control – BWR Program (AMP B.1.32.2) and verified that this AMP included activities that monitor and control water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion. In addition, the project team verified that the One-Time Inspection Program (AMP B.1.23) included inspection activities to verify the effectiveness of the water chemistry control program to manage loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. The project team concluded that these AMPs will adequately manage loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to steam and for steel piping, piping components, and piping elements exposed to treated water.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.9 for further evaluation.

3.4.2.2.10 <u>QA for Aging Management of NSR Components</u>

The applicant referenced LRA Section B.0.3. The project team's evaluation of LRA Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

<u>Conclusion</u>

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were further evaluated.

3.4.2.3 AMR Results That Are Not Consistent withor Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.4.1, "Summary of Aging Management Evaluations for the Steam and Power Conversion System," the applicant provides information regarding components or material/environment combination in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Tables 3.4.2-1, 3.4.2-2, 3.3.2-14-1, 3.3.2-14-3 through 3.3.2-14-5, 3.3.2-14-9 through 3.3.2-14-11, 3.3.2-14-17, 3.3.2-14-18, and 3.3.2-14-35, the applicant provides additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicates, via Notes F through J, that neither the identified component nor the material/environment combination is evaluated in the GALL Report and provided information concerning how the AERM will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

AEMs in Table 3.4.1 That Are Not Applicable to PNPS

In PNPS LRA Table 3.4.1, Item 3.4.1-21 discussion column, the applicant states that cracking due to cyclic loading, stress corrosion cracking of the high-strength steel closure bolting exposed to air with steam or water leakage is not applicable to PNPS because high-strength steel closure bolting is not used in the S&PC system.

On the basis that there is no high-strength steel closure bolting in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-23 discussion column, the applicant states that cracking due to SCC of SS piping, piping components, and piping elements exposed to CCW greater than 140°F is not applicable to PNPS because there are no SS components exposed to CCW in the S&PC system.

On the basis that there are no SS components exposed to CCW in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-24 discussion column, the applicant states that the loss of material due to general, pitting, crevice, and galvanic corrosion of steel heat exchanger components exposed to CCW is not applicable to PNPS because there are no steel heat exchanger components exposed to CCW in the S&PC system.

On the basis that there are no steel heat exchanger components exposed to CCW in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-25 discussion column, the applicant states that the loss of material due to pitting and crevice corrosion of SS piping, piping components, piping elements, and heat exchanger components exposed to CCW is not applicable to PNPS because there are no SS components exposed to CCW in the S&PC system.

On the basis that there are no SS components exposed to CCW in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-26 discussion column, the applicant states that the loss of material due to pitting, crevice, and galvanic corrosion of copper alloy piping, piping components, and piping elements exposed to CCW is not applicable to PNPS because there are no copper alloy components exposed to CCW in the S&PC system.

On the basis that there are no copper alloy components exposed to CCW in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-27 discussion column, the applicant states that the reduction of heat transfer due to fouling of steel, SS, and copper alloy heat exchanger tubes exposed to CCW is not applicable to PNPS because there are no heat exchanger tubes exposed to CCW in the S&PC system.

On the basis that there are no heat exchanger tubes exposed to CCW in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-33 discussion column, the applicant states that the loss of material due to pitting, crevice, and microbiologically influenced corrosion and fouling of SS heat exchanger components exposed to raw water is not applicable to PNPS because there are no SS heat exchanger components exposed to raw water in the S&PC system.

On the basis that there are no SS heat exchanger components exposed to raw water in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-34 discussion column, the applicant states that the reduction of heat transfer due to fouling of steel, SS, and copper alloy heat exchanger tubes exposed to raw water is not applicable to PNPS because there are no heat exchanger tubes exposed to raw water with an intended function of heat transfer in the S&PC system.

On the basis that there are no heat exchanger tubes exposed to raw water with an intended function of heat transfer in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-42 discussion column, the applicant states that the aging of steel piping, piping components, and piping elements exposed to controlled indoor air is not applicable to PNPS because there are no steel components exposed to controlled indoor air in the steam and power system.

On the basis that there are no steel components exposed to controlled indoor air in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-43 discussion column, the applicant states that the aging of steel and SS piping, piping components, and piping elements in concrete is not applicable to PNPS because there are no steel or SS components exposed to concrete in the S&PC system.

On the basis that there are no steel or SS components exposed to concrete in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.4.1, Item 3.4.1-44 discussion column, the applicant states that the aging of steel, SS, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas is not applicable to PNPS because there are no steel, SS, aluminum, or copper alloy components exposed to gas in the S&PC system.

On the basis that there are no steel, SS, aluminum, or copper alloy components exposed to gas in the S&PC system at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

<u>S&PC System AMR Line Items That Have No Aging Effect (PNPS LRA Tables 3.4.2-1, 3.4.2-2, 3.3.2-14-1, 3.3.2-14-3 through 3.3.2-14-5, 3.3.2-14-9 through 3.3.2-14-11, 3.3.2-14-17, 3.3.2-14-18, and 3.3.2-14-35)</u>

In PNPS LRA Tables 3.4.2-1, 3.4.2-2, 3.3.2-14-1, 3.3.2-14-3 through 3.3.2-14-5, 3.3.2-14-9 through 3.3.2-14-11, 3.3.2-14-17, 3.3.2-14-18, and 3.3.2-14-35, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred in the following areas:

<u>Condenser components fabricated from carbon steel, copper alloy, titanium, and elastomer exposed to indoor air, treated water, or steam greater than 270°F</u>

In PNPS LRA Table 3.4.2-2 (pages 3.4-31 and 32), via plant-specific Note 401, the applicant stated that:

> Aging management of the main condenser is not based on analysis of materials, environments and aging effects. Condenser integrity required to perform the post-accident intended function (holdup and plateout of MSIV leakage) is continuously confirmed by normal plant operation. This intended function does not require the condenser to be leak-tight, and the post-accident conditions in

> the condenser will be essentially atmospheric. Since normal plant operation assures adequate condenser pressure boundary integrity, the post-accident intended function to provide holdup volume and plateout surface is assured. Based on past precedence (NUREG-1796, Dresden and Quad Cities SER, Section 3.4.2.4.4, and NUREG-1769, Peach Bottom SER, Section 3.4.2.3), the staff concluded that main condenser integrity is continually verified during normal plant operation and no AMP is required to assure the post-accident intended function.

The project team reviewed the past precedents and noted that PNPS had similar intended function for the main condenser. The project team found that to maintain the intended function of plateout and holdup during postaccident conditions, the main condenser and the components which make up the main condenser complex need to remain intact. During normal plant operations, condenser vacuum is monitored continuously to verify its integrity. The acceptable performance of the main condenser during normal plant operation is adequate assurance that it will perform the plateout and holdup postaccident function. Therefore, the project team concurred with the applicant's conclusion that no AMP is required to assure the postaccident intended function and that this aging effect is not applicable to PNPS.

Glass in condensation external environment (Table 3.3.2-14-1)

Glass as a material is impervious to normal plant environments. This conclusion is based on the fact that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at the temperatures or during the time periods of concern for extended operation.

Plastic in condensation external and raw water internal environments (Table 3.3.2-14-1)

In accordance with Section 2.1.8 of Appendix A of EPRI Technical Report 1003056, "Non-Class 1 Mechanical Implementation Guidelines and Mechanical Tools," Revision 3, PVC and thermoplastics are relatively unaffected by water or humidity.

Unlike metals, plastics do not display corrosion rates. Rather than depending on an oxide layer for protection, they depend on chemical resistance to the environment to which they are exposed. Therefore, based on industry experience review and the assumption of proper design and application of the material, aging of plastics in condensation external and raw water internal environments is not an applicable aging effect.

On the basis of its review of current industry research and operating experience, the project team found that for plastic and glass, condensation external and raw water internal environments will not result in aging that will be of concern during the PEO. Therefore, the project team concluded that there are no applicable AERMs for plastic and glass components exposed to condensation external and raw water internal environments. Furthermore, as described above, the project team also concluded that for condenser components fabricated from carbon steel, copper alloy, titanium, and elastomer exposed to indoor air, treated water, or steam greater than 270°F environments, there are no aging effects, and no AMP is required to assure the postaccident function.

3.4.2.3.1 Condensate Storage System – Summary of Aging Management Evaluation – PNPS LRA Table 3.4.2-1

The project team reviewed PNPS LRA Table 3.4.2-1, which summarizes the results of AMR evaluations for the condensate storage system component groups.

In LRA Table 3.4.2-1, the applicant proposed to manage loss of material for SS for component types of bolting, piping, tubing, and valve body exposed to an external environment of condensation using PNPS AMP B.1.30, "System Walkdown Program."

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program."

The project team found that, based on the above review, OEthe aging effect of loss of material for component types of bolting, piping, tubing, and valve body exposed to an external environment of condensation is effectively managed using the System Walkdown Program.

3.4.2.3.2 Main Condenser and MSIV Leakage Pathway – Summary of Aging Management Evaluation – PNPS LRA Table 3.4.2-2

The project team reviewed PNPS LRA Table 3.4.2-2, which summarizes the results of AMR evaluations for the main condenser and MSIV leakage pathway component groups.

In LRA Table 3.4.2-2, the applicant proposed to manage cracking due to fatigue of SS material for component types of orifices, thermowells, tubing, and valve body exposed to an internal environment of steam greater than 270°F using metal fatigue TLAA. The evaluation of metal fatigue is documented in Section 4.3.2 of this audit and review report.

3.4.2.3.3 CWS – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-1

The project team reviewed PNPS LRA Table 3.3.2-14-1, which summarizes the results of AMR evaluations for the circulating water NSR component groups affecting safety-related systems.

In LRA Table 3.4.2-14-1, the applicant proposed to manage loss of material for copper alloy greater than 15-percent zinc and copper alloy less than 15-percent zinc for component types of piping, strainer housing, tubing, and valve body exposed to an external environment of condensation using PNPS AMP B.1.30, "System Walkdown Program."

The project team reviewed the System Walkdown Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The System Walkdown Program description states that this program entails inspection of external surfaces of components subject to AMR. This program is consistent with GALL AMP XI.M36, "External Surfaces Monitoring Program." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material for component types of piping, strainer housing, tubing, and valve body exposed to an external environment of condensation is effectively managed using the System Walkdown Program. On this basis, the project team found that management of loss of material in CWS is acceptable.

3.4.2.3.4 Condensate System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-3

The project team reviewed PNPS LRA Table 3.3.2-14-3, which summarizes the results of AMR evaluations for the condensate system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.4.2.3.5 CDS – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-4

The project team reviewed PNPS LRA Table 3.3.2-14-4, which summarizes the results of AMR evaluations for the CDS NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.4.2.3.6 Condensate Storage and Transfer System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-5

The project team reviewed PNPS LRA Table 3.3.2-14-5, which summarizes the results of AMR evaluations for the condensate storage and transfer system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.4.2.3.7 Extraction Steam System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-9

The project team reviewed PNPS LRA Table 3.3.2-14-9, which summarizes the results of AMR evaluations for the extraction steam NSR component groups affecting safety-related systems.

In LRA Table 3.3.2-14-9, the applicant proposed to manage cracking due to fatigue of nickel alloy and SS materials for component types of expansion joint, tubing, and valve body exposed to an internal environment of steam greater than 270°F or treated water greater than 270°F using metal fatigue TLAA. The evaluation of metal fatigue is documented in Section 4.3.2 of this audit and review report.

In Table 3.3.2-14-9, the applicant proposed to manage cracking and loss of material of nickel alloy material for component type of expansion joint exposed to an environment of steam greater than 270°F or treated water greater than 270°F using PNPS AMP B.1.32.2, "Water Chemistry Control – BWR Program."

The project team reviewed the Water Chemistry Control – BWR Program, and its evaluation is documented in Section 3.0.3.1.13 of this audit and review report. This program is consistent with GALL AMP XI.M2, "Water Chemistry." On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found that since the water chemistry will be periodically monitored and controlled within established levels of contaminants, the aging effect of cracking and loss of material of nickel alloy material for component type of expansion joint exposed to an environment of steam greater than 270°F or treated water greater than 270°F is effectively managed using the Water Chemistry Control – BWR Program. However, verification of the effectiveness of the program is not performed. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in the Table 2 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

As described above, the project team concluded that these AMPs will adequately manage cracking and loss of material of nickel alloy material for component type of expansion joint exposed to an environment of steam greater than 270°F or treated water greater than 270°F.

3.4.2.3.8 Feedwater System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-10

The project team reviewed PNPS LRA Table 3.3.2-14-10, which summarizes the results of AMR evaluations for the feedwater system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.4.2.3.9 Feedwater Heater Drains and Vents System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-11

The project team reviewed PNPS LRA Table 3.3.2-14-11, which summarizes the results of AMR evaluations for the feedwater heater drains and vents system NSR component groups affecting safety-related systems. The results of these evaluations are all consistent with the GALL Report.

3.4.2.3.10 Main Condenser – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-17

The project team reviewed PNPS LRA Table 3.3.2-14-17, which summarizes the results of AMR evaluations for the main condenser NSR component groups affecting safety-related systems.

In LRA Table 3.3.2-14-17, the applicant proposed to manage cracking due to fatigue of SS material for component types of orifice exposed to an internal environment of steam greater than 270°F using metal fatigue TLAA. The evaluation of metal fatigue is documented in Section 4.3.2 of this audit and review report.

3.4.2.3.11 MS System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-18

The project team reviewed PNPS LRA Table 3.3.2-14-18, which summarizes the results of AMR evaluations for the MS system NSR component groups affecting safety-related systems.

In LRA Table 3.3.2-14-18, the applicant proposed to manage cracking due to fatigue of SS material for component types of orifice and tubing exposed to an internal environment of steam greater than 270°F using metal fatigue TLAA. The evaluation of metal fatigue is documented in Section 4.3.2 of this audit and review report.

3.4.2.3.12 Turbine Generator and Auxiliary System – Summary of Aging Management Evaluation – PNPS LRA Table 3.3.2-14-35

The project team reviewed PNPS LRA Table 3.3.2-14-35, which summarizes the results of AMR evaluations for the turbine generator and auxiliary system NSR component groups affecting safety-related systems.

In LRA Table 3.3.2-14-35, the applicant proposed to manage loss of material of carbon steel, SS, and copper alloy less than 15-percent zinc materials for component types of filter housing,

heater exchanger (shell), heater housing, orifice, piping, pump casing, strainer housing, tank, thermowell, tubing, and valve body exposed to a treated water environment using PNPS AMP B.1.32.1, "Water Chemistry Control – Auxiliary Systems Program."

The project team reviewed the Water Chemistry Control – Auxiliary Systems Program, and its evaluation is documented in Section 3.0.3.3.6 of this audit and review report. The program monitors conductivity, corrosion products, and dissolved oxygen in accordance with industry recommendation. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of carbon steel, SS, and copper alloy less than 15-percent zinc materials for component types of filter housing, heater exchanger (shell), heater housing, orifice, piping, pump casing, strainer housing, tank, thermowell, tubing, and valve body exposed to a treated water environment is effectively managed using PNPS AMP B.1.32.1, "Water Chemistry Control – Auxiliary Systems Program." However, verification of the effectiveness of the Water Chemistry Control – Auxiliary Systems Program is not described in the associated LRA Table 2 line items. The project team asked the applicant a generic question to resolve the discrepancy why the One-Time Inspection Program was not credited in these Table 2 line items.

In its response, the applicant stated that since the One-Time Inspection Program is applicable to each water chemistry control program, it is also applicable to each line item in Table 2 that credits a water chemistry control program. The applicant further stated that the water chemistry control programs in LRA Appendices A and B will be revised to clearly indicate that the One-Time Inspection Program will verify the effectiveness of the Water Chemistry Control – BWR Program.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the effectiveness of the Water Chemistry Control – Auxiliary Systems, BWR, and Closed Cooling Water Programs is confirmed by the One-Time Inspection Program and that LRA Appendix A (UFSAR Supplement) is revised for these three water chemistry control programs to include the sentence, "The One-Time Inspection Program will confirm the effectiveness of the program."

As described above, the project team concluded that these AMPs will adequately manage loss of material of carbon steel, SS, and copper alloy less than 15-percent zinc materials for component types of filter housing, heater exchanger (shell), heater housing, orifice, piping, pump casing, strainer housing, tank, thermowell, tubing, and valve body exposed to a treated water environment.

<u>Conclusion</u>

On the basis of its review, the project team found that the applicant appropriately evaluated AMR results involving material, environment, AERMs, and AMP combinations that are not addressed in the GALL Report.

3.4.3 Conclusion

On the basis of thereview provided above, the project team concluded that the applicant has demonstrated that the aging effects associated with the S&PC system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concluded that they adequately describe the AMPs credited for managing aging of the S&PC components, as required by 10 CFR 54.21(d).

3.5 Aging Management of Structures and Component Supports

This section of the audit and review report documents the project team's review and evaluation of PNPS AMR results for the aging management of the structural components and commodities associated with the following systems:

- primary containment
- reactor building
- intake structure
- process facilities
- yard structures
- bulk commodities

3.5.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.5, the applicant provided the results of its AMRs for the structural components and component groups.

In PNPS LRA Table 3.5.1, "Summary of Aging Management Programs for Structures and Component Supports Evaluated in Chapters II and III of NUREG-1801," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the primary containment, structures, component supports, and piping and component insulation components and component groups. The applicant also identified for each component type in the PNPS LRA Table 3.5.1 those components that are consistent with the GALL Report, those for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant provided a summary of the AMR results for component types associated with (1) primary containment, (2) reactor building, (3) intake structure, (4) process facilities, (5) yard structures, and (6) bulk commodities. Specifically, the information for each component type included intended function, material, environment, AERM, AMPs, the GALL Report Volume 2 item, cross-reference to the PNPS LRA Table 3.5.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporated applicable operating experience in the determination of AERMs. These reviews included evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.5.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.5 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the primary containment, structures, component supports, and piping and component insulation components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained to be consistent with the CLB for the PEO.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.5.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further evaluations were in accordance with the acceptance criteria in SRP-LR. The project team's audit evaluation is documented in Section 3.5.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.5.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the primary containment, structures, component supports, and piping and component insulation components.

Table 3.5-1 below provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in LRA Section 3.5 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.5-1 Project Team Evaluation for Containment, Structures, Component Supports, and Piping and Component Insulation in the GALL Report

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment					
3.5.1-1	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment (as applicable).	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	ISI (IWL) and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater if environment is nonaggressive. A plant-specific program is to be evaluated if environment is aggressive.	None	Not applicable to PNPS. See audit report Section 3.5.2.2.1.1.
3.5.1-2	Concrete elements; all	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the PEO.	None	Not applicable to PNPS. See audit report Section 3.5.2.2.1.2.
3.5.1-3	Concrete elements: foundation, subfoundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a dewatering system is relied upon to control erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the dewatering system through the PEO.	None	Not applicable to PNPS. See audit report Section 3.5.2.2.1.2.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-4	Concrete elements: dome, wall, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific AMP is to be evaluated.	None	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.3.
3.5.1-5	Steel elements: drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, suppression chamber (as applicable)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Containment Inservice Inspection Program Containment Leak Rate Program Structures Monitoring Program	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.4.
3.5.1-6	Steel elements: steel liner, liner anchors, integral attachments	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Containment Inservice Inspection Program Containment Leak Rate Program Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.4.
3.5.1-7	Prestressed containment tendons	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	N/A\	Not applicable (PWR only). See audit report Section 3.5.2.2.1.5.
3.5.1-8	Steel and SS elements: vent line, vent header, vent line bellows, downcomers	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.6.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-9	Steel, SS elements, DSM welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with the GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.6.
3.5.1-10	SS penetration sleeves, penetration bellows, DSM welds	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examinations/ evaluations for bellows assemblies and DSM welds	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.7.
3.5.1-11	SS vent line bellows	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examination/ evaluation for bellows assemblies and DSM welds	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.7.
3.5.1-12	Steel, SS elements, DSM welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.8.
3.5.1-13	Steel, SS elements, DSM welds: torus; vent line; vent header; vent line bellows; downcomers	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report. See audit report Section 3.5.2.1.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-14	Concrete elements: dome, wall, basemat ring girder, buttresses, containment (as applicable)	Loss of material (scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	None	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.9.
3.5.1-15	Concrete elements: walls, dome, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable).	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	None	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.1.10.
3.5.1-16	Seals, gaskets, and moisture barriers	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	Containment Inservice Inspection Containment Leak Rate Program Structures Monitoring Program	Consistent with GALL Report. See audit report Section 3.5.2.1.1.
3.5.1-17	Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure mechanisms	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanisms	10 CFR Part 50, Appendix J and plant technical specifications	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report. See audit report Section 3.5.2.1.2.
3.5.1-18	Steel penetration sleeves and DSM welds; personnel airlock, equipment hatch and CRD hatch	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Containment Inservice Inspection Containment Leak Rate Program	Consistent with GALL Report. See audit report Section 3.5.2.1.3.
3.5.1-19	Steel elements: SS suppression chamber shell (inner surface)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J	None	Not applicable to PNPS. See audit report Section 3.5.2.3,
3.5.1-20	Steel elements: suppression chamber liner (interior surface)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	None	Not applicable to PNPS. See audit report Section 3.5.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-21	Steel elements: drywell head and downcomer pipes	Fretting or lockup due to mechanical wear	ISI (IWE)	Containment Inservice Inspection	Consistent with GALL Report. See audit report Section 3.5.2.1.4.
3.5.1-22	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion	ISI (IWL)	None	Not applicable (PWR only)
Safety-Related and Other Structures; and Component Supports					
3.5.1-23	All groups except Group 6: interior and above grade exterior concrete	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.1.
3.5.1-24	All groups except Group 6: interior and above grade exterior concrete	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.2.
3.5.1-25	All groups except Group 6: steel components: all structural steel	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the Structures Monitoring Program is to include provisions to address protective coating monitoring and maintenance.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-26	All groups except Group 6: accessible and inaccessible concrete: foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.4.
3.5.1-27	All groups except Group 6: accessible and inaccessible interior/exterior concrete	Cracking due to expansion due to reaction with aggregates	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.5.
3.5.1-28	Groups 1-3, 5-9: All	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the PEO.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.6.
3.5.1-29	Groups 1-3, 5-9: foundation	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the PEO.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.7.
3.5.1-30	Group 4: radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; steam generator supports	Lockup due to wear	ISI (IWF) or Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.1.8.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-31	Groups 1-3, 5, 7-9: below-grade concrete components, such as exterior walls below grade and foundation	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel	Structures Monitoring Program; examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is nonaggressive. A plant-specific program is to be evaluated if environment is aggressive.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.2.
3.5.1-32	Groups 1-3, 5, 7-9: exterior above and below grade reinforced concrete foundations	Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide	Structures Monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.2.
3.5.1-33	Groups 1-5: concrete	Reduction of strength and modulus due to elevated temperature	A plant-specific AMP is to be evaluated.	None	Not applicable to PNPS. See audit report Section 3.5.2.2.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-34	Group 6: Concrete; all	Increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is nonaggressive. A plant-specific program is to be evaluated if environment is aggressive.	Inspection of Water-Control Structures	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.4.1.
3.5.1-35	Group 6: exterior above and below grade concrete foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Inspection of Water-Control Structures	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.4.2.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-36	Group 6: all accessible/ inaccessible reinforced concrete	Cracking due to expansion/reaction with aggregates	Accessible areas: Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Inspection of Water-Control Structures	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.4.3.
3.5.1-37	Group 6: exterior above and below grade reinforced concrete foundation interior slab	Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide	For accessible areas, Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Inspection of Water-Control Structures	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.4.3.
3.5.1-38	Groups 7, 8: tank liners	Cracking due to SCC; loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	None	Not applicable to PNPS. See audit report Section 3.5.2.2.2.5.
3.5.1-39	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report. See audit report Section 3.5.2.2.2.6.
3.5.1-40	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.6.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-41	Vibration isolation elements	Reduction or loss of isolation function/radiation hardening, temperature, humidity, sustained vibratory loading	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report, which recommends further evaluation. See audit report Section 3.5.2.2.2.6.
3.5.1-42	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	None	Not applicable to PNPS. See audit report Section 3.5.2.2.2.7.
3.5.1-43	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	Masonry Wall Program	Consistent with GALL Report. See audit report Section 3.5.2.2.2.1.
3.5.1-44	Group 6 elastomer seals, gaskets, and moisture barriers	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report. See audit report Section 3.5.2.1.6 .
3.5.1-45	Group 6: exterior above and below grade concrete foundation; interior slab	Loss of material due to abrasion, cavitation	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance	Inspection of Water-Control Structures	Consistent with GALL Report. See audit report Section 3.5.2.1.7.
3.5.1-46	Group 5: fuel pool liners	Cracking due to SCC; loss of material due to pitting and crevice corrosion	Water Chemistry and monitoring of spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels	Water Chemistry Control	Consistent with GALL Report. See audit report Section 3.5.2.1.12.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-47	Group 6: all metal structural members	Loss of material due to general (steel only), pitting, and crevice corrosion	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	Inspection of Water-Control Structures	Consistent with GALL Report. See audit report Section 3.5.2.1.8.
3.5.1-48	Group 6: earthen water control structures – dams, embankments, reservoirs, channels, canals, and ponds	Loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs	Inspection of Water-Control Structures	Consistent with GALL Report. See audit report Section 3.5.2.2.2.4.
3.5.1-49	Support members; welds; bolted connections; support anchorage to building structure	Loss of material/general, pitting, and crevice corrosion	Water Chemistry and ISI (IWF)	Water Chemistry ISI (IWF)	Consistent with GALL Report. See audit report Section 3.5.2.1.9.
3.5.1-50	Groups B2 and B4: galvanized steel, aluminum, SS support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	Structures Monitoring Program	Consistent with GALL Report. See audit report Section 3.5.2.1.10.
3.5.1-51	Group B1.1: high-strength low-alloy bolts	Cracking due to SCC; loss of material due to general corrosion	Bolting Integrity	None	Consistent with GALL Report.
3.5.1-52	Groups B2 and B4: sliding support bearings and sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	None	Not applicable to PNPS. See audit report Section 3.5.2.3.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.5.1-53	Groups B1.1, B1.2, and B1.3: support members: welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	ISI (IWF)	ISI (IWF)	Consistent with GALL Report. See audit report Section 3.5.2.1.11.
3.5.1-54	Groups B1.1, B1.2, and B1.3: constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	None	Not applicable to PNPS. See audit report Section 3.5.2.3.
3.5.1-56	Groups B1.1, B1.2, and B1.3: sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	ISI (IWF)	Consistent with GALL Report. See audit report Section 3.5.2.2.2.1.
3.5.1-57	Groups B1.1, B1.2, and B1.3: Vibration isolation elements	Reduction or loss of isolation function/radiation hardening, temperature, humidity, sustained vibratory loading	ISI (IWF)	None	Not applicable to PNPS. See audit report Section 3.5.2.3.
3.5.1-58	Galvanized steel and aluminum support members; welds; bolted connections; support anchorage to building structure exposed to air-indoor uncontrolled	None	None	None	Consistent with GALL Report. See audit report Section 3.5.2.2.2.6.
3.5.1-59	SS support members; welds; bolted connections; support anchorage to building structure	None	None	None	Consistent with GALL Report. See audit report Section 3.5.2.2.2.6.

Note: Item 3.5.1-55 is for PWR only.

3.5.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Section 3.5.2.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the aging effects related to the primary containment, reactor building, intake structure, process facilities, yard structures, and bulk commodities:

- Containment Leak Rate (B.1.9)
- Fire Protection (B.1.13.1)
- Containment InService Inspection (CII-IWE) (B.1.16.1)
- In-Service Inspection (ISI-IWF) (B.1.16.2)
- Periodic Surveillance and Preventive Maintenance (B.1.24)
- Structures Monitoring – Masonry Wall Program (B.1.29.1)
- Structures Monitoring (B.1.29.2)
- Water Control Structures Monitoring Program (B.1.29.3)
- Water Chemistry Control – BWR (B.1.32.2)

Project Team Evaluation

For component groups evaluated in the GALL Report for which the applicant has claimed consistency with the GALL Report, and for which the GALL Report does not recommend further evaluation, the project team performed an audit to determine whether the plant-specific components contained in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes described how the information in the tables aligns with the information in the GALL Report. The project team audited those AMRs with Notes A through E, which indicate that the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified in the GALL Report. The project team audited those line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The project team audited these line items to verify consistency with the GALL Report. The project team verified that the identified exceptions to the GALL AMPs has been reviewed and accepted by the project team. The project team also

determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item is different from but consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report. However, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component that was under review. The project team audited these line items to verified consistency with the GALL Report. The project team also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item is different from but consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The project team audited these line items to verify consistency with the GALL Report. The project team verified whether the AMR line item of the different component was applicable to the component under review. The project team verified whether the identified exceptions to the GALL AMPs had been reviewed and accepted by the project team. The project team also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The project team audited the line items to verify consistency with the GALL Report. The project team also determined whether the identified AMP would manage the aging effect consistent with the AMP identified by the GALL Report and whether the AMR was valid for the site-specific conditions.

The project team conducted an audit and review of the information provided in the LRA, as documented in the audit and review report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The project team's evaluation is discussed below.

For aging management evaluations that the applicant stated are consistent with the GALL Report and for which further evaluation is not recommended, the project team conducted its review and audit to determine if the applicant's reference to the GALL Report in the LRA is acceptable.

The project team reviewed its assigned PNPS LRA AMR line items to determine that the applicant (1) provides a brief description of the system, components, materials, and environment; (2) states that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the primary containment, reactor building, intake structure, process facilities, yard structures, and bulk commodities components that are subject to an AMR. The project team also determined that the LRA line item is

consistent with the GALL Report Volume 2 system tables line item for component type and material, environment, aging effects, and AMP.

To confirm consistency with the GALL Report during the onsite audit in the weeks of May 22 and June 19, 2006, the project team requested the applicant to clarify the following LRA line items.

3.5.2.1.1 Loss of Sealing and Leakage through Containment Due to Deterioration of Joint Seals, Gaskets, and Moisture Barriers (Caulking, Flashing, and Other Sealants)

During the audit and review, the project team noted that in the discussion section of Table 3.5.1, Item 3.5.1-16, of the PNPS LRA, the applicant stated that seals and gaskets are not included in the Containment Inservice Inspection Program at PNPS. One of the components for this item number is moisture barriers. The applicant was asked to explain how PNPS seals the joint between the containment drywell shell and drywell concrete floor if there is no moisture barrier. The applicant was also asked to explain why the inspection of this joint is not part of the Containment Inservice Inspection Program at PNPS.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that PNPS primary containment does not have a moisture barrier. Therefore, an AMP is not required. The referenced line item on page 3.5-55 applies only to primary containment electrical penetration seals and sealant. Table 3.5.1, Item 3.5.1-16 is revised to read, "The aging effects cited in the NUREG-1801 Item are loss of sealing and leakage. Loss of sealing is a consequence of the aging effect, cracking, and change in material properties. For PNPS, the Containment Leak Rate Program manages cracking and change in material properties for the primary containment seals and gaskets. The Structures Monitoring Program manages cracking and change in material properties for the reactor building equipment lock doors. There is no moisture barrier where the drywell steel shell becomes embedded in the drywell concrete floor."

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM as recommended by the GALL Report.

For loss of sealing and leakage through containment due to deterioration of elastomer, rubber, and other similar material joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, cracking and change in material properties due to deterioration of the elastomer drywell floor liner seal (moisture barrier) exposed to a protected-from-weather environment is managed using the Containment Inservice Inspection Program by the applicant. The moisture barrier is a containment internal seal, and therefore, 10 CFR Part 50, Appendix J does not apply.

The project team reviewed the applicant's Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment

Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing the deterioration (cracking and change in material properties) of the primary containment moisture barrier through visual inspections.

Because the applicant's plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of deterioration of the PNPS primary containment moisture barrier through visual inspections as the ASME Code Section XI, Subsection IWE, the project team found it to be an acceptable management program for detecting cracking and change in material properties.

For loss of sealing and leakage through containment due to deterioration of elastomer, rubber, and other similar material joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, cracking and change in material properties due to deterioration of the elastomer primary containment electrical penetration seals and sealant exposed to a protected-from-weather environment are managed using the Containment Leak Rate Program (with exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant's Containment Leak Rate Program. This evaluation is documented in Section 3.0.3.2.8 of this audit and review report. The Containment Leak Rate Program is the only AMP needed to detect deterioration of the containment electrical penetration seals and sealant. Although the GALL Report specifies GALL AMP XI.S1, "ASME Section XI, Subsection IWE," also for this material, environment, and aging effect, the 1998 Edition and later editions of the ASME Code Section XI, Subsection IWE, do not require the inspection of seals and gaskets. Since the applicant has not assigned two AMPs to manage this aging effect, the applicant has conservatively called the application of only the Containment Leak Rate Program a different program with respect to the GALL Report.

Because the applicant's Containment Leak Rate Program is consistent with the GALL Report (with exceptions) and the 1998 Edition and later editions of the ASME Code Section XI, Subsection IWE, do not require the inspection of seals and gaskets, the project team found the Containment Leak Rate Program alone to be an acceptable management program for detecting cracking and change in material properties of containment electrical penetration seals and sealants.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.2 <u>Loss of Leak Tightness in Closed Position Due to Mechanical Wear of Locks, Hinges, and Closure Mechanisms</u>

In the discussion section of Table 3.5.1, Item 3.5.1-17, of the PNPS LRA, the applicant stated that locks, hinges, and closure mechanisms are active components and are therefore not subject to an AMR. During the audit and review, the applicant was asked to provide any license

renewal regulatory guidance document or previous LRA NRC SER that has ever stated that locks, hinges, and closure mechanisms are active components. If locks, hinges, and closure mechanisms are active components at PNPS, the applicant was asked to provide an itemized list of these active components with their qualified life or specified time period of replacement. The applicant was also asked to explain how PNPS tracks the active life of these components before replacement.

During interviews with the project team, the applicant's staff stated that it may be a misnomer to refer to these components as active components since 10 CFR 54.21(a)(1)(I) does not refer to active or passive components, but rather excludes components from AMR that perform an intended function, as described in 10 CFR 54.4, with moving parts or with a change in configuration or properties. Locks, hinges, and closure mechanisms perform their functions with moving parts. This exception is not based on a qualified life or specified time period of replacement for a component. Section 54.21(a)(1)(ii) of 10 CFR provides a separate exclusion for components that are replaced based on a qualified life. Other precedents for locks, hinges, and closure mechanisms as active components that have received approval by the NRC are found in Peach Bottom (NUREG-1769, Section 3.03.14.2, page 3-58) and Millstone (NUREG-1838, Section 3.3A.2.1.4, page 3-245).

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.3 Loss of Material Due to General, Pitting, and Crevice Corrosion

In the discussion section of Table 3.5.1, Item 3.5.1-18, of the PNPS LRA, the applicant stated:

> For loss of material due to general, pitting and crevice corrosion of steel (and dissimilar metal welds) penetration sleeves, personnel airlock, equipment hatch and CRD hatch exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE" and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, loss of material of the carbon steel CRD removal hatch, equipment hatch, personnel airlock, primary containment electrical penetrations, torus electrical penetrations, and torus mechanical penetrations exposed to a protected-from-weather environment is managed using the Containment Inservice Inspection Program (plant-specific) and the Containment Leak Rate Program (with exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant's Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing the loss of material for the primary containment and its integral attachments.

Because the applicant's plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of loss of material for the primary containment and its integral attachments as the ASME Code Section XI, Subsection IWE, the project team

found it to be an acceptable management program for loss of material of the above components.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.4 Fretting or Lockup Due to Mechanical Wear

In the discussion section of Table 3.5.1, Item 3.5.1-21, of the PNPS LRA, the applicant stated that PNPS plant operating experience has not identified fretting or lockup due to mechanical wear for the drywell head and downcomers. During the audit and review, the project team noted that plant operating experience does not find fretting or lockup due to mechanical wear – inspections do. The applicant was asked to explain if PNPS does not currently inspect for wear of the drywell head and downcomer pipes under the CLB using the Containment Inservice Inspection Program. If PNPS does currently inspect these components for wear, the applicant was asked to justify not performing these same inspections during an extended license period. If required, the applicant was asked to provide drawings showing the spatial distance between components such that fretting cannot occur.

During interviews with the project team, the applicant's technical staff stated that CRs are a primary source of operating experience documentation reviewed for license renewal. CRs document negative inspection results. The GALL Report defines neither fretting nor lockup and further confuses the subject by stating that fretting and lockup are caused by mechanical wear, which is an aging mechanism resulting in the aging effect loss of material. The definition in the GALL Report, Section IX.E, merely states that fretting and lockup are aging effects along with a cause, but doesn't say what it is or what it looks like. As indicated in the line item for drywell head in PNPS LRA Table 3.5.2-1, the Containment Inservice Inspection – IWE Program and the Containment Leak Rate Program manage loss of material. Loss of material is the aging effect caused by mechanical wear. PNPS inspects the drywell head and downcomers (torus vent system) per the requirements of ASME Code Section XI. In addition, the drywell head and downcomers are stationary, well-braced components, and the spatial distance between connecting components makes fretting and lockup unlikely to occur.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.5 Loss of Material Due to General and Pitting Corrosion

In the discussion section of Table 3.5.1, Item 3.5.1-39, of the PNPS LRA, the applicant stated:

> For loss of material due to general, pitting, and crevice corrosion of steel support members, welds, bolted connections; and support anchorage to building structures exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S6, "Structures Monitoring Program."

However, for those AMR results line items that reference Table 3.5.1, Item 3.5.1-39, the applicant stated that loss of material of carbon steel fire hose reels and damper framing

exposed to a protected-from-weather environment is managed using the Fire Protection Program. However, the discussion column of Table 3.5.1, Item 3.5.1-39, does not credit the Fire Protection Program. Moreover, based on the program description and the enhancements, it seems the appropriate program that should have been credited was the Fire Water System Program. RAI 3.5.1-1 was generated to ask the applicant to justify why the Fire Protection Program was not credited in the discussion column of Table 3.5.1, Item 3.5-39, and which is the correct program that should have been credited.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the aging management program listed in LRA Table 3.5.2-6 line item for damper framing is correct. The Fire Protection program manages loss of material for steel fire damper frames. The valves mentioned in Appendix B.1.13.2, Fire Water System Program description, do not include dampers; they are valves in piping containing water. Damper frames are not included in this program. The aging management program listed in LRA Table 3.5.2-6 line item for fire hose reels should cite the Fire Water System Program, which manages loss of material for fire hose reels.

The discussion column of LRA Table 3.5.1, item 3.5.1-39 is revised to state:

> "Consistent with NUREG-1801 for most components. Structures Monitoring program will manage aging effects identified by this line item. The Fire Protection Program manages aging effects for steel fire damper frames and the Fire Water System Program manages aging effects for fire hose reels."

The project team reviewed the applicant's Fire Water System Program. This evaluation is documented in Section 3.0.3.2.11 of this audit and review report. The Fire Water System Program applies to water-based fire protection systems which consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations (including fire hose reels), standpipe, and aboveground and underground piping and components. Components are tested in accordance with applicable NFPA codes and standards. Such testing assures that carbon steel fire hose reels and damper housing will be inspected for corrosion (loss of material).

Because the applicant's Fire Water System Program includes hose stations (including fire hose reels) which are tested in accordance with NFPA codes and standards to detect corrosion, the project team found it to be an acceptable management program for loss of material of fire hose reels in lieu of the Structures Monitoring Program.

The project team reviewed the applicant's Fire Protection Program. This evaluation is documented in Section 3.0.3.2.10 of this audit and review report. The program is enhanced to require visual inspection of components when the diesel-driven fire pump is running to verify no degradation is occurring.

Based on the review of the above change to the LRA, the applicant's response is found acceptable.

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.6 Loss of Sealing Due to Deterioration of Seals, Gaskets, and Moisture Barriers (Caulking, Flashing, and Other Sealants)

During the audit and review, the project team noted that in Table 3.5.2-6 on page 3.5-83 of the PNPS LRA, for component seals and gaskets (doors, hatches, and manways), material rubber is protected-from-weather environment; the aging effects are cracking and change in material properties. The aging management program shown is the Structures Monitoring Program. The GALL Report line item referenced is III.A6-12, and the Table 1 reference is 3.5.1-44. The note shown is E, a different AMP than that shown in the GALL Report. However, the GALL Report Item III.A6-12 and Table 1 Item 3.5.1-44 both specify the Structures Monitoring Program. The applicant was asked to explain why the note shown is not A instead of E for the lower half of this AMR line item.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that in Table 3.5.2-6 on page 3.5-83 of the LRA, for structure and/or component/commodity of seals and gaskets, material rubber in a protected-from-weather environment, Note E, was used because it applies to the top half of the line item. The LRA is clarified to indicate that Note A applies to the lower half of the line item.

In the upper half of this line item, the applicant has referenced Table 1 line item 3.5.1-16 and For this line item, the GALL report recommends Containment Leak Rate and Containment ISI Programs, and the applicant correctly specified footnote “E’, because in Table 2 the applicant is crediting Structures Monitoring Program.

The project team reviewed the applicant’s Structures Monitoring Program. This evaluation is documented in Section 3.0.3.2.17 of this audit and review report. The program will be enhanced to provide guidance for performing structural examinations of elastomers (seal, gasket, seismic joint filler, and roof elastomers) to identify cracking and change in material properties.

On the basis of its review of the applicant’s response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.7 Loss of Material Due to Abrasion, Cavitation

In the discussion section of Table 3.5.1, Item 3.5.1-45, of the PNPS LRA, the applicant stated:

> For loss of material due to abrasion and cavitation of reinforced concrete exterior above and below grade foundation and interior slab exposed to flowing water, the GALL Report recommends programs consistent with GALL AMP XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants.”

However, loss of material of reinforced concrete exterior walls below grade (SSW area), exterior walls below grade (CWS area), foundation, interior walls below grade, exterior walls above grade, exterior walls below grade, and foundation (cooling tower) exposed to a fluid

environment is managed using the Structures Monitoring Program (with enhancements) by the applicant.

The project team reviewed the applicant's Structures Monitoring Program. This evaluation is documented in Section 3.0.3.2.17 of this audit and review report. The project team determined that the attributes of GALL AMP XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," applicable to the water control structures at PNPS have been incorporated into the PNPS Structures Monitoring Program. On this basis, the project team found the Structures Monitoring Program to be an acceptable aging management program for loss of material of the components listed above.

However, there is no line item in the AMR results Table 2 where Table 1 Item 3.5.1-45 is referenced. In RAI 3.5.1-2, the applicant was asked to justify why this line item was not referenced.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant responded that since the aging effects cited in NUREG-1801 for these components is not applicable for PNPS concrete, the line items for these group 6 components in Table 3.5.2-3 do not reference NUREG-1801 item 3.5.1-45. This treatment is the same as that of other concrete components in Table 3.5.2.x for which no aging effects are applicable. Accordingly, Table 3.5-1, line item 3.5.1-45 is not referenced , but site-specific Note "501" indicates the referenced aging management program will confirm the absence of significant aging effects for the PEO. The project team found the response to be acceptable.

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.8 <u>Loss of Material Due to General (Steel Only), Pitting, and Crevice Corrosion</u>

In the discussion section of Table 3.5.1, Item 3.5.1-47, of the PNPS LRA, the applicant stated:

> For loss of material due to general, pitting, and crevice corrosion of group six metal structural members exposed to indoor uncontrolled air, outdoor air, flowing water, or standing water, the GALL Report recommends programs consistent with GALL AMP XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants."

However, loss of material of metal structural steel beams, columns, plates exposed to a protected-from-weather-or-fluid environment; metal anchorage/embedment exposed to a fluid environment; metal manway hatches and hatch covers exposed to a protected-from-weather or weather environment; and structural bolting exposed to a fluid environment is managed using the Structures Monitoring Program (with enhancements) by the applicant.

The project team reviewed the applicant's Structures Monitoring Program. This evaluation is documented in Section 3.0.3.2.17 of this audit and review report. PNPS is not committed to RG 1.127. GALL AMP XI.S7 states that for plants not committed to RG 1.127, Revision 1, aging management of water control structures may be included in the Structures Monitoring Program.

The attributes of GALL AMP XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," applicable to the water control structures at PNPS have been incorporated into the PNPS Structures Monitoring Program.

Because the applicant's Structures Monitoring Program includes the attributes of GALL AMP XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," applicable to the water control structures at PNPS as permitted by the GALL Report, the project team found it to be an acceptable management program for loss of material of the components listed above.

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.9 Loss of Material Due to General, Pitting, and Crevice Corrosion

In the discussion section of Table 3.5.1, Item 3.5.1-49, of the PNPS LRA, the applicant stated:

For loss of material due to general, pitting, and crevice corrosion of stainless steel and steel support members; bolted connections; support anchorage to building structure exposed to treated water (< 140°F) the GALL Report recommends programs consistent with GALL AMP XI.M2, "Water Chemistry," for BWR water, and GALL AMP XI.S3, "ASME Section XI, Subsection IWF."

However, loss of material of carbon steel and SS anchorage/embedments exposed to a fluid environment is managed using the Water Chemistry Control – BWR Program and the Inservice Inspection Program by the applicant.

The project team reviewed the applicant's Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.3 of this audit and review report. The PNPS Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWF requirements for managing the loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within containment.

Because the applicant's plant-specific Inservice Inspection Program includes the same requirements for inspection and detection of loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within containment as the ASME Code Section XI, Subsection IWF, the project team found it to be an acceptable management program for loss of material of carbon steel and SS anchorage/embedment.

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.10 Loss of Material Due to Pitting and Crevice Corrosion

In the discussion section of Table 3.5.1, Item 3.5.1-50, of the PNPS LRA, the applicant stated that loss of material due to pitting and crevice corrosion of Groups B2 and B4 galvanized steel, aluminum, and SS components in an outdoor air environment is not applicable to PNPS.

During the audit and review, the project team noted that NUREG-1833 on page 93 for Item TP-6 states that an approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in H.B. Robinson SER Section 3.5.2.4.3.2, galvanized steel and SS in an outdoor air environment could result in loss of material due to constant wetting and drying conditions. Aluminum would also be susceptible to a similar kind of aging effect in the outdoor environment. The applicant was asked to provide a discussion of the actual Group B2 and B4 galvanized steel, aluminum, and SS PNPS components which are within the scope of license renewal and exposed to an outdoor air environment. In addition, the applicant was asked to discuss the location of these components at PNPS and how they are protected from constant wetting and drying conditions.

During the audit and review, the applicant stated that loss of material due to pitting and crevice corrosion of aluminum and SS components in an outdoor environment is not applicable if the atmospheric environment is nonaggressive. The ambient environment at PNPS is not chemically polluted by vapors of sulfur dioxide or other similar substances, and the external environment does not contain saltwater or high chloride content. In this nonaggressive environment, the occasional wetting and drying from normal outdoor weather does not result in any significant loss of material in aluminum or SS components. The conclusion that no aging effects require management for these materials in an outdoor air environment is supported by operating experience and by previously approved staff positions documented in the Farley SER (NUREG-1825, page 3-314).

Components that may be considered in the B2 and B4 grouping consist of those line items in PNPS LRA Table 3.5.2-6.

The AMR results for galvanized steel components in outdoor air should indicate loss of material as an aging effect with structures monitoring as the AMP. In the discussion column entry for PNPS LRA Table 3.5.1, Item 3.5.1-50, the applicant stated that loss of material is not an applicable aging effect for SS or aluminum components in outdoor air.

The project team asked the applicant to justify why there is no aging effect for galvanized steel and stainless material in an outdoor environment. Industry experience indicates an aging effect of loss of material. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Item 3.5.1-50, discussion is revised to read as follows:

> This aging effect is managed by the Structures Monitoring Program.

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.11 <u>Loss of Material Due to General and Pitting Corrosion</u>

In the discussion section of Table 3.5.1, Item 3.5.1-53, of the PNPS LRA, the applicant stated that loss of material due to general and pitting corrosion is not an aging effect. For loss of material due to general and pitting corrosion of steel support members; welds, bolted

connections; and support anchorage to building structure exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S3, "ASME Section XI, Subsection IWF."

However, loss of material of steel RV support assembly, RV stabilizer supports, torus external supports (columns, saddles), anchorage/embedment, base plates, component and piping supports ASME Class 1, 2, 3 and MC, anchor bolts, and ASME Class 1, 2, 3 and MC supports bolting exposed to a protected-from-weather environment and anchorage/embedment, base plates, component and piping supports ASME Class 1, 2, 3 and MC, anchor bolts, and ASME Class 1, 2, 3 and MC supports bolting exposed to a weather environment is managed using the Inservice Inspection Program by the applicant.

The project team reviewed the applicant's Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.3 of this audit and review report. The PNPS Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWF requirements for managing the loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within containment.

Because the applicant's plant-specific Inservice Inspection Program includes the same requirements for inspection and detection of loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within containment as the ASME Code Section XI, Subsection IWF, the project team found it to be an acceptable management program for loss of material of the components listed above.

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

3.5.2.1.12 <u>None (Galvanized Steel and Aluminum Support Members: Weld; Bolted Connection; Support Anchorage to Building Structure)</u>

During the audit and review, the project team noted that in PNPS LRA Table 3.5.2-6 (page 3.5-73) for component electrical and instrument panels and enclosures, and for material galvanized steel in a protected-from-weather environment, the aging effect is none. The GALL Report line item referenced is III.B3-3, which is for the following components: support members, welds, bolted connections, and support anchorage to building structure. The applicant was asked to explain why the PNPS LRA AMR line item has a Note A shown instead of a Note C, different component with respect to the GALL Report line item. Or as an alternative, a letter Note A with a number note explaining that the component is different.

In its response, the applicant stated that the GALL Report does not mention every type of component that may be subject to AMR (e.g., panel is not in the GALL Report), nor does the terminology used at a specific plant always align with that used in the GALL Report. Consequently, matching plant components to the GALL Report components is occasionally subjective. In this particular case, panels, which have no specific function other than to support and protect electrical equipment, were considered a support member, and Note A was applied. The use of either Note A or C has no real impact on the AMR results. Note A will be changed

to Note C for component electrical and instrument panels and enclosures and galvanized steel in a protected-from-weather environment in PNPS LRA Table 3.5.2-6 (page 3.5-73). No change is required to the other entries for this line item. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.2-6, page 3.5-73, for structure and/or component/commodity of electrical and instrument panels and enclosures, material galvanized steel, and environment protected from weather is revised to specify Note C.

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

Conclusion

The project team has evaluated the applicant's claim of consistency with the GALL Report. The project team also has reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the project team found that the AMR results which the applicant claimed to be consistent with the GALL Report are consistent with the AMRs in the GALL Report.

3.5.2.2 AMR Results for Which Further Evaluation Is Recommended

Summary of Information in the Application

In PNPS LRA Section 3.5.2.2, the applicant provided further evaluation of aging management as recommended by the GALL Report for the aging effects related to the primary containment, reactor building, intake structure, process facilities, yard structures, and bulk commodities components and component groups. The applicant also provided information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in PNPS LRA Table 3.5.1, the GALL Report recommends further evaluation. When further evaluation is recommended, the project team reviewed these further evaluations provided in PNPS LRA Section 3.5.2.2 against the criteria provided in SRP-LR Section 3.5.2.2. The project team's assessments of these evaluations are documented in this section. These assessments are applicable to each Table 2 AMR line item in Section 3.5 citing the item in Table 1.

3.5.2.2.1 PWR and BWR Containments

3.5.2.2.1.1 Aging of Inaccessible Concrete Areas

The project team reviewed PNPS LRA Section 3.5.2.2.1.1 against the criteria in SRP-LR Section 3.5.2.2.1.1.

SRP-LR Section 3.5.2.2.1.1 states that increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in inaccessible areas of PWR and BWR concrete and steel containments. The existing program relies on ASME Code Section XI, Subsection IWL, to manage these aging effects. However, the GALL Report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if the environment is aggressive. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.5.2.2.1.1, the applicant addressed increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. The PNPS LRA stated that PNPS has a Mark I freestanding steel containment located within the reactor building. Inaccessible and accessible concrete areas are designed in accordance with American Concrete Institute (ACI) specification ACI 318-63, "Building Code Requirements for Reinforced Concrete," which results in low permeability and resistance to aggressive chemical solutions by requiring the following:

- high cement content
- low water-to-cement ratio
- proper curing
- adequate air entrainment

PNPS concrete also meets requirements of later ACI guide ACI 201.2R-77, "Guide to Durable Concrete," since both documents use the same ASTM standards for selection, application, and testing of concrete.

The below-grade environment is not aggressive (pH greater than 5.5, chlorides less than 500 ppm, and sulfates less than 1500 ppm). Concrete was provided with air content between 3 and 6 percent and a water/cement ratio between 0.44 and 0.60. Therefore, increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel are not applicable to concrete in inaccessible areas. The absence of concrete aging effects is confirmed under the Structures Monitoring Program.

The project team found that these aging effects are not applicable to the PNPS Mark I freestanding steel containment. The listed possible aging effects apply to concrete elements of PWR containments and concrete BWR containments. The PNPS Mark I steel containment is located within the concrete reactor building, and the previous applicant discussion is for that concrete structure.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.1 for further evaluation.

3.5.2.2.1.2 Cracks and Distortion Due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, Cracking, and Differential Settlement Due to Erosion of Porous Concrete Subfoundations If Not Covered by the Structures Monitoring Program

The project team reviewed PNPS LRA Section 3.5.2.2.1.2 against the criteria in SRP-LR Section 3.5.2.2.1.2.

SRP-LR Section 3.5.2.2.1.2 states that cracks and distortion due to increased stress levels from settlement could occur in PWR and BWR concrete and steel containments. Also, reduction of foundation strength, cracking, and differential settlement of concrete elements due to erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. The existing program relies on the Structures Monitoring Program to manage these aging effects. Some plants may rely on a dewatering system to lower the site groundwater level. If the plant's CLB credits a dewatering system, the GALL Report recommends verification of the continued functionality of the dewatering system during the PEO. The GALL Report recommends no further evaluation if this activity is within the scope of the applicant's Structures Monitoring Program.

In PNPS LRA Section 3.5.2.2.1.2, the applicant states that for the crack and distortion due to increased stress levels from settlement, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations (if not covered by the Structures Monitoring Program), this aging effect is not applicable to PNPS. PNPS has a Mark I freestanding steel containment located within the reactor building and supported by the reactor building foundation. PNPS does not rely on a dewatering system for control of settlement. Structures are founded on dense to very dense silty sand and sand and gravel above the rock subgrade. PNPS containment was not identified in IN 97-11 as a plant susceptible to erosion of porous concrete subfoundations. Additionally, groundwater in-leakage is minimized by a waterproof membrane. This membrane protects the reactor building concrete against exposure to groundwater. Ground water was not aggressive during plant construction, and no changes in groundwater conditions have been observed at PNPS.

As a result, cracking and distortion due to increased stress level from settlement and reduction of foundation strength cracking and differential settlement due to erosion of porous concrete subfoundation are not applicable to PNPS concrete structures.

The project team determined through discussions with the applicant's technical staff that the cracking and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations (if not covered by the Structures Monitoring Program) are not plausible aging effects due to the nonexistence of these aging mechanisms. The applicant states that the aging effects due to settlement are not expected at PNPS for the Mark I steel containment since it is located within the reactor building and supported by the reactor building foundation. The reactor building is founded on sound bedrock which prevents significant settlement. In addition, there is no porous concrete subfoundation below the reactor building of concern. The project team agrees with the applicant that these aging effects are not applicable to the PNPS containment.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.2 for further evaluation.

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

The project team reviewed PNPS LRA Section 3.5.2.2.1.3 against the criteria in SRP-LR Section 3.5.2.2.1.3.

SRP-LR Section 3.5.2.2.1.3 states that a reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME Code Section XI, Subsection IWL, would not be able to identify the reduction of strength and modulus of concrete due to elevated temperature. Subsection CC-3400 of ASME Code Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The GALL Report recommends further evaluation of a plant-specific AMP if any portion of the concrete containment components exceeds specified temperature limits (i.e., general area temperature greater than 150°F and local area temperature greater than 200°F). Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of the SRP-LR).

In PNPS LRA Section 3.5.2.2.1.3, the applicant states that for the reduction of strength of modulus of concrete structures due to elevated temperature, this aging effect is not applicable to PNPS. ASME Code Section III, Division 2, Subsection CC indicates that aging due to elevated temperature exposure is not significant as long as concrete general area temperatures do not exceed 150°F and local area temperatures do not exceed 200°F. During normal operation, areas within primary containment are within these temperature limits. Therefore, reduction of strength and modulus of concrete structures due to elevated temperature is not an AERM for PNPS containment concrete.
The project team determined through discussions with the applicant's technical staff that the reduction of strength and modulus for concrete structures due to elevated temperature are not plausible aging effects due to the nonexistence of these aging mechanisms. The applicant states that the aging effects due to elevated temperature are not expected at PNPS for the concrete associated with the Mark I steel containment since general areas temperatures within the primary containment do not exceed 150°F and local area temperatures do not exceed 200°F. The project team agrees with the applicant that these aging effects are not applicable to the PNPS containment.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.3 for further evaluation.

3.5.2.2.1.4 Loss of Material Due to General, Pitting, and Crevice Corrosion

The project team reviewed PNPS LRA Section 3.5.2.2.1.4 against the criteria in SRP-LR Section 3.5.2.2.1.4.

SRP-LR Section 3.5.2.2.1.4 states that the loss of material due to general, pitting, and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect for inaccessible areas if corrosion is significant. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.5.2.2.1.4, the applicant addressed loss of material of steel elements of accessible and inaccessible areas for all types of PWR and BWR containments due to general, pitting, and crevice corrosion. The PNPS LRA stated that PNPS containment is a Mark I steel containment located within the reactor building. The PNPS reactor building concrete in contact with the drywell shell is designed in accordance with specification ACI 318-63, "Building Code Requirements for Reinforced Concrete." The concrete meets requirements of later ACI guide ACI 201.2R-77 since both documents use the same ASTM standards for selection, application, and testing of concrete. Concrete is monitored for cracks under the Structures Monitoring Program. The drywell steel shell and the area where the drywell shell becomes embedded in the drywell concrete floor are inspected in accordance with the Containment Inservice Inspection (IWE) Program.

For loss of material due to general, pitting, and crevice corrosion of carbon steel for drywell, torus, drywell head, embedded shell and sand pocket regions, drywell support skirt, torus ring girder, downcomers, liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, and suppression chamber exposed to indoor uncontrolled air or treated water, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, loss of material of the carbon steel drywell head, drywell shell, drywell sump liner, drywell to torus vent system, torus manway, torus ring girder, torus shell, and torus thermowell exposed to a protected-from-weather environment is managed using the Containment Inservice Inspection Program (plant-specific) and the Containment Leak Rate Program (exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant's Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing the loss of material for the primary containment and its integral attachments.

Because the applicant's plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of loss of material for the primary containment and its integral attachments as the ASME Code Section XI, Subsection IWE, the project team

found it to be an acceptable management program for loss of material of the above components.

For loss of material due to general, pitting, and crevice corrosion of carbon steel for drywell, torus, drywell head, embedded shell and sand pocket regions, drywell support skirt, torus ring girder, downcomers, liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, and suppression chamber exposed to indoor uncontrolled air or treated water, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, loss of material of the carbon steel drywell sump liner, torus ring girder, and torus shell exposed to a fluid environment is managed using the Containment Inservice Inspection Program (plant-specific) and the Containment Leak Rate Program (exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant's Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing the loss of material for the primary containment and its integral attachments.

Because the applicant's plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of loss of material for the primary containment and its integral attachments as the ASME Code Section XI, Subsection IWE, the project team found it to be an acceptable management program for loss of material of the above components.

To prevent corrosion of the lower part of the drywell shell, the interior and exterior surfaces are protected from contact with the atmosphere by complete concrete encasement. It is not credible for groundwater to reach the drywell shell, assuming a crack in the concrete, since the concrete at this location is greater than 8 feet thick and poured in multiple horizontal planes. The exterior surface of the drywell shell at the sand cushion area is effectively drained and protected from condensation or water that might enter the air gap from above. Therefore, significant corrosion of the drywell shell is not expected.

During the audit and review, the project team asked the applicant to discuss how PNPS compares to interim staff guidance document (ISG)-2006-01, "Plant Specific Aging Management Program for Inaccessible Areas of Boiling Water Reactor Mark I Steel Containment Drywell Shell," proposal actions. In a letter dated June 7, 2006 (ADAMS Accession Number ML061710422), the applicant stated that the coating specified for the PNPS drywell shell exterior surface was an alkyd-base primer (red lead or zinc chromate). No degradation of this coating in the sand cushion area was noted in 1987 when fiberscopes were used to examine the 4-inch annulus air gap drain lines. To ensure the drywell shell exterior remains dry during RFOs, the drywell to reactor building bellows assembly separates the refueling cavity filled with water from the exterior surface of the drywell shell. Any leakage through the bellows assembly is directed to a drain system (refueling bellows seal trough drains) which is equipped with an alarm for notification of operators.

The applicant also stated that there has been no observed leakage causing moisture in the vicinity of the sand cushion at PNPS, and no moisture has been detected or is suspected on the inaccessible areas of the drywell shell. Further, as discussed above, any potential leakage through the refueling bellows assembly is directed to a drain system. Therefore, no additional components have been identified that require AMR as a source of moisture that might affect the drywell shell in the lower region. As it stated in the response to NRC GL 87-05, PNPS performed UT thickness measurements of the drywell shell in January 1987. The UT thickness measurements were taken at 12 locations directly above the sand cushion region. These measurements detected no loss of wall thickness. In 1987, access holes were machined in the drain line elbows (all four drain lines) to allow access for remote visual examination using fiberscope. This inspection determined that the four annulus air gap drains are unobstructed and found no signs of corrosion on the visible portions of the drywell surface. PNPS monitors the annulus air gap drains during every RFO in accordance with PNPS procedures.

PNPS performed additional UT thickness measurements adjacent to the sand cushion region at the 9 foot, 1 inch elevation in 1999 and 2001. The sand cushion region of the drywell shell is inaccessible unless concrete is removed. For the examination in 1999 and 2001, concrete at the periphery of the 9 foot, 2 inch elevation was chipped away to allow UT wall thickness measurements of the drywell shell to be taken at the level of the upper sand cushion. The observed readings indicated that the drywell wall thickness in these areas is essentially the same as the as-built. However, PNPS removed UT thickness measurements in the sand cushion region from the IWE program after the 2001 outage cited the following:

1. Satisfactory results from monitoring for leakage from the annulus air gap drains.

2. Satisfactory drywell wall thickness at the 9 foot, 1 inch elevation after 27 years of operation (as of 1999).

3. High radiation in areas of sand cushion UT exams.

4. The potential for damage to the drywell shell from concrete removal tools.

In the same letter, the applicant stated under “Ongoing Actions to Prevent Drywell Corrosion” that the following ongoing actions are being taken to prevent and identify drywell corrosion:

1. PNPS monitors the four annulus air gap drains twice every RFO, once after floodup and again before flooddown at the end of the outage. Leakage has never been detected from the annulus air gap drains at PNPS.

2. Functional checks are performed each RFO on the flow switch associated with the bellows seal leakage monitoring system.

3. Drywell interior surfaces are examined for degradation every RFO as required by Technical Specification 4.7.A.2.d. Additionally, drywell interior surfaces are examined in every other outage in accordance with the PNPS IWE Program. Drywell structures are examined in accordance with ASME Code Section XI, 1998 Edition with 2000 Addenda, Subsection IWE requirements for Class MC and metallic liner of Class CC components

of light water cooled plants. Since IWE requirements were mandated in 1996, no areas have been identified that exceeded code acceptance criteria on the drywell interior surfaces during these inspections.

4. PNPS inspects the liner drains for the water reservoirs on the refuel floor (e.g., spent fuel pool, dryer/separator pool, and the reactor cavity) for leakage. Leakage into the liner drains could be the precursor for water leaks which could wet the drywell shell exterior surface. These drains are examined for leakage after filling the refueling cavity.

5. Paragraph IWE-1242 of the ASME Code, Section XI, states that the surface areas likely to experience accelerated degradation and aging require augmented examination. These examinations are included in the PNPS Inservice Inspection Program along with other containment examinations. The IWE requirements for augmented examination are required by 10 CFR 50.55a.

6. UT thickness examinations will continue to be performed under the PNPS IWE program at two locations in the upper drywell immediately adjacent to the fuel pool due to the potential for leakage from the fuel pool liner.

7. The drywell shell to floor joint is inspected under the PNPS IWE program.

In conclusion, the applicant stated as follows:

> PNPS has effectively addressed the issue of drywell shell corrosion through actions taken in response to GL 87-05 as well as additional actions subsequent to the response to GL 87-05. UT examinations to determine the drywell wall thickness at the sand cushion region and upper drywell indicated no detectable loss of material and hence no discernable corrosion rate. Based on this corrosion rate, no discernable loss of drywell shell thickness is projected through the period of extended operation. The above described ongoing actions to prevent drywell shell degradation provide continuing assurance of satisfactory drywell shell condition through the period of extended operation.

The project team evaluated the information provided above and the information provided to the NRC's aging management inspection team on the status of the drywell shell and made the following findings:

- The operating experience confirmed that there is no indication of water in the air gap between the shell and the shield concrete. In addition, no leakage has been found through the refueling bellows into the area monitored by the air gap leakage detection system. Functional checks are performed each refueling outage on the flow switch associated with this leakage alarm system.

- The four annulus air gap drains are monitored twice every outage, once after flood-up and again prior to flood-down at the end of the outage. PNPS inspects the liner drains for the water reservoirs on the refuel floor (e.g., spent fuel pool, dryer/separator pool and reactor cavity) for leakage. Leakage into the liner drains could be a precursor for

water leaks that could wet the drywell shell exterior surface. These drains are examined for leakage after filling the refueling cavity through operator tour observations

- UT thickness examinations will continue to be performed under the PNPS IWE program at two locations in the upper drywell immediately adjacent to the fuel pool due to the potential for leakage from the fuel pool liner.

The project team discussed issues related to the above information with the applicant's technical staff and determined that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.4 for further evaluation.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

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

The project team reviewed PNPS LRA Section 3.5.2.2.1.5 against the criteria in SRP-LR Section 3.5.2.2.1.5.

SRP-LR Section 3.5.2.2.1.5 states that the loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5, "Concrete Containment Tendon Prestress Analysis," of the SRP-LR.

The applicant stated in the PNPS LRA that for the loss of prestress due to relaxation, shrinkage, creep, and elevated temperature, this aging effect is not applicable to PNPS. PNPS is a Mark I containment and does not incorporate prestressed concrete in its design. Therefore, loss of prestress due to relaxation, shrinkage, creep, and elevated temperature is not an applicable aging effect.

The project team determined through discussions with the applicant's technical staff that because PNPS is a BWR with Mark I containment, the aging effect of loss of prestress due to relaxation, shrinkage, creep, and elevated temperature is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.5 for further evaluation.

3.5.2.2.1.6 Cumulative Fatigue Damage

In PNPS LRA Section 3.5.2.2.1.6, the applicant states that fatigue is a TLAA as defined in 10 CFR 54.3, and TLAAs are evaluated in accordance with 10 CFR 54.21(c). The project team's evaluation of this TLAA is addressed separately in Section 4.6 of this audit and review report.

During the audit and review, the project team noted in PNPS LRA Table 3.5.2-1 (page 3.5-54) that the note assigned for the component torus shell with the aging effect of cracking fatigue is Note E. Note E is consistent with the GALL Report material, environment, and aging effect, but a different AMP is credited. The applicant was asked to explain why this note is E when the AMP shown for this line item is TLAA and the referenced GALL Report Item II.B1.1-4 also specifies a TLAA.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.2-1, page 3.5-54, for structure and/or component/commodity of torus shell, aging effect cracking fatigue, is revised to specify Note A.

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

In the discussion section of Table 3.5.1, Item 3.5.1-9, of the PNPS LRA, the applicant stated: "Not applicable. See Section 3.5.2.2.1.6." However, during the audit and review, the project team noted the following statement was made in PNPS LRA Section 3.5.2.2.1.6: "Fatigue TLAAs for the steel drywell, torus, and associated penetrations are evaluated and documented in Section 4.6." The components associated with PNPS LRA Table 3.5.1, Item 3.5.1-9, are penetration sleeves, penetration bellows, suppression pool shell, and unbraced downcomers. The applicant was asked to explain why Item 3.5.1-9 was not applicable when a fatigue TLAA has been performed for the torus and penetrations. Also, the applicant was asked to explain why the vent line, vent header, and vent line bellows are not listed in PNPS LRA Sections 3.5.2.2.1.6 and 4.6, as referenced in PNPS LRA Table 3.5.1, Item 3.5.1-8.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the PNPS LRA will be supplemented to reflect the following changes:

> Fatigue analyses have been evaluated for the torus, drywell to torus vent system, and torus penetrations. The following line for the torus penetrations is added to Table 3.5.2-1: "Torus mechanical penetrations // PB, SSR // Carbon steel // Protected from weather // Cracking // TLAA-metal fatigue // II.B4-4 (c)-13) // 3.5.1-9 // A."

The evaluation of the drywell to torus vent system fatigue analysis determined that it was not a TLAA. The significant contributor to fatigue of the vent system is post-LOCA chugging, a one plant-life event. As there will still be only one design-basis LOCA for the life of the plant, including the PEO, this analysis is not based on a time-limited assumption and is not a TLAA because fatigue for the vent system is event-driven and not an age-related effect.

The discussion column entry for PNPS LRA Table 3.5.1, Item 3.5.1-8, is changed to read as follows:

> Fatigue analysis is a TLAA for the torus shell. Fatigue for the vent system is event-driven and the analysis is not a TLAA. See Section 3.5.2.2.1.6.

The discussion column entry for PNPS LRA Table 3.5.1, Item 3.5.1-9, is changed to read:

> Fatigue analysis is a TLAA for the torus penetrations. See Section 3.5.2.2.1.6.

Section 3.5.2.2.1.6 is changed to read as follows:

> TLAA are evaluated in accordance with 10 CFR 54.21(c) as documented in Section 4 of the application. Fatigue TLAAs for the torus and associated penetrations are evaluated as documented in Section 4.6.

On the basis of its review, the project team found the applicant appropriately addressed the AEM, as recommended by GALL Report.

3.5.2.2.1.7 Cracking Due to SCC

The project team reviewed PNPS LRA Section 3.5.2.2.1.7 against the criteria in SRP-LR Section 3.5.2.2.1.7.

SRP-LR Section 3.5.2.2.1.7 states that cracking due to SCC of SS penetration sleeves, penetration bellows, and DSM welds could occur in all types of PWR and BWR containments. Cracking due to SCC could also occur in SS vent line bellows for BWR containments. The existing program relies on ASME Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations/evaluations implemented to detect these aging effects for SS penetration sleeves, penetration bellows, DSM welds, and SS vent line bellows.

In PNPS LRA Section 3.5.2.2.1.7, the applicant states that NUREG-1801 recommends further evaluation of inspection methods to detect cracking due to SCC since visual VT-3 examinations may be unable to detect this aging effect. Potentially susceptible components at PNPS are penetration sleeves and bellows.

SCC becomes significant for SS if tensile stresses and a corrosive environment exist. The stresses may be applied (external) or residual (internal). The normal environment inside the drywell is dry. The penetration components are not exposed to corrosive environments. Therefore, SCC is not an AERM for the penetration sleeves and bellows since the conditions necessary for SCC do not exist. The project team determined through discussions with the applicant's staff that cracking due to SCC for penetration sleeves and bellows is not applicable to PNPS since the conditions necessary for SCC do not exist.

During interviews with the project team, the applicant's staff stated that the GALL Report's referenced programs involve visual inspection and leak rate testing, which are not optimum methods for managing SCC. Therefore, when possible, the "other" method which may be used to detect cracking is the existing Containment Leak Rate Program, and when necessary, augmented ultrasonic exams are utilized to detect cracks, which is the optimum method for managing SCC. As stated in PNPS LRA Section 3.5.2.2.1.7, SCC is not an aging effect requiring management for the penetration sleeves and bellows, since the conditions necessary

for SCC do not exist. However, the components are evaluated for aging effects (e.g., cracking requiring management as shown in PNPS LRA Table 3.5.2-1).

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.7 for further evaluation.

3.5.2.2.1.8 Cracking Due to Cyclic Loading

The project team reviewed PNPS LRA Section 3.5.2.2.1.8 against the criteria in SRP-LR Section 3.5.2.2.1.8.

SRP-LR Section 3.5.2.2.1.8 states that cracking due to cyclic loading of suppression pool steel and SS shells (including welded joints) and penetrations (including penetration sleeves, DSM welds, and penetration bellows) could occur for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers. The existing program relies on ASME Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. However, VT-3 visual inspection may not detect fine cracks. The GALL Report recommends further evaluation for detection of this aging effect.

In PNPS LRA Section 3.5.2.2.1.8, the applicant states that cyclic loading can lead to cracking of penetration sleeves, penetration bellows, and torus pool steel. If a CLB analysis does not exist, further evaluation is recommended of inspection methods to detect cracking due to cyclic loading since visual VT-3 examinations may be unable to detect this aging effect.

The analysis of cracking due to cyclic loading of the drywell, torus, and associated penetrations is a TLAA which is evaluated as documented in PNPS LRA Section 4.6.

For cracking due to cyclic loading of steel, SS and DSM welds for penetration sleeves, penetration bellows, suppression pool shell, and unbraced downcomers exposed to indoor uncontrolled air or outdoor air, the GALL Report recommends programs consistent with GALL AMP XI.S1, “ASME Section XI, Subsection IWE,” and GALL AMP XI.S4, “10 CFR Part 50, Appendix J.”

However, cracking due to cyclic loading of the carbon steel primary containment mechanical penetrations (including those with bellows) exposed to a protected-from-weather environment is managed using the Containment Inservice Inspection Program (plant-specific) and the Containment Leak Rate Program (exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant’s Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing cracking of the primary containment and its integral attachments.

Because the applicant’s plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of cracking for the primary containment and its integral attachments as the ASME Code Section XI, Subsection IWE, the project team found it

to be an acceptable management program for cracking of the primary containment mechanical penetrations (including those with bellows).

For cracking due to cyclic loading of steel, SS and DSM welds for torus, vent line, vent header, vent line bellows, and downcomers exposed to indoor uncontrolled air, the GALL Report recommends programs consistent with GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J."

However, cracking due to cyclic loading of the SS drywell to torus vent line bellows exposed to a protected-from-weather environment is managed using the Containment Inservice Inspection Program (plant-specific) and the Containment Leak Rate Program (exceptions to the GALL Report) by the applicant.

The project team reviewed the applicant's Containment Inservice Inspection Program. This evaluation is documented in Section 3.0.3.3.2 of this audit and review report. The Containment Inservice Inspection Program encompasses the ASME Code Section XI, Subsection IWE requirements for managing cracking of the primary containment and its integral attachments.

Because the applicant's plant-specific Containment Inservice Inspection Program includes the same requirements for inspection and detection of cracking for the primary containment and its integral attachments as the ASME Code Section XI, Subsection IWE, the project team found it to be an acceptable management program for cracking of the drywell to torus vent line bellows.

On the basis of its review, the project team found that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

During the audit and review, the project team noted that in PNPS LRA Table 3.5.2-1 (page 3.5-51), for component bellows (RV and drywell), one of the AMPs shown is the Containment Inservice Inspection – IWE Program, which is a plant-specific AMP. A Note C has been assigned to this AMR line item, and the component is different from but consistent with material, environment, aging effect, and AMP for the GALL Report line item. The AMP is consistent with the GALL Report AMP description. The applicant was asked to show how the PNPS LRA line item bellows are different from the GALL Report Table 1 Item 3.5.1-13 bellows. The applicant was also asked to explain how the plant-specific PNPS Containment Inservice Inspection – IWE AMP is consistent with the GALL Report's specified AMP.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that Note C was incorrectly assigned to this line of PNPS LRA Table 3.5.2-1. The correct note for this line is Note E.

On the basis of its review of the applicant's response, the project team found the response acceptable and that the applicant appropriately addressed the AEM, as recommended by the GALL Report.

In the discussion section of Table 3.5.1, Items 3.5.1-12 and 3.5.1-13, of the PNPS LRA, the applicant does not make reference to PNPS LRA Section 3.5.2.2.1.8 for further evaluation. During the audit and review, the applicant was asked to explain why this link was not made to

the further evaluation section. Also the applicant was asked to explain the need for augmented ultrasonic exams to detect fine cracks since a CLB fatigue analysis does exist.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Items 3.5.1-12 and 3.5.1-13, are revised to add a statement to "See section 3.5.2.2.1.8" in the discussion column.

LRA Section 3.5.2.2.1.8 is revised to include the following statement:

> Cyclic loading can lead to cracking of steel and stainless steel penetration bellows, and dissimilar metal welds of BWR containments and BWR suppression pool shell and downcomers.

Cracking due to cycle loading is not expected to occur in the drywell, torus, associated penetration bellows, penetration sleeves, unbraced downcomers, and DSM welds. A review of plant operating experience did not identify cracking of the components, and primary containment leakage has not been identified as a concern. Nonetheless,the Containment Inservice Inspection (IWE), the existing Containment Leak Rate Program, and, when necessary, augmented ultrasonic exams will continue to be used to detect cracking. Observed conditions that have the potential for impacting an intended function are evaluated or corrected in accordance with the corrective action process. The Containment Inservice Inspection and Containment Leak Rate Programs are described in Appendix B.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.8 for further evaluation.

3.5.2.2.1.9 <u>Loss of Material (Scaling, Cracking, and Spalling) Due to Freeze-Thaw</u>

The project team reviewed PNPS LRA Section 3.5.2.2.1.9 against the criteria in SRP-LR Section 3.5.2.2.1.9.

SRP-LR Section 3.5.2.2.1.9 states that the loss of material (scaling, cracking, and spalling) due to freeze-thaw could occur in PWR and BWR concrete containments. The existing program relies on ASME Code Section XI, Subsection IWL, to manage this aging effect. The GALL Report recommends further evaluation of this aging effect for plants located in moderate to severe weathering conditions.

In PNPS LRA Section 3.5.2.2.1.9, the applicant states that PNPS has a Mark I freestanding steel containment located within the reactor building. Loss of material (scaling, cracking, and spalling) due to freeze-thaw is applicable only to concrete containments. Therefore, loss of material and cracking due to freeze-thaw do not apply. The project team determined through discussions with the applicant's technical staff that because PNPS is a BWR with Mark I containment, the aging effect loss of material (scaling, cracking, and spalling) due to freeze-thaw is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.9 for further evaluation.

3.5.2.2.1.10 Cracking Due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide

The project team reviewed PNPS LRA Section 3.5.2.2.1.10 against the criteria in SRP-LR Section 3.5.2.2.1.10.

SRP-LR Section 3.5.2.2.1.10 states that cracking due to expansion and reaction with aggregate and increase in porosity and permeability due to leaching of calcium hydroxide could occur in concrete elements of PWR and BWR concrete and steel containments. The existing program relies on ASME Code Section XI, Subsection IWL, to manage these aging effects. The GALL Report recommends further evaluation if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

In PNPS LRA Section 3.5.2.2.1.10, the applicant states that PNPS has a Mark I freestanding steel containment located within the reactor building. In accordance with NUREG-1801, aging management is not required because PNPS containment concrete (basemat) is designed in accordance with specification ACI 318-63, "Building Code Requirements for Reinforced Concrete," and the concrete specification requires that the potential reactivity of aggregates be acceptable based on testing in accordance with ASTM C-289 and C-295. The project team determined through discussions with the applicant's technical staff that because PNPS is a BWR with a Mark I containment, the aging effect of cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide, is not applicable to PNPS.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.10 for further evaluation.

3.5.2.2.2 Safety-Related and Other SC Supports

3.5.2.2.2.1 Aging of Structures Not Covered by Structures Monitoring Program

The project team reviewed PNPS LRA Section 3.5.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.1.

SRP-LR Section 3.5.2.2.2.1 states that 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) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, and 9 structures; (2) increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, and 9 structures; (3) loss of material due to corrosion for Groups 1-5, 7, and 8 structures; (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, and 7-9 structures; (5) cracking due to expansion and reaction with aggregates for Groups 1-5 and 7-9 structures; (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3 and 5-9 structures; and (7) reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1-3 and 5-9 structures. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the Structures Monitoring Program.

Lockup due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or ASME Code Section XI, Subsection IWF, to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or Structures Monitoring Program.

In PNPS LRA Section 3.5.2.2.2.1, the applicant addressed various aging effects not covered by the Structures Monitoring Program of concrete and steel elements due to various aging mechanisms. The PNPS LRA stated that PNPS concrete structures subject to AMR are included in the Structures Monitoring Program. This is true for concrete items even if the AMR did not identify AERMs. Aging effects discussed below for structural steel items are also addressed by the Structures Monitoring Program. Additional discussion of specific aging effects follows.

1. Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling) Due to Corrosion of Embedded Steel for Groups 1-5, 7, and 9 Structures

The applicant stated in the PNPS LRA that the aging mechanisms associated with cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel are applicable only to below-grade concrete/grout structures. The below-grade environment for PNPS is not aggressive, and concrete is designed in accordance with specification ACI 318-63, "Building Code Requirements for Reinforced Concrete," which results in low permeability and resistance to aggressive chemical solutions by providing a high-cement, low-water/cement ratio (between 0.44 and 0.60), proper curing, and adequate air content between 3 percent and 6 percent. Therefore, cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel are not AERMs for PNPS Groups 1-5, 7, and 9 structures.

The project team determined through discussions with the applicant's technical staff that the cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, and 9 structures are not plausible aging effects at PNPS due to the lack of aggressive groundwater (pH 6.2 greater than 5.5; chlorides 420 ppm less than 500 ppm; sulfates 16 ppm less than 1500 ppm), and the concrete is designed in accordance with specification ACI 318-63 with a high-cement, low-water/cement ratio, proper curing, and adequate air content between 3 and 6 percent. However, the above aging effects for these groups are included within the Structures Monitoring Program by the applicant.

2. Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling) Due to Aggressive Chemical Attack for Groups 1-5, 7, and 9 Structures

The applicant stated in the PNPS LRA that for the increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, and 9 structures, this aging effect is not applicable to PNPS. Aggressive chemical attack becomes significant to concrete exposed to an aggressive environment. Resistance to mild acid attack is enhanced by using a dense concrete with low permeability and low water-to-cement ratio of less than 0.50. These groups of structures at PNPS use a dense low permeable concrete with a maximum water-to-cement ratio of 0.48, which provides an

acceptable degree of protection against aggressive chemical attack. Water chemical analysis results confirm that the site groundwater is considered to be nonaggressive. PNPS concrete is constructed in accordance with the recommendations in ACI 201.2R-77 for durability.

The site's below-grade environment is not aggressive. Therefore, increase in porosity and permeability cracking and loss of material (spalling, scaling) due to aggressive chemical attack are not AERMs for PNPS Groups 1-5, 7, and 9 concrete structures.

The project team determined through discussions with the applicant's technical staff that the increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, and 9 structures are not plausible aging effects at PNPS due to the lack of aggressive groundwater and the concrete being constructed in accordance with the recommendations in ACI 201.2R-77 for durability. However, the above aging effects for these groups are included within the Structures Monitoring Program by the applicant.

3. Loss of Material Due to Corrosion for Groups 1-5, 7, and 8 Structures

The applicant stated in the PNPS LRA that for the loss of material due to corrosion for Groups 1-5, 7, and 8 structures, this aging effect is applicable to PNPS. The PNPS Structures Monitoring Program will be used to manage AERMs for PNPS Groups 1-5, 7, and 8 structures.

The project team determined through discussions with the applicant's technical staff that the loss of material due to corrosion for Groups 1-5, 7, and 8 structures is an aging effect which will be managed by the applicant's Structures Monitoring Program.

4. Loss of Material (Spalling, Scaling) and Cracking Due to Freeze-Thaw for Groups 1-3, 5, and 7-9 Structures

The applicant stated in the PNPS LRA that due to the loss of material (spalling, scaling) and cracking attributed to freeze-thaw for Groups 1-3, 5, and 7-9 structures, this aging effect is not applicable to PNPS. Aggregates were in accordance with specifications and materials conforming to ACI and ASTM standards. PNPS structures are constructed of a dense, durable mixture of sound coarse aggregate, fine aggregate, cement, water, and admixture. Water/cement ratios are within the limits provided in ACI 318, and air entrainment percentages were within the range prescribed in NUREG-1801. Therefore, loss of material (spalling, scaling) and cracking due to freeze-thaw are not AERMs for PNPS Groups 1-3, 5, and 7-9 structures.

The project team determined through discussions with the applicant's technical staff that the loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, and 7-9 structures are not plausible aging effects at PNPS due to concrete being constructed in accordance with ACI and ASTM standards. However, the above aging effects for these groups are included within the Structures Monitoring Program by the applicant.

5. Cracking Due to Expansion and Reaction with Aggregates for Groups 1-5 and 7-9 Structures

The applicant stated in the PNPS LRA that the aggregates were selected locally and were in accordance with specifications and materials conforming to ACI and ASTM standards at the time of construction, which are in accordance with the recommendations in ACI 201.2R-77 for concrete durability. PNPS structures are constructed of a dense, durable mixture of sound coarse aggregate, fine aggregate, cement, water, and admixture. Water/cement ratios are within the limits provided in ACI 318-63, and air entrainment percentages were within the range prescribed in NUREG-1801. Therefore, cracking due to expansion and reaction with aggregates for Groups 1-3, 5, and 7-9 structures is not an AERM for PNPS concrete.

The project team determined through discussions with the applicant's technical staff that the cracking due to expansion and reaction with aggregates for Groups 1-5 and 7-9 structures are not plausible aging effects at PNPS due to concrete being constructed in accordance with ACI and ASTM standards with a high-cement, low-water/cement ratio. However, the above aging effects for these groups are included within the Structures Monitoring Program by the applicant.

6. Cracks and Distortion Due to Increased Stress Levels from Settlement for Groups 1-3 and 5-9 Structures

The applicant stated in the PNPS LRA that the Groups 1-3 and 5-9 structures at PNPS are founded on dense to very dense silty sand and sand and gravel. No significant settlement has occurred since construction, and additional settlement is not anticipated. Therefore, cracks and distortion due to increased stress levels from settlement for Groups 1-3 structures is not an aging mechanism for PNPS concrete.

The project team determined through discussions with the applicant's technical staff that the cracks and distortion due to increased stress levels from settlement for Groups 1-3 and 5-9 structures are not plausible aging effects due to the nonexistence of these aging mechanisms. The applicant states that the aging effects due to settlement are not expected at PNPS for Groups 1-3 and 5-9 Class 1 structures. The PNPS Class 1 structures are founded on sound bedrock or supported by steel pilings which prevent significant settlement. The project team agrees with the applicant that these aging effects are not applicable to PNPS Class 1 structures. On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

7. Reduction in Foundation Strength, Cracking, and Differential Settlement Due to Erosion of Porous Concrete Subfoundation for Groups 1-3 and 5-9 Structures

The applicant stated in the PNPS LRA that the PNPS structures are not constructed of porous concrete. Concrete was provided in accordance with ACI 318-63 requirements resulting in dense, well-cured, high-strength concrete with low-permeability. Therefore, reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation are not AERMs for PNPS Groups 1-3 and 5-9 structures.

The project team determined through discussions with the applicant's technical staff that reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1-3 and 5-9 structures are not plausible aging effects due to the nonexistence of these aging mechanisms. The applicant states that the aging effects of reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1-3 and 5-9 structures are not applicable to PNPS since there are no porous concrete subfoundations of concern below these structures. The project team agrees with the applicant that these aging effects are not applicable to PNPS Groups 1-3 and 5-9 structures.

8. Lockup Due to Wear for Lubrite® Radial Beam Seats in BWR Drywell and Other Sliding Support Surfaces

The applicant stated in the PNPS LRA that due to the wear-resistant material used, the low frequency (number of times) of movement, and the slow movement between sliding surfaces, lockup due to wear is not an AERM at PNPS. However, Lubrite® plates are included within the Structures Monitoring Program and Inservice Inspection (ISI-IWF) Program to confirm the absence of AERMs for this component.

The project team determined through discussions with the applicant's technical staff that the lockup due to wear for Lubrite® radial beam seats in BWR drywell and other sliding support surfaces is not a plausible aging effect at PNPS due to the wear-resistant material used, the low frequency (number of times) of movement, and the slow movement between sliding surfaces. However, the above aging effects for Lubrite® components associated with the PNPS drywell beam seats are included within the Structures Monitoring Program by the applicant.

The project team determined through discussions with the applicant's technical staff that the applicant has included the above eight structure/aging effect combinations in its Structures Monitoring Program, and no further evaluation is required in accordance with the GALL Report. However, although not required, the applicant has elected to provide further evaluation for each of the eight aging effects referenced above. The project team found this additional evaluation acceptable.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.1 for further evaluation.

3.5.2.2.2.2 <u>Aging Management of Inaccessible Areas</u>

The project team reviewed PNPS LRA Section 3.5.2.2.2.2 against the criteria in SRP-LR Sections 3.5.2.2.2.2.1 through 3.5.2.2.2.2.5. In Section 3.5.2.2.2.2 of the PNPS LRA, the applicant responded to five separate areas of concern identified in the SRP-LR with a single response. The five areas of concern from the SRP-LR are provided below, followed by the applicant's response.

3.5.2.2.2.2.1 <u>Aging Management of Inaccessible Areas [Item 1]</u>

SRP-LR Section 3.5.2.2.2.2.1 states that the loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these groups of structures for plants located in moderate to severe weathering conditions.

3.5.2.2.2.2.2 Aging Management of Inaccessible Areas [Item 2]

SRP-LR Section 3.5.2.2.2.2.2 states that cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation of inaccessible areas of these groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3.5.2.2.2.2.3 Aging Management of Inaccessible Areas [Item 3]

SRP-LR Section 3.5.2.2.2.2.3 states that cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. The existing program relies on the Structures Monitoring Program to manage these aging effects. Some plants may rely on a dewatering system to lower the site ground-water level. If the plant's CLB credits a dewatering system, the GALL Report recommends verification of the continued functionality of the dewatering system during the PEO. The GALL Report recommends no further evaluation if this activity is included in the scope of the applicant's Structures Monitoring Program.

3.5.2.2.2.2.4 Aging Management of Inaccessible Areas [Item 4]

SRP-LR Section 3.5.2.2.2.2.4 states that an increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel, could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas of these groups of structures if the environment is aggressive. The acceptance criteria are described in Branch Technical Position RLSB-1.

3.5.2.2.2.2.5 Aging Management of Inaccessible Areas [Item 5]

SRP-LR Section 3.5.2.2.2.2.5 states that increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide, could occur in below-grade inaccessible concrete areas of Groups 1-3, 5, and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

3.5.2.2.2.2.5 Aging Management of Inaccessible Areas [Item 6]

In PNPS LRA Section 3.5.2.2.2.2, the applicant addressed the above five items and stated that PNPS concrete for Groups 1-3, 5, and 7-9 inaccessible concrete areas was provided in accordance with specification ACI 318-63, "Building Code Requirements for Reinforced Concrete," which requires the following, resulting in low permeability and resistance to aggressive chemical solution:

- high cement content
- low water permeability
- proper curing
- adequate air entrainment

PNPS concrete also meets the requirements of later ACI guide ACI 201.2R-77, "Guide to Durable Concrete," since both documents use the same ASTM standards for selection, application, and testing of concrete.

Inspections of accessible concrete have not revealed degradation related to corrosion of embedded steel. The site's below-grade environment is not aggressive (pH greater than 5.5, chlorides less than 500 ppm, and sulfates less than 1500 ppm). Therefore, corrosion of embedded steel is not an AERM for PNPS concrete.

The project team determined through discussions with the applicant's technical staff that the aging management of inaccessible areas due to aggressive chemical attack for Groups 1-5, 7, and 9 structures are not plausible aging effects at PNPS due to the lack of aggressive groundwater (pH: 6.2, chlorides: 420 ppm, and sulfates: 16 ppm) and the concrete being constructed in accordance with the recommendations in ACI 201.2R-77 for durability with a high-cement, low-water/cement ratio. The applicant will perform opportunistic inspections of inaccessible concrete areas when they become accessible under the Buried Piping Inspection Program and the Structures Monitoring Program. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. Commitment No. 25 will revise the Structures Monitoring Program to require opportunistic inspections of inaccessible concrete areas when they become accessible. Furthermore, as part of the structural monitoring program, the applicant will continue to perform periodic groundwater monitoring to confirm lack of aggressiveness. This is Follow-up Item No. 3.5.2.2.2.2-1.

The project team found that, based on the programs identified above and the commitment, the applicant has met the criteria of SRP-LR Sections 3.5.2.2.2.2.1 through 3.5.2.2.2.2.5 for further evaluation.

3.5.2.2.2.3 Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature

The project team reviewed PNPS LRA Section 3.5.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.3.

SRP-LR Section 3.5.2.2.2.3 states that a reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Groups 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150°F except for local areas, which are allowed to have increased temperatures not to exceed 200°F. The GALL Report recommends further evaluation of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits (i.e., general area temperature greater than 150°F and local area temperature greater than 200°F). The acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.5.2.2.2.3, the applicant stated that Groups 1-5 concrete elements do not exceed the temperature limits associated with aging degradation due to elevated temperature. Therefore, reduction of strength and modulus of concrete due to elevated temperatures is not an AERM for PNPS. The project team determined through discussions with the applicant's technical staff that the reduction of strength and modulus of concrete structures due to elevated temperatures is not a plausible aging effect due to the nonexistence of these aging mechanisms. The applicant states that the aging effects due to elevated temperature are not expected at PNPS for the concrete associated with Groups 1-5 structures since general area temperatures within the primary containment do not exceed 150°F and local area temperatures do not exceed 200°F. The project team agrees with the applicant that these aging effects are not applicable to the PNPS Groups 1-5 structures concrete.

During the audit and review, the applicant was asked by the project team to provide the maximum temperatures that concrete experiences in Groups 1-5 structures.

During interviews with the project team, the applicant's technical staff stated that the PNPS concrete is expected to experience an average general area temperature of 148°F (UFSAR Table 5.2-2). For structures outside the drywell, the bulk area maximum temperature is 120°F for Groups 1-5 structures as identified in Table 10.9-2 of PNPS UFSAR. Concrete within the drywell consists of the reactor pedestal, sacrificial shield wall, and the drywell floor. Assurance that bulk concrete temperatures within the drywell remain below 150°F is obtained through maintaining average bulk containment temperature within the limits allowed by PNPS Technical Specification Section 3.2-H (page 3/4.2-5). Although upper elevations of the drywell may exceed 150°F, the concrete of the drywell is at lower elevations. The drywell cooling system provides cooling to ensure temperature limits are not exceeded. The highest concrete temperature in the drywell is at the sacrificial shield wall. The concrete in this wall is not load bearing.

On the basis that elevated temperatures are not expected at PNPS for the concrete structures associated with Groups 1-5 structures, the project team found that this aging effect is not applicable to PNPS.

3.5.2.2.2.4 <u>Aging Management of Inaccessible Areas for Group 6 Structures</u>

The project team reviewed PNPS LRA Section 3.5.2.2.2.4 against the criteria in SRP-LR Section 3.5.2.2.2.4.

SRP-LR Section 3.5.2.2.2.4 states that the GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance.

1. Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling), Aggressive Chemical Attack; and Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling), Corrosion of Embedded Steel Could Occur in Below-Grade Inaccessible Concrete Areas of Group 6 Structures

In PNPS LRA Section 3.5.2.2.2.4.1, the applicant stated that below-grade exterior reinforced concrete at PNPS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate). Therefore, increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel are not AERMs for below-grade inaccessible concrete areas of PNPS Group 6 structures.

The project team determined through discussions with the applicant's technical staff that the increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel in below-grade inaccessible concrete areas of Group 6 structures are not significant aging effects at PNPS due to the lack of aggressive groundwater (pH: 6.2, chlorides: 420 ppm, and sulfates: 16 ppm) and the concrete being constructed in accordance with the recommendations in ACI 201.2R-77 for durability with a high-cement, low-water/cement ratio. The applicant will perform opportunistic inspections of inaccessible concrete areas when they become accessible under the Buried Piping Inspection Program and the Structures Monitoring Program. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of commitments. Commitment No. 25 will revise the Structures Monitoring Program to require opportunistic inspections of inaccessible concrete areas when they become accessible. Furthermore, as part of the structural monitoring program, the applicant will continue to perform periodic groundwater monitoring to confirm lack of aggressiveness. This is Follow-up Item No. 3.5.2.2.2.4-1.

During the audit and review, the project team noted that in the discussion section of Table 3.5.1, Item 3.5.1-34, of the PNPS LRA, the applicant does not make reference to PNPS LRA Section 3.5.2.2.2.4(1) for further evaluation. During the audit and review, the applicant was asked to explain why this link was not made to the further evaluation section.

In its response, the applicant stated that SRP-LR Item 3.5.1-34 indicates that further evaluation is necessary only for aggressive environments. No reference was provided to further evaluation in PNPS LRA Section 3.5.2.2.2.4(1) since the PNPS environment is not aggressive, as noted in PNPS LRA Table 3.5.1, Item 3.5.1-34, under the discussion column. For clarification, in its letter dated September 13, 2006 (ADAMS Accession Number ML062650072),

the applicant stated that LRA Table 3.5.1, Item 3.5.1-34, discussion is revised to add "See Section 3.5.2.2.2.4(1)."

The project team finds that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4.1 for further evaluation.

2. Loss of Material (Spalling, Scaling) and Cracking Due to Freeze-Thaw Could Occur in Below-Grade Inaccessible Concrete Areas of Group 6 Structures

In PNPS LRA Section 3.5.2.2.2.4, the applicant stated that for the loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Group 6 structures, this aging effect is not applicable to PNPS because the aggregates were selected locally and were in accordance with specifications and materials conforming to ACI and ASTM standards at the time of construction. PNPS structures are constructed of a dense, durable mixture of sound coarse aggregate, fine aggregate, cement, water, and admixture. Water/cement ratios are within the limits provided in ACI 318, and air entrainment percentages were within the range prescribed in the GALL Report. Therefore, loss of material (spalling, scaling) and cracking due to freeze-thaw are not AERMs for PNPS Group 6 structures below-grade and not continuously exposed to raw water. For Group 6 concrete that is continuously exposed to raw water of the Cape Cod Bay that may become saturated, it is conservatively considered susceptible to freeze-thaw and managed by the Structures Monitoring Program.

The project team determined through discussions with the applicant's technical staff that the loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Group 6 structures are not aging effects at PNPS due to concrete being constructed in accordance with ACI and ASTM standards with a high-cement, low-water/cement ratio. For Group 6 concrete that is continuously exposed to raw water of the Cape Cod Bay that may become saturated, it is conservatively considered susceptible to freeze-thaw and managed by the Structures Monitoring Program.

During the audit and review, the project team noted that in the discussion section of Table 3.5.1, Item 3.5.1-35, of the PNPS LRA, the applicant does not make reference to PNPS LRA Section 3.5.2.2.2.4(2) for further evaluation. During the audit and review, the applicant was asked to explain why this link was not made to the further evaluation section.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Item 3.5.1-35 discussion is revised to add "See section 3.5.2.2.2.4(2)" and replace the reference to "ACI-301" with "ACI 318."

The project team finds that, based on the programs identified above and the LRA amendment, the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4.2 for further evaluation.

3. Cracking Due to Expansion and Reaction with Aggregates and Increase in Porosity and Permeability, and Loss of Strength Due to Leaching of Calcium Hydroxide Could Occur in Below-Grade Inaccessible Reinforced Concrete Areas of Group 6 Structures

In PNPS LRA Section 3.5.2.2.2.4.3, the applicant stated that for cracking due to expansion and reaction with aggregates, increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Group 6 structures, this aging effect is not applicable to PNPS because the aggregates were selected locally and were in accordance with specifications and materials conforming to ACI and ASTM standards at the time of construction, which are in accordance with the recommendations in ACI 201.2R-77 for concrete durability. PNPS structures are constructed of a dense, durable mixture of sound coarse aggregate, fine aggregate, cement, water, and admixture. Water/cement ratios are within the limits provided in ACI 318-63, and air entrainment percentages were within the range prescribed in the GALL Report. The site's below-grade environment is not aggressive (pH greater than 5.5, chlorides less than 500 ppm, and sulfates less than 1500 ppm).

The project team determined through discussions with the applicant's technical staff that the cracking due to expansion and reaction with aggregates and the increase in porosity and permeability due to leaching of calcium hydroxide in below-grade, inaccessible concrete areas of Group 6 structures is not an aging mechanism for PNPS concrete. The project team determined through discussions with the applicant's technical staff that cracking due to expansion and reaction with aggregates, increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Group 6 structures are not aging effects at PNPS due to concrete being constructed in accordance with ACI and ASTM standards with a high-cement, low-water/cement ratio and the below-grade environment being nonaggressive. However, the above aging effects for this group are included within the Structures Monitoring Program by the applicant.

During the audit and review, the project team noted that in the discussion section of Table 3.5.1, Item 3.5.1-36, of the PNPS LRA, the applicant does not make reference to PNPS LRA Section 3.5.2.2.2.4 (3) for further evaluation. During the audit and review, the applicant was asked to explain why this link is not made to the further evaluation section. Also, the statement "See Section 3.5.2.2.2.1 (5) for additional discussion" needs further clarification that this section is for Groups 1-5, 7, 9; however, it would apply to accessible Group 6 concrete. The applicant was also asked to further explain why PNPS LRA Section 3.5.2.2.2.4 (3) lists cracking of concrete due to SCC.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Item 3.5.1-36 discussion is revised to read as follows:

> Reaction with aggregates is not an applicable aging mechanism for PNPS concrete components. See Section 3.5.2.2.2.1(5) (although for Groups 1-5, 7, 9 this discussion is also applicable to Group 6) and Section 3.5.2.2.2.4(3) additional discussion. Nonetheless, the Structures Monitoring Program will confirm the absence of aging effects requiring management for PNPS Group 6 concrete components. The title of LRA Section 3.5.2.2.2.4(3) is revised to begin with "Cracking Due to Expansion and Reaction with Aggregates."

The project team found that, based on the programs identified above and the LRA amendment, the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4(3) for further evaluation.

3.5.2.2.2.5 Cracking Due to SCC and Loss of Material Due to Pitting and Crevice Corrosion

The project team reviewed PNPS LRA Section 3.5.2.2.2.5 against the criteria in SRP-LR Section 3.5.2.2.2.5.

SRP-LR Section 3.5.2.2.2.5 states that cracking due to SCC and loss of material due to pitting and crevice corrosion could occur for Groups 7 and 8 SS tank liners exposed to standing water.

In PNPS LRA Section 3.5.2.2.2.5, the applicant states that no tanks with SS liners are included in the structural AMRs. Tanks subject to AMR are evaluated with their respective mechanical systems.

The project team determined through discussions with the applicant's technical staff that the cracking due to SCC and loss of material due to pitting and crevice corrosion are not AERMs at PNPS since there are no tanks with SS liners included in the structural AMRs. Tanks subject to an AMR are evaluated with their respective mechanical systems.

On the basis that PNPS does not have any components from this group, the project team found that this aging effect is not applicable to PNPS.

3.5.2.2.2.6 Aging of Supports Not Covered by Structures Monitoring Program

The project team reviewed PNPS LRA Section 3.5.2.2.2.6 against the criteria in SRP-LR Section 3.5.2.2.2.6.

SRP-LR Section 3.5.2.2.2.6 states that the GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the Structures Monitoring Program. These include (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete for Groups B1-B5 supports; (2) loss of material due to general and pitting corrosion for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the Structures Monitoring Program.

In PNPS LRA Section 3.5.2.2.2.6, the applicant states that NUREG-1801 recommends further evaluation of certain component support/aging effect combinations if they are not covered by the applicant's Structures Monitoring Program. Component supports at PNPS are included in the Structures Monitoring Program for Groups B2 through B5 and Inservice Inspection (ISI-IWF) Program for Group B1.

1. Reduction in concrete anchor capacity due to degradation of the surrounding concrete for Groups B1 through B5 supports.

PNPS concrete anchors and surrounding concrete are included in the Structures Monitoring Program (Groups B2 through B5) and Inservice Inspection (ISI-IWF) Program (Group B1).

2. Loss of material due to general and pitting corrosion for Groups B2 through B5 supports

Loss of material due to corrosion of steel support components is an AERM at PNPS. This aging effect is managed by the Structures Monitoring Program.

3. Reduction/loss of isolation function due to degradation of vibration isolation elements for Group B4 supports

The PNPS AMR did not identify any component support structure/aging effect combination corresponding to NUREG-1801, Volume 2, Item III.B4-12.

The project team finds that the applicant has included the above AEM combinations within the scope of its Structures Monitoring Program or Inservice Inspection (IWF) Program and agrees that no further evaluation is required. The project team determined through discussions with the applicant's technical staff that reduction/loss of isolation function due to degradation of vibration isolation elements for Group B4 supports is not an AERM at PNPS since there are no vibration isolation components within the scope of license renewal. The project team reviewed the applicant's Structures Monitoring Program and Inservice Inspection (IWF) Program, and these evaluations are documented in Section 3.0.3.2.17 and Section 3.0.3.3.3 of this audit and review report, respectively. The project team finds the applicant's Structures Monitoring Program and Inservice Inspection (IWF) Program acceptable for managing the above AEM combinations of component supports for the GALL Report component support Groups B1 through B5, as those combinations are applicable.

During the audit and review, the project team noted that in the discussion section of Table 3.5.1, Item 3.5.1-40, of the PNPS LRA, the applicant states:

> Plant experience has not identified reduction in concrete anchor capacity or other concrete aging mechanisms. Nonetheless, the Structures Monitoring Program will confirm absence of aging effects requiring management for PNPS concrete components.

The project team cannot find an AMR line item in Table 2 for this component (building concrete at locations of expansion and grouted anchors; grout pads for support base plates). During the audit and review, the applicant was asked to provide the Table 2 number, PNPS LRA page number, and component for where this AMR line item is evaluated and shown.

In its response, the applicant stated that building concrete at locations of expansion and grouted anchors and grout pads for support base plates are shown as "foundation" and "Reactor vessel support pedestal" in PNPS LRA Table 3.5.2-1 (page 3.5-55); "foundation" in Tables 3.5.2-2 through 3.5.2-5 (pages 3.5-59, 3.5-61, and 3.5-64); and as "Equipment pads/foundations" in Table 3.5.2-6 (page 3.5-80). Further evaluation is provided in PNPS LRA Section 3.5.2.2.2.6(1), page 3.5-15. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated for clarification that the PNPS LRA Table 3.5.1, Item 3.5.1-40 discussion is revised to add "See Section 3.5.2.2.2.6(1)."

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.6 for further evaluation.

3.5.2.2.2.7 Cumulative Fatigue Damage Due to Cyclic Loading

In LRA Section 3.5.2.2.2.7, the applicant states that fatigue is a TLAA as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). The project team's evaluation of this TLAA is addressed separately in Section 4 of the SER related to the PNPS LRA.

The applicant stated in Section 3.5.2.2.2.7 of the PNPS LRA that for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3, this aging effect is not applicable to PNPS. During the process of identifying TLAAs in the PNPS CLB, no fatigue analyses were identified for these components. The project team determined through discussions with the applicant's technical staff that there are no CLB fatigue analyses for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 and, therefore, cumulative fatigue damage cannot be evaluated as an aging effect for these components.

On the basis that PNPS does not have any components from this group with fatigue analyses, the project team found that this aging effect is not applicable to PNPS.

3.5.2.2.3 QA for Aging Management of NSR Components

The applicant referenced PNPS LRA Section B.0.3. The project team's evaluation of LRA Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

Conclusion

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were evaluated further.

3.5.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.5.1, "Summary of Aging Management Evaluations for the Primary Containment, Structures, Component Supports, and Piping and Component Insulation," the applicant provided information regarding components or material/environment combinations in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant provided additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicated, via Notes F through J, that neither the identified component nor the material/environment combination is evaluated in the GALL Report and provided information concerning how the AERM will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

AEMs in Table 3.5.1 That Are Not Applicable to PNPS

The project team reviewed PNPS LRA Table 3.5.1, which provides a summary of aging management evaluations for the SC supports evaluated in the GALL Report.

In PNPS LRA Table 3.5.1, Item 3.5.1-19 discussion column, the applicant stated that the cracking of steel elements – SS suppression chamber shell (inner surface) – due to SCC is not applicable to PNPS.

The project team found that Table 3.5.1, Item 3.5.1-19, is applicable to SS suppression chambers. The PNPS suppression chamber is carbon steel.

On the basis that there is no SS suppression chamber shell in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-20 discussion column, the applicant stated that the loss of material of steel elements – suppression chamber liner (interior surface) – due to general, pitting, and crevice corrosion is not applicable to PNPS.

The project team found that Table 3.5.1, Item 3.5.1-20, is applicable to concrete containments. The PNPS containment is a Mark I steel containment.

On the basis that there is no suppression chamber liner in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-22 discussion column, the applicant stated that the loss of material of prestressed containment – tendons and anchorage components – due to corrosion is not applicable to PNPS.

The project team found that Table 3.5.1, Item 3.5.1-22, is applicable to concrete containments. The PNPS containment is a Mark I steel containment without prestressed tendons.

On the basis that there are no tendons and anchorage components in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-51 discussion column, the applicant stated that cracking and loss of material of Group B1.1 – high-strength, low-alloy bolts – due to stress corrosion and general corrosion is not applicable to PNPS. SCC of high-strength anchor bolts is not an AERM at PNPS for two reasons: (1) high-strength bolting at PNPS is not exposed to a corrosive environment or high tensile stresses; and (2) high-strength structural bolts are installed with

friction-type contact surfaces via the turn-of-the-nut method; therefore, for bolts greater than 1 inch in diameter, a significant preload (in the order of 70 percent of ultimate strength) is not practical to develop. The PNPS Inservice Inspection (IWF) Program manages loss of material for high-strength low-alloy bolts.

The project team agrees with the applicant that cracking of high-strength low-alloy bolts due to stress corrosion will not occur for Group B1.1 components since a corrosive environment and high tensile stresses do not exist.

On the basis that the environment and high tensile stresses needed to cause cracking from SCC do not exist for high-strength low-alloy bolts in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-52 discussion column, the applicant stated that the loss of mechanical function of Groups B2 and B4 – sliding support bearing and sliding support surfaces due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads – is not applicable to PNPS as discussed below.

In the discussion section of Table 3.5.1, Item 3.5.1-52, of the PNPS LRA, the applicant stated that loss of mechanical function due to the listed mechanisms is not an aging effect. Proper design prevents distortion, overload, and fatigue due to vibratory and cyclic thermal loads. During the audit and review, the applicant was asked to explain (1) how loss of mechanical function due to corrosion is not an aging effect which needs to be managed for the PEO; and (2) if proper design prevents distortion, overload, and fatigue due to vibratory and cyclic thermal loads, whether there has ever been a component failure at PNPS due to any of these conditions; (3) whether there has ever been a component failure in the nuclear industry due to any of these conditions; and (4) where sliding support bearings and sliding support surfaces are used in component Groups B2 and B4 at PNPS and what environment they are exposed to.

In its response, the applicant stated that loss of material due to corrosion is an aging effect that can cause a loss of intended function. Loss of mechanical function would be considered a loss of intended function. Loss of mechanical function is not an aging effect, but is the result of aging effects. There have been component failures in the industry due to distortion, overload, and excessive vibration. Such failures typically result from inadequate design or events rather than the effects of aging. Failures due to cyclic thermal loads are very rare for structural supports due to their relatively low temperatures.

The sliding surface material used at PNPS is Lubrite®, which is a corrosion-resistant material. Components are inspected under the Inservice Inspection (IWF) Program for torus saddle supports and Structures Monitoring Program for the Lubrite® components of radial beam seats. Plant operating experience has not identified failure of Lubrite® components used in structural applications. No current industry experience has identified failure associated with Lubrite® sliding surfaces. Components associated with B2 grouping are limited to the torus radial beam seats and support saddles. There are no sliding support surfaces associated with the B4 component grouping for sliding surfaces at PNPS.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Item 3.5.1-52 discussion is revised to read as follows:

> Loss of mechanical function due to the listed mechanisms is not an aging effect. Such failures typically result from inadequate design or operating events rather than from the effects of aging. Failures due to cyclic thermal loads are rare for structural supports due to their relatively low temperatures.

The project team agrees with the applicant that loss of mechanical function due to distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads are not AERMs. Such failures do typically result from inadequate design or events rather than the effects of aging.

On the basis that the mechanisms provided in PNPS LRA Table 3.5.1, Item 3.5.1-52, other than corrosion, are not aging mechanisms which cause aging effects for Groups B2 and B4 components in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-54 discussion column, the applicant stated that the loss of mechanical function of Groups B1.1, B1.2, and B1.3 – constant and variable load spring hangers; guides and stops due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads – is not applicable to PNPS as discussed below.

In the discussion section of Table 3.5.1, Item 3.5.1-54, of the PNPS LRA, the applicant stated that loss of mechanical function due to the listed mechanisms is not an aging effect. Proper design prevents distortion, overload, and fatigue due to vibratory and cyclic thermal loads. During the audit and review, the applicant was asked to explain (1) how loss of mechanical function due to corrosion is not an aging effect which needs to be managed for the PEO; (2) if proper design prevents distortion, overload, and fatigue due to vibratory and cyclic thermal loads, whether there has ever been a component failure at PNPS due to any of these conditions; (3) whether there has never been a component failure in the nuclear industry due to any of these conditions; and (4) what PNPS inspects for during VT-3 visual examinations of Groups B1.1, B1.2, and B1.3 components under its Inservice Inspection Program during its current license and also anticipated VT-3 visual examinations during its possible extended license period.

In its response, the applicant stated that the discussion for Item 3.5.1-54 was not saying that failures have not occurred, but that loss of mechanical function is not an aging effect. For license renewal, the applicant identifies a number of aging effects that can cause loss of intended function. Loss of intended function includes loss of mechanical function. The loss of function is not considered an aging effect. Aging effects that could cause loss of mechanical function for components in Item 3.5.1-54 are addressed elsewhere in the AMRs. For example, loss of material due to any mechanism is addressed in Table 3.5.2-6 under listings for component and piping supports ASME Class 1, 2, 3, and MC (page 3.5-71) and component and piping supports (page 3.5-72). Component failures at PNPS and in the nuclear industry have certainly occurred due to overload (typically caused by an event such as water hammer) or vibratory and cyclic thermal loads. Because of the low operating temperatures, failures due to cyclic thermal loads are extremely rare for structural commodities. Failures due to distortion or

vibratory loads have also occurred due to inadequate design, but rarely, if ever, due to the normal effects of aging.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that LRA Table 3.5.1, Item 3.5.1-54, is revised to state as follows:

> Loss of mechanical function due to distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads are not aging effects requiring management. Such failures typically result from inadequate design or events rather than the effects of aging. Loss of material due to corrosion, which could cause loss of mechanical function, is addressed under Item 3.5.1-53 for Groups B1.1, B1.2, and B1.3 support members.

The project team agreed with the applicant that loss of mechanical function due to distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads are not AERMs. Such failures do typically result from inadequate design or events rather than the effects of aging.

On the basis that the mechanisms provided in PNPS LRA Table 3.5.1, Item 3.5.1-54, other than corrosion, are not aging mechanisms which cause aging effects for Groups B1.1, B1.2, and B1.3 components in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

In PNPS LRA Table 3.5.1, Item 3.5.1-57 discussion column, the applicant stated that the reduction or loss of isolation function of Groups B1.1, B1.2, and B1.3 (i.e., vibration isolation elements due to radiation hardening, temperature, humidity, and sustained vibratory loading) is not applicable to PNPS because no supports with vibration isolation elements have been identified in the scope of license renewal.

The project team found that PNPS does not have Groups B1.1, B1.2, and B1.3 vibration isolation elements in the scope of license renewal.

On the basis that there are no Groups B1.1, B1.2, and B1.3 vibration isolation elements in the SC supports at PNPS, the project team finds that, for this component type, this aging effect is not applicable to PNPS.

<u>SC Supports AMR Line Items That Have No Aging Effects (PNPS LRA Tables 3.5.2-1 through 3.5.2-6)</u>

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant stated that no aging effects were identified occurred when components fabricated from concrete material are exposed to a protected-from-weather, weather, or fluid environment. In the PNPS LRA, the applicant states that inaccessible and accessible concrete areas are designed in accordance with ACI specification ACI 318-63, “Building Code Requirements for Reinforced Concrete,” which results in low permeability and resistance to aggressive chemical solutions by requiring the following:

- high cement content

- low water-to-cement ratio
- proper curing
- adequate air entrainment

PNPS concrete also meets requirements of later ACI guide ACI 201.2R-77, "Guide to Durable Concrete," since both ACI documents use the same ASTM standards for selection, application, and testing of concrete. The below-grade environment is not aggressive (pH greater than 5.5, chlorides less than 500 ppm, and sulfates less than 1500 ppm). Concrete was provided with air content between 3 and 5 percent and, in general, a water/cement ratio between 0.44 and 0.60. Therefore, increase in porosity and permeability due to leaching of calcium hydroxide, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel are not applicable to concrete in accessible and inaccessible areas.

Aggregates used at PNPS were in accordance with specifications and materials conforming to ACI and ASTM standards. PNPS concrete structures are constructed of a dense, durable mixture of sound coarse aggregate, fine aggregate, cement, water, and admixture. Therefore, loss of material (spalling, scaling) and cracking due to freeze-thaw and cracking due to expansion and reaction with aggregates are not AERMs for PNPS structures. ASME Code, Section III, Division 2, Subsection CC, indicates that aging due to elevated temperature exposure is not significant as long as concrete general area temperatures do not exceed 150°F and local area temperatures do not exceed 200°F. During normal operation, areas within the PNPS primary containment and other structures are within these temperature limits. Therefore, reduction of strength and modulus of concrete structures due to elevated temperature is not an AERM for PNPS concrete. However, the applicant has elected to confirm the absence of concrete aging effects under its Structures Monitoring Program.

The project team found that the quality of the reinforced concrete used at PNPS meets the codes and standards referenced in the GALL Report such that the concrete is not susceptible to the aging effects listed above. The below-grade environment was found not to be aggressive at PNPS, with continuing groundwater monitoring to occur during the period of extended license. Therefore, no aging effects are considered to be applicable to components fabricated from concrete material protected from weather, exposed to weather, or exposed to fluid environments. However, PNPS will confirm the absence of concrete aging effects under its Structures Monitoring Program.

On the basis of its review of current industry research and operating experience, the project team found that protected-from-weather, exposed-to-weather, or exposed-to-fluid concrete components will not result in aging that will be of concern during the PEO. The project team finds that the applicant's AMR evaluations concerning potential aging effects are acceptable. Therefore, the project team concluded that there are no applicable AERMs for concrete components exposed to protected-from-weather, exposed-to-weather, or exposed-to-fluid environments.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components

fabricated from Lubrite® plate material were in a protected-from-weather environment. In the PNPS LRA, the applicant states that Lubrite® plates are used in the drywell beam seats and the torus support saddles at PNPS. Lubrite® materials for nuclear applications are designed to resist deformation, have a low coefficient of friction, resist softening at elevated temperatures, resist corrosion, withstand high intensities of radiation, and not score or mar; therefore, they are not susceptible to AERMs. Due to the wear-resistant material used, the low frequency (number of times) of movement, and the slow movement between sliding surfaces, lockup and loss of mechanical function of Lubrite® plates from wear, corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads are not considered to be AERMs at PNPS. Nonetheless, Lubrite® plates are included within the Structures Monitoring Program and Inservice Inspection (IWF) Program. The project team found that industry operating experience and PNPS ISI inspection reports for slide-bearing plates have identified no recordable degradation due to any aging effects. Therefore, no aging effects are considered to be applicable to components fabricated from Lubrite® plate material exposed to a protected-from-weather environment.

On the basis of its review of current industry research and operating experience, the project team found that a protected-from-weather environment on Lubrite® plate will not result in aging that will be of concern during the PEO. The project team finds acceptable the applicant's AMR evaluations that Lubrite® plate in a protected-from-weather environment will have no identified aging effects that actually occur. Therefore, the project team concluded that there are no applicable AERMs for Lubrite® plate components exposed to a protected-from-weather environment.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from aluminum material were in a exposed-to-weather environment.

In the PNPS LRA, the applicant states that the ambient environment at PNPS is not chemically polluted by vapors of sulfur dioxide or other similar substances and the external environment does not contain saltwater or high chlorides. In this nonaggressive environment, the occasional wetting and drying from normal outdoor weather does not result in any significant loss of material for aluminum components. Therefore, loss of material due to pitting and crevice corrosion is not an AERM for aluminum components exposed to a weather environment. The project team found that industry operating experience and previously approved staff positions documented in the Farley SER (NUREG-1825, page 3-314) support the conclusion that there are no aging effects for aluminum in a weather environment. Therefore, no aging effects are considered to be applicable to components fabricated from aluminum material exposed to a weather environment.

On the basis of its review of current industry operating experience and approved staff positions, the project team found that a weather environment on aluminum at PNPS will not result in aging that will be of concern during the PEO. The project team finds acceptable the applicant's AMR evaluations that aluminum in a weather environment will have no identified aging effects that actually occur. Therefore, the project team concluded that there are no applicable AERMs for aluminum components exposed to a weather environment.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from SS material were in a exposed-to-weather environment.

In the PNPS LRA, the applicant states that the ambient environment at PNPS is not chemically polluted by vapors of sulfur dioxide or other similar substances and the external environment does not contain saltwater or high chlorides. In this nonaggressive environment, the occasional wetting and drying from normal outdoor weather does not result in any significant loss of material for SS components. Therefore, loss of material due to pitting and crevice corrosion is not an AERM for SS components exposed to a weather environment. The project team found that industry operating experience and previously approved staff positions documented in the Farley SER (NUREG-1825, page 3-314) support the conclusion that there are no aging effects for SS in a weather environment. Therefore, no aging effects are considered to be applicable to components fabricated from SS material exposed to a weather environment.

On the basis of its review of current industry operating experience and approved staff positions, the project team found that a weather environment on SS at PNPS will not result in aging that will be of concern during the PEO. The project team finds acceptable the applicant's AMR evaluations that SS in a weather environment will have no identified aging effects that actually occur. Therefore, the project team concluded that there are no applicable AERMs for SS components exposed to a weather environment.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from Pyrocrete® material were in a protected-from-weather environment.

During the audit and review, the project team noted that in PNPS LRA Table 3.5.2-6 (page 3.5-80), for component fireproofing, the aging effect for Pyrocrete® material in a protected-from-weather environment is none. The applicant was asked to provide a technical basis as to why Pyrocrete® does not have any aging effects in the environment listed.

During interviews with the project team, the applicant's staff stated that Pyrocrete® (used for fireproofing) is cement base composite material. Pyrocrete® is not identified in the GALL Report. As such, PNPS's technical evaluation of Pyrocrete® in determining applicable aging effects was the same as that for concrete, which is based on EPRI 1002950, "Aging Effects for Structures and Structural Components (Structural Tools)," Revision 1, Section 5. Accordingly, no aging effects were determined for Pyrocrete® protected from weather. However, as indicated in PNPS LRA Table 3.5.2-6 (page 3.5-80), the Fire Protection Program and Structures Monitoring Program will confirm the absence of significant aging effects throughout the PEO.

The project team found Pyrocrete® to be a cementitious material that, like concrete in a protected-from-weather environment, will not experience aging effects. Industry operating experience supports the conclusion that there are no aging effects for Pyrocrete® in a protected-from-weather environment. Therefore, no aging effects are considered to be

applicable to components fabricated from Pyrocrete® material exposed to a protected-from-weather environment. Nonetheless, Pyrocrete® is included within the Fire Protection Program and Structures Monitoring Program to ensure aging effects such as cracking or loss of material are not occurring.

On the basis of current industry research and operating experience, the project team found that a protected-from-weather environment on Pyrocrete® at PNPS will not result in aging that will be of concern during the PEO. The project team finds acceptable the applicant's AMR evaluations that Pyrocrete® in a protected-from-weather environment will have no identified aging effects that actually occur. Therefore, the project team concluded that there are no applicable AERMs for Pyrocrete® components exposed to a protected-from-weather environment.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from fiberglass, calcium silicate, or Stratafab® material were in a protected-from-weather environment. In the PNPS LRA, the applicant states that loss of insulating characteristics due to insulation degradation is not an AERM for insulation material. Insulation products (i.e., made from fiberglass fiber, calcium silicate, SS, and similar materials) that are protected from weather do not experience aging effects that would significantly degrade their ability to insulate as designed. A review of site operating experience identified no aging effects for insulation used at PNPS. No aging effects are considered to be applicable to components fabricated from fiberglass, calcium silicate, or Stratafab® material exposed to a protected-from-weather environment.

On the basis of its review of current industry research and operating experience, the project team found that a protected-from-weather environment on fiberglass, calcium silicate, or Stratafab® will not result in aging that will be of concern during the PEO. Therefore, the project team concluded that there are no applicable AERMs for fiberglass, calcium silicate, or Stratafab® components exposed to protected-from-weather environments.

In PNPS LRA Tables 3.5.2-1 through 3.5.2-6, the applicant identified AMR line items where no aging effects were identified as a result of its aging review process. Specifically, instances in which the applicant states that no aging effects were identified occurred when components fabricated from PVC material were exposed to a protected-from-weather environment.

During the audit and review, the project team noted that in Table 3.5.2-6 on page 3.5-83 of the PNPS LRA, for component water stops, the aging effect is none for material PVC in a exposed-to-weather environment. By definition, the component water stops could be exposed to water. For environment exposed to fluid environment, the aging effects listed are cracking and change in material properties. The applicant was asked to provide a technical basis as to why PVC water stops do not have any aging effects that need aging management when they could be exposed to a fluid environment. The applicant was also asked to provide the specification that called for PVC water stops during construction instead of rubber.

During interviews with the applicant's technical staff, the applicant's staff stated that the PVC water stops identified in PNPS LRA Table 3.5.2-6 (page 3.5-83) are used in the reinforced

concrete basin and are not exposed to the same environment as the fill material. The aging effects attributed to PVC water stops are evaluated based on Section 7.0 of the EPRI "Structural Tools." Exposure to water for these commodities is insignificant since the concrete encapsulating the PVC water stop and the surrounding concrete provide ample protection such that aging management is not required.

On the basis that PVC water stops are almost totally encapsulated in concrete to protect them from a fluid environment and expose them only to a protected-from-weather environment, the project team found that a protected-from-weather environment on PVC will not result in aging that will be of concern during the PEO. Therefore, the project team concluded that there are no applicable AERMs for PVC components exposed to a weather environment.

3.5.2.3.1 Primary Containment – Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-1)

The project team reviewed PNPS LRA Table 3.5.2-1, which summarizes the results of AMR evaluations for the primary containment component groups.

In PNPS LRA Table 3.5.2-1, the applicant proposed to manage cracking and change in material properties of concrete material for component types of floor slabs and walls exposed to a protected-from-weather environment using PNPS AMP B.1.29.2, "Structures Monitoring."

The project team reviewed the Structures Monitoring Program, and its evaluation is documented in Section 3.0.3.2.17 of this audit and review report. The program performs visual inspection of concrete structures for cracking and change in material properties. On this basis, the project team found that management of cracking and change in material properties of concrete material is acceptable.

3.5.2.3.2 Reactor Building – Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-2)

The project team reviewed PNPS LRA Table 3.5.2-2, which summarizes the results of AMR evaluations for the reactor building component groups.

In PNPS LRA Table 3.5.2-2, the applicant proposed to manage loss of material of stainless materials for component types of spent fuel pool storage racks exposed to a fluid environment using PNPS AMP B.1.32.2, "Water Chemistry Control – BWR Program."

During the audit and review, the project team noted in Table 3.5.2-2 on page 3.5-58 of the PNPS LRA that the aging effect is loss of material for component spent fuel pool storage racks, material SS in an exposed-to-fluid environment. The applicant was asked to explain by what aging mechanism loss of material occurs and why the aging effect is not cracking.

During interviews with the applicant's technical staff, the applicant's staff stated that, as shown in PNPS LRA Table 3.5.2-2, the aging effect for component spent fuel pool storage racks is loss of material. The specific aging mechanism is pitting and crevice corrosion because SSs are susceptible to this aging mechanism when exposed to oxygenated water in a treated water

environment. Cracking is not an AERM for SS in the spent fuel pool because cracking due to stress corrosion is dependent on temperature (greater than140°F). The spent fuel pool treated water environment is less than 140°F.

The project team reviewed the applicant's Water Chemistry Control – BWR Program, and its evaluation is documented in Section 3.0.3.1.11 of this audit and review report. The objective of the program is to manage aging effects caused by corrosion and cracking mechanisms. The program relies on monitoring and control of water chemistry based on EPRI Report 1008192 (BWRVIP-130). EPRI guidelines in BWRVIP-130 include recommendations for controlling water chemistry in the spent fuel pool. The project team accepts the position that loss of material exhibited by the SS spent fuel pool storage racks exposed to a fluid environment is properly managed by the Water Chemistry Control – BWR Program, which through the addition of chemicals will reduce the amount of dissolved oxygen in the spent fuel pool treated water and reduce pitting and crevice corrosion of SS. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effect of loss of material of SS material exposed to a fluid environment is effectively managed using the Water Chemistry Control – BWR Program. On this basis, the project team found that management of loss of material of SS spent fuel pool storage racks in the reactor building to be acceptable.

3.5.2.3.3 Intake Structure – Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-3)

The project team reviewed PNPS LRA Table 3.5.2-3, which summarizes the results of AMR evaluations for the intake structure component groups.

In PNPS LRA Table 3.5.2-1, the applicant proposed to manage cracking and change in material properties of concrete material for component types of floor slabs and walls exposed to a protected-from-weather environment using PNPS AMP B.1.29.2, "Structures Monitoring."

The project team reviewed the Structures Monitoring Program, and its evaluation is documented in Section 3.0.3.2.17 of this audit and review report. The program performs visual inspection of concrete structures for cracking and change in material properties. On this basis, the project team found that management of cracking and change in material properties of concrete material is acceptable.

3.5.2.3.4 Process Facilities – Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-4

The project team reviewed PNPS LRA Table 3.5.2-4, which summarizes the results of AMR evaluations for the process facilities component groups. The project team finds all AMR evaluation results in PNPS LRA Table 3.5.2-3 are consistent with the GALL Report or, if not consistent, previously discussed in Sections 3.5.2.1, 3.5.2.2, 3.5.2.3.1, and 3.5.2.3.2 of this audit and review report.

3.5.2.3.5 Yard Structures –Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-5)

The project team reviewed PNPS LRA Table 3.5.2-5, which summarizes the results of AMR evaluations for yard structure component groups. The project team finds that all AMR evaluation results in PNPS LRA Table 3.5.2-5 are consistent with the GALL Report or, if not consistent, previously discussed in Sections 3.5.2.1, 3.5.2.2, 3.5.2.3.1, and 3.5.2.3.2 of this audit and review report.

3.5.2.3.6 Bulk Commodities – Summary of Aging Management Evaluation (PNPS LRA Table 3.5.2-6)

The project team reviewed PNPS LRA Table 3.5.2-6, which summarizes the results of AMR evaluations for the bulk commodities component groups.

In PNPS LRA Table 3.5.2-6, the applicant proposed to manage cracking and delaminating separation of cera blanket materials for component types of fire stops exposed to a protected-from-weather environment using PNPS AMP B.1.13.1, "Fire Protection."

The project team reviewed the Fire Protection Program, and its evaluation is documented in Section 3.0.3.2.11 of this audit and review report. The Fire Protection Program includes fire barrier inspection and diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration 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 requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The project team accepts the position that cracking and delaminating separation exhibited by cera blanket materials for fire stops exposed to a protected-from-weather environment is properly managed by the Fire Protection Program, which under program element "detection of aging effects," will perform examinations of cera blanket fire stops to identify cracking and delaminating separation. On the basis of its review of the applicant's plant-specific and industry operating experience, the project team found the aging effects of cracking and delaminating separation of cera blanket material exposed to a protected-from-weather environment are effectively managed using the Fire Protection Program. On this basis, the project team found that management of cracking and delaminating separation of cera blanket fire stops in bulk commodities is acceptable.

In PNPS LRA Table 3.5.2-6, the applicant proposed to manage loss of material of cerafiber and cera blanket materials for component types of fire wrap exposed to a protected-from-weather environment using PNPS AMP B.1.13.1, "Fire Protection."

The project team reviewed the Fire Protection Program, and its evaluation is documented in Section 3.0.3.2.11 of this audit and review report. The Fire Protection Program includes fire barrier inspection and diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration 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 requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The project team accepts the position that loss of material exhibited by cerafiber and cera blanket

materials for fire wraps exposed to a protected-from-weather environment is properly managed by the Fire Protection Program, which under program element “detection of aging effects,” will perform examinations of cerafiber and cera blanket fire wraps to identify loss of material. On the basis of its review of the applicant’s plant-specific and industry operating experience, the project team found that the aging effect of loss of material of cerafiber and cera blanket material exposed to a protected-from-weather environment is effectively managed using the Fire Protection Program. On this basis, the project team found that management of loss of material of cerafiber and cera blanket fire wraps in bulk commodities is acceptable.

In PNPS LRA Table 3.5.2-6, the applicant proposed to manage cracking and change in material properties for components types of building pressure boundary sealant and compressible joints and seals of elastomer materials exposed to a protected-from-weather environment using PNPS AMP B.1.29.2, "Structures Monitoring."

The project team reviewed the Structures Monitoring Program, and its evaluation is documented in Section 3.0.3.2.17 of this audit and review report. The Structures Monitoring Program will be enhanced to to provide guidance for performing structural examination of elastomer materials to identify cracking and change in material properties. On this basis, the project team found that management of loss of material of elastomers is acceptable.

Conclusion

On the basis of its review, the project team found that the applicant appropriately evaluated AMR results involving material, environment, AERMs, and AMP combinations that are not addressed in the GALL Report.

3.5.3 Conclusion

On the basis of its review, the project team concluded that the applicant has demonstrated that the aging effects associated with the auxiliary systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the auxiliary systems components, as required by 10 CFR 54.21(d).

3.6 Aging Management of Electrical Components

This section of the audit and review report documents the project team’s review and evaluation of PNPS AMR results for the aging management of the electrical component and component groups associated with the following systems:

- high-voltage insulators
- insulated cables and connectors
- phase bus
- switchyard bus

3.6.1 Summary of Technical Information in the Application

In PNPS LRA Section 3.6, the applicant provided the results of its AMRs for the electrical components and component groups.

In PNPS LRA Table 3.6.1, "Summary of Aging Management Evaluations for the Electrical Components," the applicant provided a summary comparison of its AMR line items with the AMR line items evaluated in the GALL Report for the electrical components and component groups. The applicant also identified for each component type in PNPS LRA Table 3.6.1 those components that are consistent with the GALL Report, those for which the GALL Report recommends further evaluation, and those components that are not addressed in the GALL Report together with the basis for their exclusion.

In PNPS LRA Table 3.6.2-1 the applicant provided a summary of the AMR results for component types associated with (1) high-voltage insulators, (2) insulated cables and connectors, (3) phase bus, and (4) switchyard bus. Specifically, the information for each component type included intended function, material, environment, AERM, AMPs, the GALL Report (Volume 2) item, cross-reference to the PNPS LRA Table 3.6.1 (Table 1), and generic and plant-specific notes related to consistency with the GALL Report.

The applicant's AMRs incorporated applicable operating experience in the determination of AERMs. These reviews included evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of CRs and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.6.2 Project Team Evaluation

The project team reviewed PNPS LRA Section 3.6 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the electrical components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO.

The project team reviewed certain identified AMR line items to confirm the applicant's claim that these AMR line items were consistent with the GALL Report. The project team did not repeat its review of the matters described in the GALL Report. However, the project team did verify that the material presented in the PNPS LRA was applicable and that the applicant had identified the appropriate GALL Report AMR line items. The project team's audit evaluation is documented in Section 3.6.2.1 of this audit and review report. In addition, the project team's evaluations of the AMPs are documented in Section 3.0.3 of this audit and review report.

The project team reviewed those selected AMR line items for which further evaluation is recommended by the GALL Report. The project team confirmed that the applicant's further evaluations were in accordance with the acceptance criteria in SRP-LR. The project team's audit evaluation is documented in Section 3.6.2.2 of this audit and review report.

The project team also reviewed the remaining AMR line items that were not consistent with or not addressed in the GALL Report based on NRC-approved precedents. The audit included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. The project team's evaluation is documented in Section 3.6.2.3 of this audit and review report.

Finally, the project team reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provided an adequate description of the programs credited with managing or monitoring aging for the electrical components.

Table 3.6-1 below provides a summary of the project team's evaluation of components, AEMs, and AMPs listed in PNPS LRA Section 3.6 that are addressed in the GALL Report. It also includes the section of the audit and review report in which the project team's evaluation is documented.

Table 3.6-1 Project Team Evaluation for Electrical Components in the GALL Report

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.6.1-1	Electrical equipment subject to 10 CFR 50.49 EQ requirements	Degradation due to various aging mechanisms	Environmental Qualification of Electric Components	Environmental Qualification of Electric Components	Consistent with the GALL Report, which recommends further evaluation. SeeSection 3.6.2.2.1.
3.6.1-2	Electrical cables, connections, and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements	Reduced IR and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	Non-EQ Insulated Cables and Connections	Consistent with the GALL Report. See Section 3.6.2.1.
3.6.1-3	Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor IR	Reduced IR and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Used In Instrumentation Circuits Not Subject to 10 CFR 50.49 EQ Requirements	Non-EQ Insulated Cables and Connections	Consistent with the GALL Report. See Section 3.6.2.1.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.6.1-4	Conductor insulation for inaccessible medium voltage (2 kV to 35 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion, water trees	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	Non-EQ Inaccessible Medium-Voltage Cable Program	Consistent with the GALL Report. See Section 3.6.2.1.
3.6.1-6	Fuse Holders (Not part of a larger assembly): Fuse holders – metallic clamp	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	None	Not consistent with the GALL Report. See Section 3.6.2.3.
3.6.1-7	MEB – Bus/connection	Loosening of bolted connections due to thermal cycling and ohmic heating	Metal-Enclosed Bus	Metal-Enclosed Bus Inspection	Consistent with the GALL Report. See Section 3.6.2.1.
3.6.1-8	MEB – Insulation/ insulators	Reduced IR and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Metal-Enclosed Bus	Metal-Enclosed Bus Inspection	Consistent with the GALL Report. See Section 3.6.2.1.
3.6.1-9	MEB – Enclosure assemblies	Loss of material due to general corrosion	Structures Monitoring Program	Metal-Enclosed Bus Inspection	Consistent with the GALL Report on material, environment, and aging effects but different program is credited. See Section 3.6.2.1.
3.6.1-10	MEB – Enclosure assemblies	Hardening and loss of strength due to elastomers degradation	Structures Monitoring Program	Metal-Enclosed Bus Inspection	Consistent with the GALL Report on material, environment, and aging effects but different program is credited. See Section 3.6.2.1.

Item No.	Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Project Team Evaluation
3.6.1-11	High-voltage insulators	Degradation of insulation quality due to presence of any salt deposits and surface contamination; loss of material caused by mechanical wear due to wind blowing on transmission conductors	A plant-specific AMP is to be evaluated.	None	Consistent with the GALL Report, which recommends further evaluation. See Section 3.6.2.2.2.
3.6.1-12	Transmission conductors and connections; switchyard bus and connections	Loss of material due to wind-induced abrasion and fatigue; loss of conductor strength due to corrosion; increased resistance of connection due to oxidation or loss of preload	A Plant-Specific AMP is to be Evaluated	None	Consistent with the GALL Report, which recommends further evaluation. See Section 3.6.2.2.2.
3.6.1-13	Cable connections – Metallic parts	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	None	Not consistent with the GALL Report.. See Section 3.6.2.3.
3.6.1-14	Fuse holders (not part of a larger assembly)- insulation material	None	None	NA-No AERM or AMP	Consistent with GALL Report. See Section 3.6.2.3.

3.6.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Information in the Application

For aging management evaluations that the applicant states are consistent with the GALL Report, the project team conducted its audit and review to determine if the applicant's reference to the GALL Report in the PNPS LRA is acceptable.

In PNPS LRA Section 3.6.2.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the aging effects related to the (1) insulated cables and connectors, and (2) phase bus:

- EQ of Electric Components (B.1.11)
- Metal-Enclosed Bus Inspection Program (B.1.18)
- Non-EQ Inaccessible Medium-Voltage Cable Program (B.1.19)
- Non-EQ Instrumentation Circuits Test Review Program (B.1.20)
- Non-EQ Insulated Cables and Connections Program (B.1.21)

Project Team Evaluation

The project team reviewed its assigned PNPS LRA AMR line items to determine that the applicant (1) provides a brief description of the system, components, materials, and environment; (2) states that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identifies those aging effects for the insulated cables and connectors and metal enclosed buses (MEBs) that are subject to an AMR.

3.6.2.1.1 Loss of Material Due to General Corrosion

In the discussion section of Table 3.6.1, Item 3.6.1-9, of the PNPS LRA, the applicant stated that loss of material of MEB – enclosure assemblies is managed by the Metal-Enclosed Bus Inspection Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.6.1, Item 3.6.1-9, the applicant included a reference to Note E.

The project team reviewed the AMR results line referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," the applicant has proposed the Metal-Enclosed Bus Inspection Program.

Section VI, Items VI.A-12 and VI-13, of the GALL Report referenced the Structures Monitoring Program for inspecting the external of the MEB for loss of material due to general corrosion and inspecting the enclosure seals for hardening and loss of strength due to elastomers degradation. In PNPS LRA Section B.1.18, the applicant stated that the program attribute of the Metal-Enclosed Bus Inspection Program would be consistent with the program attribute in the GALL Report, Section XI.E4, with an exception. The exception is to inspect MEB enclosure assemblies in addition to internal surfaces using the Metal-Enclosed Bus Inspection Program. The project team asked the applicant if the enclosure seals were included in the scope of the Metal-Enclosed Bus Inspection Program and what were the acceptance criteria for inspecting the external of enclosure assemblies. In its response, the applicant stated that the PNPS Metal-Enclosed Bus Inspection Program will visually inspect the enclosure assemblies for evidence of loss of material, and enclosure assembly elastomers will be visually inspected and manually flexed. The applicant will revise LRPD-02 to read as follows:

(Section 3.3.B.6.b – Acceptance Criteria – add after first paragraph)

> The acceptance criteria for enclosure assemblies will be no loss of material due to general corrosion. The acceptance criteria for elastomers will be no hardening and loss of strength due to degradation.

The project team found the applicant's response acceptable because it is consistent with the GALL Structural Monitoring Program, and it will inspect external of the MEB, including seals, and the acceptance criteria for inspecting the components of external of the MEB will be provided in the plant's basis document. The project team verified that LRPD-02 was revised as described. On this basis, the project team found this exception acceptable.

3.6.2.1.2 Hardening and Loss of Strength Due to Elastomer Degradation

In the discussion section of Table 3.6.1, Item 3.6.1-10, of the PNPS LRA, the applicant stated that elastomer degradation of MEB – enclosure assemblies is managed by the Metal-Enclosed Bus Inspection Program. During the audit and review, the project team noted that for the AMR results line that points to Table 3.6.1, Item 3.6.1-9, the applicant included a reference to Note E.

The project team reviewed the AMR results line referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," the applicant has proposed the Metal-Enclosed Bus Inspection Program.

As discussed in Section 3.6.2.1.1, the project team found the Metal-Enclosed Bus Inspection Program acceptable to inspect the elastomer degradation.

Conclusion

The project team has evaluated the applicant's claim of consistency with the GALL Report. The project team also has reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the project team found that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report.

3.6.2.2 AMR Results for Which Further Evaluation Is Recommended

Summary of Information in the Application

In PNPS LRA Section 3.6.2.2, the applicant provided further evaluation of aging management as recommended by the GALL Report for transmission conductors, switchyard bus, and high-voltage insulators components groups. The applicant also provided information concerning how it will manage the related aging effects.

Project Team Evaluation

For some AMR line items assigned to the project team in PNPS LRA Tables 3.6.1, the GALL Report recommends further evaluation. When further evaluation is recommended, the project team reviewed these further evaluations provided in PNPS LRA Section 3.6.2.2 against the criteria provided in SRP-LR Section 3.6.2.2. The project team's assessment of these evaluations are documented in this section. These assessments are applicable to each Table 2 AMR line item in Section 3.6 citing the item in Table 1.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

PNPS LRA Section 3.6.2.2.1 is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The project team's evaluation of this TLAA is addressed separately in Section 4.4 of this audit and review report.

3.6.2.2.2 Degradation of Insulator Quality Due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material Due to Mechanical Wear

The project team reviewed PNPS LRA Section 3.6.2.2.2 against the criteria in SRP-LR Section 3.6.2.2.2.

SRP-LR Section 3.6.2.2.2 states that the degradation of insulator quality due to the presence of any salt deposits and surface contamination could occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP for plants located in environments such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of saltwater bodies or industrial pollution). Loss of material due to mechanical wear caused by wind blowing on transmission conductors could occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.6.2.2.2, the applicant states that high-voltage insulators supporting conductors that provide recovery of offsite power following SBO include those associated with the switchyard bus located between switchyard breakers 352-2/352-3 and startup transformer X4. High-voltage insulators associated with this path are subject to AMR. Various airborne materials, such as dust, salt, and industrial effluents, can contaminate insulator surfaces. The buildup of surface contamination in most areas is washed away by rain. The glazed and coated 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. PNPS is located near the sea coast, so salt spray is considered. However, salt spray buildup is a short-term concern based on local weather conditions (event-driven). Under conducive weather conditions, salt buildup occurs in a matter of hours or days. Therefore, surface contamination is not an applicable aging mechanism for high-voltage insulators at PNPS. Mechanical wear is an aging effect for strain and suspension insulators in that they are subject to movement. Wear has not been apparent during routine inspections. If left unmanaged for the PEO, surface rust would not cause a loss of intended function and, thus, is not a significant concern. Loss of material due to wear will not cause a loss of intended function of the insulators. Therefore, loss of material is not an AERM for insulators.

The project team noted that industry operating experience has shown that the potential for loss of offsite power due to salt deposit to switchyard insulators exists. On March 17, 1993, Crystal River Unit 3 experienced a loss of the 230 kV switchyard (normal offsite power to safety-related busses) when a light rain caused arcing across salt-laden 230 kV insulators and opened breakers in the switchyard. In March 1993, the Brunswick Unit 2 switchyard experienced a flashover of some high-voltage insulators. The incident was attributed to a winter storm in the area. Since 1982, PNPS has also experienced several loss of offsite power events when ocean

storms deposited salt on the 345 switchyard, causing the insulator to arc to ground. In light of this industry and plant operating experience, the project team requested the applicant to provide a justification of why an AMP is not necessary. In its response, the applicant stated that as shown by operating experience cited in this question, flashover due to salt contamination of insulators is caused by events, typically storms, regardless of the age of the insulators. This is clearly not an effect of aging. Therefore, surface contamination is not an applicable aging mechanism for high-voltage insulator at PNPS. Since the condition is caused by severe weather condition unrelated to aging, an AMP is not appropriate to address this concern. However, while salt spray buildup is a short-term concern based on local weather condition (event-driven), such buildup can cause problems with the offsite power supply system. Because of this operating experience, PNPS has applied Sylgard® (room-temperature vulcanizing (RTV) silicone) coating to some switchyard insulators to reduce flashover. The addition of RTV silicone to the insulators has reduced the likelihood of insulator flashover. In addition, system walkdowns are performed at least once per refueling cycle and are normally performed more frequently in order to do a visual inspection on the switchyard high-voltage insulators that are in scope of license renewal in accordance with EN-DC-178. These walkdowns will continue to be performed into the PEO. The project team found the applicant's response acceptable because visual inspections of insulators are performed by the system walkdowns. These walkdowns will detect any aging degradation due to the presence of salt deposits.

In PNPS LRA Section 3.6.2.2.2, the applicant stated that mechanical wear is an aging effect for strain and suspension insulators in that they are subject to movement. Wear has not been apparent during routine inspections. If left unmanaged for the PEO, surface rust would not cause a loss of intended function and, thus, is not a significant concern. Loss of material due to mechanical wear caused by wind blowing on transmission conductors occurs in high-voltage insulators. The project team requested the applicant to provide a technical justification of why loss of material is not a significant AERM at PNPS. Also, the project team requested the applicant to provide a technical justification of why surface rust would not cause a loss of intended function for high-voltage insulators if left unmanaged for the PEO. In its response, the applicant stated that loss of material due to mechanical wear is an aging effect for strain and suspension insulators if they are subject to significant movement. A possible cause for movement of the insulators is wind blowing the supported transmission conductor, allowing the conductor to swing from side to side. Although this mechanism is possible, industry experience has shown that transmission conductors do not normally swing and that when they do, due to substantial wind, they do not continue to swing for very long once the wind has subsided. PNPS has no transmission conductors supported by high-voltage insulators in scope of license renewal, and therefore, loss of material due to wear of high-voltage insulators is not an AERM for the PEO. Various airborne materials, such as dust, salt, and industrial effluents, can contaminate insulator surfaces. The buildup of surface contamination is gradual and in most areas washed away by rain, while the glazed and coated insulator surfaces at PNPS aids in contamination removal. The applicant applied Sylgard® (RTV silicone) coatings to some switchyard insulators to reduce flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles, such as near any facilities that discharge soot. PNPS is not located near any facilities that produce airborne particles such as soot. Therefore, surface contamination is not an applicable aging mechanism for high-voltage insulators at PNPS. The project team found the applicant's response acceptable because

PNPS has no transmission conductors supported by high-voltage insulators in scope of license renewal. Therefore, aging due to mechanical wear of high-voltage insulators is not an applicable aging effect. The project team also found that surface contamination of high-voltage insulators can be a problem in areas where there are greater concentrations of airborne particles, such as near facilities that discharge soot. Since PNPS is not located near any such environments, surface contamination is not an applicable aging mechanism for high-voltage insulators at PNPS.

Regarding the surface rust aging effect, the applicant responded that LRA Section 3.6.2.2.2 has a typographical error in the fourth paragraph. The applicant will amend the LRA to read as follows:

> Mechanical wear is an aging effect for strain and suspension insulator in that they are subject to movement. Wear has not been apparent during routine inspections. If left unmanaged for period of extended operation, surface contamination would not cause a loss of intended function and thus, is not a significant concern.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant revised LRA Section 3.6.2.2.2 as described above.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.6.2.2.2 for further evaluation.

3.6.2.2.3 <u>Loss of Material Due to Wind-Induced Abrasion and Fatigue, Loss of Conductor Strength Due to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of Preload</u>

The project team reviewed PNPS LRA Section 3.6.2.2.3 against the criteria in SRP-LR Section 3.6.2.2.3.

SRP-LR Section 3.6.2.2.3 states that a loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload could occur in transmission conductors and connections and in the switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

In PNPS LRA Section 3.6.2.2.3, the applicant states that transmission conductors are uninsulated, stranded electrical cables used outside buildings in high-voltage applications. The transmission conductor commodity group includes the associated fastening hardware, but excludes the high-voltage insulators. Major active equipment assemblies include their associated transmission conductor terminations.

The applicant also states in the LRA that transmission conductors are subject to AMR if they are necessary for recovery of offsite power following an SBO. However, PNPS does not utilize transmission conductors in the circuits for recovery of offsite power following an SBO. Other transmission conductors are not subject to AMR since they do not perform a license renewal

intended function. The switchyard bus is uninsulated, unenclosed, rigid electrical conductors used in medium- and high-voltage applications. The switchyard bus includes the hardware used to secure the bus to high-voltage insulators. The switchyard bus establishes electrical connections to disconnect switches, switchyard breakers, and transformers to support recovery of offsite power following SBO. Connection surface oxidation for aluminum switchyard bus is not applicable since switchyard bus connections requiring AMR are welded connections. For ambient environmental conditions at PNPS, no aging effects have been identified that could cause a loss of intended function for the PEO. Vibration is not applicable since flexible connectors connect the switchyard bus. Therefore, there are no AERMs for aluminum switchyard bus.

The project team noted that torque relaxation for bolted connection is a concern for switchyard bus connections. An electrical connection must be designed to remain tight and maintain good conductivity through a large temperature range. Meeting this design requirement is difficult if the material specified for the bolt and the conductor are different and have different rates of thermal expansion. For example, copper or aluminum bus/conductor materials expand faster than most bolting materials. If thermal stress is added to stresses inherent at assembly, the join member or fasteners can yield. If plastic deformation occurs during thermal loading (i.e., heatup) when the connection cools, the joint will be loose. EPRI document TR-104213, “Bolted Joint Maintenance and Application Guide,” recommends inspection of bolted joints for evidence of overheating, signs of burning or discoloration, and indication of loose bolts. The project team requested the applicant to provide a technical discussion of why torque relaxation for bolted connection of the switchyard bus is not a concern for PNPS. In its response, the applicant stated that at PNPS bus to bus connections are welded instead of bolted. Switchyard buses are connected by flexible connectors to insulator and active components. Since the switchyard bus is typically under a constant load, thermal cycling that could cause torque relaxation is infrequent. With no connection to vibrating equipment, vibration is not an aging mechanism for the switchyard bus. The switchyard connection to the startup transformer is part of the active assembly maintained by the plant maintenance program. Therefore, torque relaxation is not an AERMs for the switchyard bus. In addition, thermography is performed at least once every 6 months to maintain the integrity of the connections. This program will continue into the PEO. The project team found the applicant’s response acceptable because thermography is performed to detect the heat created by high resistance due to bolt loosening of switchyard bus connections. The project team reviewed PNPS Procedure No. 3.M.3-60, “Infrared Thermography,” and verified that switchyard bus connections to startup transformers and air circuit breakers within the scope of license renewal are inspected for bolt loosening.

The project team also noted that increased resistance of switchyard bus connections due to oxidation is a potential aging effect. The project team requested the applicant to provide a technical justification of why increased resistance of connection due to oxidation is not an AERM. In its response, the applicant stated that a potential mechanism contributing to aging of switchyard bus connections is surface oxidation, which can lead to increased contact or connection resistance. Connection surface oxidation is not significant for switchyard bus connections at PNPS since the switchyard bus connections are welded. Therefore, no aging effects due to surface oxidation are required to be managed for the PEO. The connections to active devices are inspected under the Maintenance Rule program. In addition, thermography is performed at least once every 6 months to maintain the integrity of the connections. This

program will continue into the PEO. The project team found the applicant's response acceptable because heat created by increased resistance of switchyard bus connections due to corrosion will be detected using thermography. This method will maintain the integrity of the connections.

The project team found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.6.2.2.3 for further evaluation.

3.6.2.2.4 QA for Aging Management of NSR Components

The applicant referenced PNPS LRA Section B.0.3. The project team's evaluation of Section B.0.3 is provided in Section 3.0.4 of this audit and review report.

Conclusion

On the basis of its review, for component groups evaluated in the GALL Report for which the GALL Report recommends further evaluation, the project team determined that the applicant adequately addressed the issues that were evaluated further.

3.6.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

Summary of Information in the Application

In PNPS LRA Table 3.6.1, "Summary of Aging Management Evaluations for the Electrical Components," the applicant provided information regarding components or material/environment combination in the GALL Report that it evaluated and identified as not applicable to its plant.

In PNPS LRA Table 3.6.2-1, the applicant provided additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report. Specifically, the applicant indicated, via Notes F through J, that neither the identified component nor the material/environment combination is evaluated in the GALL Report and provided information concerning how the AERM will be managed.

Project Team Evaluation

The project team reviewed additional details of the results of the AMRs for material, environment, AERM, and AMP combinations that are not consistent with the GALL Report or are not addressed in the GALL Report.

In PNPS LRA Table 3.6.1, Item 3.6.1-6 discussion column, the applicant stated that fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation of fuse holders (not part of a larger assembly) with metallic clamps is not applicable to PNPS because a review of PNPS documents indicates that fuse holders using metallic clamps are either part of an active device or located in circuits

that perform no intended function. Therefore, fuse holders with metallic clamps at PNPS are not subject to AMR at PNPS.

On the basis that fuse holders are either part of an active assembly or located in circuits that perform no license renewal intended function, the project team found that an AMR is not required for fuse holders (insulation and metallic parts) at PNPS.The project team also found that, for this component type, no aging effect is applicable to PNPS.

In PNPS LRA Table 3.6.1, Item 3.6.1-13 discussion column, the applicant states that the loosening of bolting connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation of the metallic parts of cable connections is not applicable to PNPS because cable connectors outside of active devices are taped or sleeved for protection. operating experience with metallic pins on electrical cable connections at PNPS indicated no AERMs.

The project team noted that electrical cable connections are subject to the above aging stressors. GALL AMP XI.E6, "Electrical Cable Connection Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," specifies that connections associated with cables within the scope of license renewal are part of this program, regardless of their association with active or passive components. The project team requested the applicant to provide a basis document including an AMP with the 10 elements for cable connections or provide a technical justification for why an AMP was not necessary. In its response, the applicant stated that an evaluation of thermal cycling, ohmic heating, electrical transient, vibration, chemical contamination, corrosion, and oxidation stressors for the metallic parts of electrical cable connections identified no AERMs. Metallic parts of electrical cable connections potentially exposed to thermal cycling and ohmic heating are those carrying significant current in power supply circuits. Typically, power cables are in a continuous run from the supply to the load. Therefore, the connections are part of an active component that is controlled by the Maintenance Rule and is not subject to an AMR. The fast action of circuit protective devices at high currents mitigates stresses associated with electrical faults and transients. In addition, mechanical stress associated with electrical faults is not a credible aging mechanism because of the low frequency of occurrence for such faults. Therefore, electrical transients are not applicable stressors. Metallic parts of electrical cable connections exposed to vibration are those associated with active components that cause vibration. Since active components are controlled by the Maintenance Rule, they are not subject to an AMR. Corrosive chemicals are not stored in most areas of the plant. Routine releases of corrosive chemicals to areas inside the plant building do not occur during plant operation. Such a release, and its effects, would be an event, not an effect of aging. The location of electrical connections inside active components protects the metallic parts from contamination. Therefore, this stressor is not applicable. Oxidation and corrosion usually occur in the presence of moisture or contamination such as industrial pollutants and salt deposits. Enclosures or spice materials protect metal connections from moisture or contamination. Therefore, oxidation and corrosion are not applicable stressors. Based on the above evaluation, the applicant concluded that there are no AERMs for metallic components of connections and no AMP is required.

The project team disagreed with the applicant's determination. Connections are passive components and in scope of license renewal. Loosening of bolted connections is the aging

effect. These aging effects need to be managed. Thermal cycling, ohmic heating, electrical transients, vibrations, chemical contamination, corrosion, and oxidation are aging mechanisms. Connections associated with cables in scope of license renewal are part of this program, regardless of their association with active or passive components. Cable lugs are integral parts of cables. Integrity of lugs can be verified by testing connections. GALL AMP XI.E1 manages connections in adverse locations only and inspects insulation degradation. Most connections are not located in adverse locations. SAND 96-0344, "Aging Management Guidelines for Electrical Cable and Terminations," indicated loose terminations were identified by several plants. EPRI-TR-104213, "Bolted Joint Maintenance and Application Guide," indicates that it is difficult to maintain tightness of electrical connections and good conductivity through a large temperature range if the materials for the bolt connections and conductors are different and have different rates of thermal expansion. For example, copper and aluminum expand faster than most bolting materials. The project team was not aware of any action taken to manage the aging effects of cable connections. Several licensee event reports reported loose connections due to corrosion, vibration, thermal cycling, etc. In past precedence, other applicants have been using thermography to detect weak/loose connections and to correct them as soon as possible and provide GALL AMP XI.E6 to manage aging effects of bolted connections. The project team issued RAI 3.6.2-1.

On the basis of its audit and review of the applicant's program, the project team found that pending resolution of RAI 3.6.2.2.N-01, the effects of aging will be adequately managed so that the intended functions will be maintained during the PEO.

3.6.3 Conclusion

On the basis of its review, the project team concluded that pending resolution of RAI 3.6.2.2.N-01, the aging effects associated with the electrical components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the PEO.

The project team also reviewed the applicable UFSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of electrical components, as required by 10 CFR 54.21(d).

4.0 Time-Limited Aging Analysis

This section of the audit and review report contains the project team's evaluation of the PNPS TLAA program. In PNPS LRA Section 4, the applicant describes the TLAA calculations and analyses that meet the definition contained in 10 CFR 54.3. Per 10 CFR 54.3, TLAAs are defined as analyses that comply with the following six criteria:

(1) involve SSCs within the scope of license renewal, as delineated in 10 CFR 54.4(a)
(2) consider the effects of aging
(3) involve time-limited assumptions defined by the current operating term (e.g., 40 years)
(4) aredetermined by the applicant to be relevant in making a safety determination
(5) involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended functions, as delineated in 10 CFR 54.4(b) are contained or incorporated by reference in the CLB

4.1 Time-Limited Aging Analysis

According Criterion (3), TLAAs are certain plant-specific safety analyses that are based on an explicitly assumed 40-year plant life or some part of it. For a TLAA to conform with the time-limited assumption in Criterion (3), the statement of consideration on 10 CFR Part 54 states that the analysis is one that is applicable to either for the entire current operating period and beyond or for the remainder of the current operating period and beyond. However, the statement of consideration clarifies that, to be applicable, the timeframe assumption for the analyses does not need to extend beyond the expiration of the proposed PEO for the facility.

For each TLAA that is identified in accordance with 10 CFR 54.21(c)(1), the applicant must demonstrate the following:

10 CFR 54.21(c)(1)(i)	That the TLAA remains valid for the PEO; or
10 CFR 54.21(c)(1)(ii)	That the TLAA has been projected to the end of the PEO; or
10 CFR 54.21(c)(1)(iii)	That the effects of aging on the intended function will be adequately managed for the PEO.

In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific exemptions granted under 10 CFR 50.12 that are based on TLAAs. For any such exemptions, the applicant must provide an evaluation that justifies the continuation of the exemptions for the PEO. Pursuant to 10 CFR 54.21(d), an applicant must include an FSAR Supplement summary description for each TLAA that is included with the scope of an applicant's LRA.

4.1.1 Summary of Technical Information in the Application

To identify the TLAAs, the applicant evaluated all evaluations, analyses, assessments, and calculations for PNPS against the six criteria for TLAAs in 10 CFR 54.3. The applicant indicates that it had searched the PNPS CLB to determine which evaluations, analyses, assessments, and calculations met the definition of a TLAA in 10 CFR 54.3. The applicant identified that the search of the CLB included a search of the following PNPS-specific and generic document sources:

- technical specifications
- UFSAR
- docketed licensing correspondence
- Fire Protection Program documents
- NRC SERs
- BWRVIP documents

The applicant also states that it reviewed additional industry documents that list generic TLAAs for the industry and that this provides additional assurance of the completeness of the PNPS-specific TLAA list. These documents included NEI 95-10, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule"; SRP-LR; the GALLReport, Revision 1, September 2005; and NRC SERs related to LRAs by other BWR

licensees. Based on this CLB search, the applicant identified the following evaluations, analyses, assessments, and calculations as meeting the six criteria for TLAAs in 10 CFR 54.3:

- The evaluations on RPV neutron embrittlement. These evaluations are discussed in PNPS LRA Section 4.2 and its six subsections.

- The metal fatigue evaluations for Class 1 components, Non-Class 1 components, and environmentally impacted Class 1 piping. These evaluations are discussed in PNPS LRA Section 4.3 and its three subsections.

- The evaluations on EQ of electrical equipment. These evaluations are discussed in PNPS LRA Section 4.4.

- The evaluations for the containment liner plate, metal containments, and penetrations fatigue analysis. These evaluations are discussed in LRA Sections 4.6 and its subsection (Section 4.6.1).

- Other TLAAs, including:

  (1) the RPV internals thermal shock reflood analysis,

  (2) the generic adjusted reference temperature analyses for RPV circumferential welds in EPRI Topical Report BWRVIP-05,

  (3) the generic fatigue analysis for RPV ID attachment welds in EPRI Topical Report BWRVIP-48,

  (4) the generic fatigue analysis for RPV instrument penetrations in EPRI Topical Report BWRVIP-49,

  (5) the generic pressure-temperature (P-T) limit analysis, fatigue analysis, Charpy-V impact upper shelf energy analysis, and circumferential/axial weld failure analysis of EPRI Topical Report BWRVIP-74, and

  (6) the generic core shroud fatigue analysis in EPRI Topical Report BWRVIP-76.

The TLAAs for these items are discussed in the subsections to PNPS LRA Section 4.7.

The applicant provides the complete list of TLAAs for the application in Table 4.1-1 of the PNPS LRA. Pursuant to 10 CFR 54.21(c)(2), the applicant did not identify any exemptions that were based on a TLAA and granted under 10 CFR 50.12.

4.1.2 Project Team Evaluation

The project team reviewed the information to determine if the applicant had provided adequate information to meet the requirements of 10 CFR 54.21(c)(1) and 10 CFR 54.21(c)(2). In PNPS LRA Section 4.1 and LRA Table 4.1-1, the applicant identified those TLAAs that were

applicable to PNPS and within the scope of the PNPS LRA. The applicant did not identify any exemptions that were based on these TLAAs and granted in accordance with 10 CFR 50.12.

Of those TLAAs in LRA Table 4.1-1, the project team evaluated the following TLAAs for acceptability:

- LRA Section 4.3, TLAA on "metal fatigue" analyses, including LRA Subsection 4.3.1, "Class 1 Fatigue," LRA Subsection 4.3.2, "Non-Class 1 Fatigue," and LRA Subsection 4.3.3, "Effects of Reactor Water Environment on Fatigue Life"

- LRA Section 4.4, TLAA on "environmental qualification analyses of electric equipment"

- LRA Section 4.6, TLAA on "containment liner plate, metal containment, and penetrations fatigue analyses"

- Three generic TLAA assessments performed by the BWRVIP on metal fatigue of RPV interior attachment welds, RPV instrument penetrations, and RPV core shroud tie rods, as provided in EPRI Topical Reports BWRVIP-48, -49, and -76, and discussed in Subsections 4.7.2.2, 4.7.2.3, 4.7.2.5 of the PNPS LRA.

The project team performed two audits of the TLAAs for the PNPS LRA. The first audit was performed June 19–23, 2006, and a second followup audit was performed July 17–19, 2006. During these audits, the project team determined that the applicant had conservatively identified all PNPS-specific evaluations, analyses, assessments, and calculations that complied with the definition of a TLAA in 10 CFR 54.3, with the following exceptions:

4.1.2.1 Flaw Growth Evaluations

The project team determined that the applicant had identified three flaw growth evaluations for Class 1 components that had the potential to be TLAAs for the PNPS LRA. The scope of the flaw evaluations include the N2F recirculation nozzle, the recirculation nozzle thermal sleeves, and the CRDRL nozzle-to-cap weld. The applicant stated that, upon further review, these flaw evaluations were not TLAAs for the PNPS LRA. The project team asked the applicant to justify its position why these flaw evaluations were not TLAAs for the LRA. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), PNPS provided its responses to the project team's question on these flaw evaluations and its bases for concluding that the flaw evaluations for the CRDRL nozzle-to-cap weld, the N2F recirculation nozzle, and the recirculation nozzle thermal sleeve were not TLAAs for the PNPS LRA.

The applicant's responses to the project team's question on these flaw evaluations is currently being reviewed by the NRC's Division of Component Integrity (DCI), Office of Nuclear Reactor Regulation, for acceptability in order to determine whether these flaw evaluations are TLAAs for the PNPS LRA. The NRC's evaluation on whether the flaw evaluations for CRDRL nozzle-to-cap weld, the N2F recirculation nozzle, and the recirculation nozzle thermal sleeve are TLAAs for the LRA and will be assessed in the SER for the PNPS LRA. This is Follow-Up Item No. 4.1.2.1-1.

4.1.2.2 Reactor Building Crane

The PNPS reactor building crane was procured to design specification CMAA-70. The project team determined that the applicant did not identify the loading analysis for procurement of the PNPS reactor building crane as a TLAA for the LRA. The project team determined that the PNPS reactor building crane had the potential to be a TLAA for the PNPS LRA because CMAA-70 requires cyclical loading evaluations for some types of cranes procured to the design standard. Section 2.4.2 of the PNPS LRA indicates that the reactor building crane was categorized as a NSR Seismic II component. The project team asked the applicant to justify why a maximum-stress-allowable analysis was performed for polar cranes, and if so, whether it was a TLAA for the PNPS LRA. The applicant responded to the project team's question in a letter dated July 5, 2006 (ADAMS Accession Number ML061940175). In its response the applicant stated that whether CMAA-70 required a maximum-stress-reduction fatigue analysis depended on the category for the crane. The applicant also stated that it did not find any PNPS-specific loading analysis based on a "number-of-loading-cycle-based" time-limited parameter. The project team determined that the maximum-stress-level reduction-type fatigue analyses for CMAA-70 cranes were required to be performed if the cranes were categorized only for seismic category I (i.e., Service Class A-1) cranes that were procured to CMAA-70 design specifications and stated that these types of analyses were optional for Seismic Category II cranes that were procured to the CMAA-70 design specifications. Since the PNPS reactor building crane is categorized as seismic category II, the project team concludes that the reactor building cranes do not need to be within the scope of a CMAA-70-type TLAA analysis on metal fatigue.

4.1.2.3 PNPS-Specific Exemptions

The project team did not identify any PNPS-specific exemptions that were based on TLAAs, including potential exemptions granted to PNPS for the plant's most recent P-T limits, which were approved on April 13, 2001.

4.1.2.4 Other TLAAs for the PNPS LRA

The NRC staff evaluates the remaining TLAAs for PNPS LRA in pertinent subsections of Section 4.2 and 4.7 of the SER for the PNPS LRA. These additional TLAAs are outside the scope of this audit and review report but are contained in LRA Sections 4.2 and 4.7 and include the following TLAAs:

- LRA Section 4.2.2, "Pressure/Temperature Limits"
- LRA Section 4.2.3, "Charpy Upper Shelf Energy"
- LRA Section 4.2.4, "Adjusted Reference Temperature"
- LRA Section 4.2.5, "Reactor Vessel Circumferential Weld Inspection Relief"
- LRA Section 4.2.6, "Reactor Vessel Axial Weld Failure Probability"
- LRA Section 4.7.1, "Reflood Thermal Shock Analysis of the Reactor Vessel Internals"
- LRA Section 4.7.2.1, "BWRVIP-05, RPV Circumferential Welds Analysis"

The reviews of these additional TLAAs are performed as part of the NRC's technical staff evaluations for the PNPS LRA and are performed by the NRC staff in the NRC's Division of

Component Integrity, NRR. The applicant identifies that P-T limits for the facilities are TLAAs for the PNPS LRA. However, the P-T limits for the PEO do not need to be submitted for review and approval as part of the LRA. Instead, the submittal of the P-T limits for the PEO will be processed through the NRC's normal 10 CFR 50.90 license amendment process. The applicant will be required to submit the P-T limits for the PEO to the NRC for review and have them approved before expiration of the end-of-life P-T limit curves for the current operating period. This is in accordance with the 10 CFR 50.90 licensing process.

4.1.3 Conclusion

On the basis of its review, pending acceptable resolution of the staff's question on the potential for the three flaw evaluations to be TLAAs, the project team concludes that the applicant provided an acceptable list of TLAAs for the PNPS LRA, as required by 10 CFR 54.21(c)(1).

In addition, pursuant to 10 CFR 54.21(c)(2), the project team concludes that the PNPS CLB does not include any exemptions which were granted on PNPS TLAAs in accordance with the exemption acceptance criteria of 10 CFR 50.12.

4.2 Reactor Vessel Neutron Embrittlement

The NRC's evaluation of the TLAAs on reactor vessel neutron embrittlement for the PNPS LRA is provided in Section 4.2 of the SER on the application.

4.3 Metal Fatigue

A metal component subjected to cyclic loading at loads less than the static design load may fail due to fatigue. Metal fatigue of components may have been evaluated based on an assumed number of transients or cycles for the current operating term. The validity of such metal fatigue analysis is reviewed for the PEO. The GALL Report identifies fatigue aging-related effects that require evaluation as possible TLAAs, pursuant to 10 CFR 54.21(c)(1). The applicant provides its TLAA on metal fatigue in Section 4.3 of the PNPS LRA.

4.3.1 Fatigue Analyses for Class 1 Components

4.3.1.1 Summary of Technical Information in the Application

PNPS LRA Section 4.3.1 provides the applicant's TLAA assessment for metal fatigue of Class 1 components in the RCPB. The applicant identifies that metal fatigue analyses for PNPS RCPB components (i.e., Class 1 components) conform to the definition of a TLAA in 10 CFR 54.3. The applicant identifies that the Class 1 components include the RPV and its appurtenances, the components internal to the RPV (RPV internals), and Class 1 piping. Henceforth, this TLAA will be referred to as the TLAA on Class 1 metal fatigue.

The applicant identifies that the original 40-year metal fatigue evaluations for the RCPB components that were designed to it are based on the methods for calculating CUF in Section III of the ASME Boiler and Pressure Vessel Code (Section III) if the components were designed in accordance with Section III.

The applicant provides the 40-year CUFs for the RPV and its appurtenances, the RPV internals, and the Class 1 piping commodity groups in Table 4.3-1 of the LRA. The applicant provides the design basis operational and transient categories that form the basis of the applicant's 40-year CUF value calculations in LRA Table 4.3-2. Table 4.3-2 of the PNPS LRA includes the design basis upper limits for these transient categories and the applicant's projections of the number of cycles that will occur for these transients through the expiration of the PEO.

4.3.1.2 Metal Fatigue Evaluation

4.3.1.2.1 Regulatory Bases for Metal Fatigue Evaluations

The GALL Report identifies fatigue aging-related effects that require evaluation as possible TLAAs, pursuant to 10 CFR 54.21(c). The staff provides its bases for evaluating TLAAs on Metal Fatigue in Section 4.3 of NUREG-1800, Revision 1, "Standard Review Plant for License Renewal Application for Nuclear Power Plants" (SRP-LR).

According to Section 4.3.1.1.1 of SRP-LR, Section III requires CUFs as the basis for performing the metal fatigue analyses for those Class 1 components that were designed to Section III. Section III sets an acceptance criterion of 1.0 on CUF values and requires additional corrective action if these calculated values are projected to exceed this value prior to the expiration of the operating license. Section 4.3.2.1.1 of the SRP-LR defines how the metal fatigue analyses for Class 1 components designed to Section III requirements may be accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).

According to Section 4.3.1.1.2 of SRP-LR, the ANSI B31.1 design code (B31.1) requires a different type of fatigue analysis for those Class 1 components that were designed to B31.1 requirements. The SRP-LR indicates that B31.1 requires calculation of a maximum allowable stress range for each B31.1 component that is subject to thermal cycling and a determination of the number of full thermal cycles that are projected through the expiration of the operating license. The SRP-LR then establishes which reduction factors from B31.1 must be applied to the maximum allowable stress ranges if the number of thermal cycles are projected to exceed 7000. Section 4.3.2.1.2 of SRP-LR defines how the metal fatigue analyses for Class 1 components designed to B31.1 may be accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.3.1.2.2 Scope of Review and Technical Evaluation

The project team reviewed the following parts of the PNPS LRA relative to the applicant's TLAA on Class 1 metal fatigue:

- LRA Section 4.3.1, "Class 1 Fatigue"
- LRA Table 4.3-1, "Maximum CUFs for Class 1 Components"
- LRA Table 4.3-2, "Projected Cycles"

The project team also performed a review of PNPS LRPD-06, PNPS 40-year design basis CUF calculations, and a GE Thermal Power Optimization Report for PNPS in order to assess

whether the documents provided are an acceptable basis for the 40-year CUF values that were listed for the Class 1 components in LRA Table 4.3-1.

The scope of the 40-year CUF values in LRA Table 4.3-1 for Class 1 components include those for the RPV, RPV nozzle appurtenances, RPV closure flange components, core shroud tie rods, and RRS piping loops A and B.

The project team also reviewed the transients listed in LRA Table 4.3-2 to assess whether the total number of cycles projected at the expiration of the PEO (i.e., after 60 years of licensed operations have elapsed) will exceed the maximum number of cycles that are allowed for the transients in the PNPS design basis. The project team performed this review to determine whether the applicant should have included updated 60-year CUF calculations for those Class 1 components that were evaluated in accordance with 40-year CUF calculations, and if not, whether cycle counting alone, performed in accordance with the applicant's Fatigue Monitoring Program, would be sufficient to manage fatigue-induced cracking without implementation of the CUF updates recommended in GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary."

The project team reviewed LRA Table 4.3-2 and PNPS Document LRPD-06 and determined that both documents projected that the total number of cycles for over one-half of the operational transients analyzed in LRA Table 4.3-2 were projected to exceed the maximum number of cycles for these transients that are allowed by the current PNPS design basis. To address this issue, the applicant provided Commitment No. 35 on the PNPS LRA in a letter dated September 13, 2006 (ADAMS Accession Number ML062650072). The staff evaluates how the TLAA on Metal Fatigue of Class 1 components, when coupled to the activities that are proposed in Commitment No. 35, is in compliance with the requirements of 10 CFR 54.21(c)(1) in Section 4.3.1.2.2.1 of this audit and review report.

4.3.1.2.2.1 Evaluation of Fatigue Analyses for Reactor Pressure Vessel (RPV) and Its Appurtenances

The applicant stated that all of the RPV components were designed to Section III.

In a letter dated July 5, 2006 (ADAMS Accession Number ML061940175), the applicant stated that Table 4.3-1 of LRA should have included the 40-year CUF value for the RPV recirculation outlet nozzle. The applicant stated that Table 4.3-1 of the LRA would be amended accordingly to include the 40-year CUF value for the recirculation outlet nozzle. In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended Table 4.3-1 of LRA and indicated that the 40-year CUF value for the RPV recirculation outlet nozzle was 0.747. This issue is closed.

In LRA Section 4.3.1.4, Feedwater Nozzle Fatigue, the applicant indicated that the RPV feedwater nozzle was the limiting Class 1 component for CUF. The applicant stated that it had projected the CUF for feedwater nozzle for 60 years, considering both the currently analyzed system design transients and rapid cycling through expiration of the PEO. The applicant projected the 60-year CUF for the feedwater nozzle to be < 0.899. The project team independently calculated the 60-year CUF value for the feedwater nozzle to be 1.217, based on

the same operational data and assumptions. The project team asked the applicant to clarify how the 60-year CUF value for the RPV feedwater nozzle was calculated, particularly when Table 4.3-2 of the LRA had indicated that the number of cycles projected at 60 years for over one-half of the design basis transients were in excess of the design basis allowables for the thermal transients.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant stated that the applicant's 60-year extrapolation of the CUF value for the feedwater nozzles in LRA Section 4.3.1.4 is no longer valid, and that, as such, this section is not required and can be deleted. The applicant stated, instead, that PNPS will manage fatigue-induced damage of the RPV components, including the RPV feedwater nozzles, in accordance with the specific aging management details in LRA Commitment No. 35.

Commitment No. 35 will require the applicant to (1) perform updated 60-year CUF calculations for the RVP components (including the RPV feedwater nozzles and other RPV appurtenances), (2) manage the aging effect of fatigue-induced damage using an inspection-based program that has been approved by the NRC, or (3) repair or replace the effected RPV location prior to exceeding a CUF value of 1.0. The activities within the scope of Commitment No. 35 will ensure that the TLAA on Metal Fatigue of the RPV components, including the PNPS feedwater nozzle, will be projected to the expiration of the PEO in accordance with 10 CFR 54.21(c)(1)(ii) or that the effect of fatigue-induced damage will be managed through inspection or corrective action (i.e., repair or replacement of the component in accordance with 10 CFR 54.21(c)(1)(iii). Based on this evaluation, the project team concludes that the applicant's TLAA on Metal Fatigue of the RPV components, when taken in conjunction with Commitment No. 35, is acceptable in accordance with 10 CFR 54.21(c)(1)(ii) or (iii).

4.3.1.2.2.2 <u>Evaluation of Fatigue Analyses for the RPV Internal Components</u>

The applicant stated that the RPV internal components were designed to the intent of Section III. The applicant also stated that the core shroud tie rods (i.e., core shroud stabilizer repair assemblies) were the only RPV internals that received a 40-year CUF calculation. The applicant listed that the CUF value for the tie rods is 0.330 through 40 years of operation. The applicant stated that this value is valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i).

The core shroud tie rod assemblies were installed in PNPS to assume the structural loading for the core shroud shells in lieu of the structural welds used in the shroud design. The project team also determined that the applicant had installed the core shroud tie rod assemblies as a modification of the PNPS core shroud design in 1995. The project team also determined that the stress analyses for the core shroud tie rod assemblies are given Reference 5 and 6, which were developed to support the modification of the plant. The stress analyses included a Section III CUF calculation for the core shroud tie rod assemblies. The project team reviewed the stress analyses and confirmed that the analyses list that the CUF for the tie rod assemblies is 0.330 over a 40 year design life. The current operating license for PNPS (Operating License No. DPR-35) is scheduled to expire on September 15, 2012. Pending its approval by the NRC, the PEO for PNPS is scheduled to initiate on September 15, 2012 and to expire on September 15, 2032. Thus, the core shroud tie rod assemblies will have received less than 38 years of operation at the expiration of the PEO for PNPS. Based on this assessment, the project team

concludes that it is valid to use the 40-year CUF value for the tie rod assemblies through the expiration of the PEO because the design life of the components since their installation in 1995 covers the duration of the PEO for PNPS. Based on this analysis, the project team concludes that the CUF value for the core shroud tie rod assemblies is acceptable in accordance with 10 CFR 54.21(c)(1)(i).

4.3.1.2.2.3 Evaluation of Fatigue Analyses for Class 1 Piping Components

The project team determined that the replacement piping for RRS piping loops A and B was the only Class 1 piping that was designed to ASME Section III requirements and had received 40-year CUF calculations for the current operating period. The applicant identified that the limiting 40-year CUF value for the RRS piping Loops A and B is 0.110. The CUF value for the RRS piping loops A and B is bounding by the CUF value for the RPV feedwater nozzle, which is the limting Safety Class 1 component for CUF.

As for other CUF calculations, the acceptance criterion for accepting the CUF calculation for the RRS Loops A and B is that the CUF value for the piping will be less than a value of 1.0, both at the expiration of the current operating period and at the expiration of PEO. The PEO, pending its approval by the NRC, will add an additional 20 years of licensed operation to the original 40-year licensed operating period and, thus, increase the licensed operating time by a factor of 1.5. The 40-year CUF value for the RRS piping loops A and B has sufficient margin in it that even if an additional safety factor of 5 were placed on the original 40-year CUF value, the CUF value would not exceed a value of 0.550. This is sufficient to account for the additional 20 years that the PEO will add to the licensed operating time for PNPS. The applicant's Fatigue Monitoring Program (Aging Management Program [AMP] B.1.11) tracks the number of thermal transients that are applicable to the CUF assessment for the RRS piping loops A and B and requires corrective action if the number of cycles for any of the thermal transients applicable to the RRS piping loops are approaching their design basis allowable limits. Based on this analysis, the project team concludes that the CUF analysis for the RRS piping loops A and B is sufficient to account for the additional 20 years of operating time imparted by the PEO and is acceptable in accordance with 10 CFR 54.21(c)(1)(ii), or that the Fatigue Monitoring Program will be sufficient to manage the TLAA on Metal Fatigue of the RRS piping loops A and B for the PEO in accordance with 10 CFR 54.21(c)(1)(iii).

In the applicant's response letter of September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended Section 4.3.1 of the LRA to include a metal fatigue analysis discussion for those Class 1 piping components that were designed to B31.1. The applicant clarified that the total number of full thermal cycle transients projected through 60 years of operation was less than 7,000 and that based on this projection, the allowable stress range analyses for these components remain valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) and do not need to be reduced. For those Class 1 piping components that were designed to B31.1, the design code's metal fatigue analysis requires that the maximum allowable stress range for the components be reduced if the number of cycles for the full thermal transients imparted on the components is projected to be greater than 7,000 cycles. According to Section 4.3.3.1.2.1 of the SRP-LR, the original maximum allowable stress range analysis in the original design basis for the B31.1 piping is considered valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) if the total number of cycles for the full thermal

transients, as postulated for the piping through the expiration of the PEO for the facility, is less than 7,000 cycles.

The project team reviewed the thermal transients that were defined and summarized in LRA Table 4.3-2 and confirmed that the total number of full thermal transients projected at the end of the PEO for PNPS (i.e., through 60 years of licensed power operations) will be less than 7,000. Based on this assessment , the project team concludes that there is no need to reduce the maximum allowable stress range values for the Class 1 B31.1 piping components and that the maximum allowable stress calculations for these components will remain valid for the PEO in accordance with requirements of 10 CFR 54.21(c)(1)(i) and the guidelines for acceptance in Section 4.3.3.1.2.1 of the SRP-LR.

4.3.1.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the TLAA on Metal Fatigue of PNPS Class 1 components in PNPS LRA, Appendix A, Section A.2.2.2.1., which provided the applicant's summary description on how TLAA on Metal Fatigue of the PNPS Class 1 components would manage the components against fatigue-induced damage for the PEO. Upon its initial review of LRA Section A.2.2.2.1, the project team determined that the summary description did provide a sufficient summary of the CUF-based fatigue analyses for those Class 1 components that were designed to Section III requirements. However, the project team concluded that the UFSAR Supplement summary description for this TLAA was not acceptable because it did not reflect the commitment in Commitment No. 35 for the LRA.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the PNPS LRA and enhanced the TLAA on Metal Fatigue of Class 1 Components to include Commitment No. 35 on the LRA. In a letter dated October 10, 2006 (ADAMS Accession Number MLXXXXXXXXX), the applicant stated that Section A.2.2.2.1, "Class 1 Metal Fatigue," is revised to reference Commitment No. 35 on the LRA. The project team has evaluated the TLAA on Metal Fatigue of Class 1 components in Sections 4.3.1.2.2.1, 4.3.1.2.2.2 and 4.3.1.2.2.3 of this audit and review report and has provided an acceptable basis for concluding that the TLAA on Metal Fatigue of Class 1 Components, when taken into account with Commitment No. 35, is acceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii) or (iii). Therefore, the project team concludes that the USFAR Supplement summary description in LRA Section A.2.2.2.1, when taken into account Commitment No. 35, is acceptable because the commitment will ensure that the TLAA on Class 1 Fatigue is acceptable in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii) and because the commitment has been incorporated by reference into the UFSAR Supplement summary description for the TLAA.

Based on this review, the project team concludes that UFSAR Supplement summary description A.2.2.2.1, as amended in the letter of October 6, 2006, complies with the requirements of 10 CFR 54.21(d).

4.3.1.4 Conclusion

On the basis of its review, the project team concludes that the applicant has demonstrated that, pursuant to 10 CFR 54.21(c)(1)(i), the TLAA on metal fatigue will remain valid for the PEO, or

that pursuant to 10 CFR 54.21(c)(1)(ii), the metal fatigue analyses for the Class 1 components will be either projected to the end of the PEO, or that, pursuant to 10 CFR 54.21(c)(1)(iii), the effect of fatigue-induced damage on the intended functions of components will be adequately managed for PEO. The project team also concludes that the UFSAR supplement, when taken in conjunction with commitment activities in Commitment No. 35, contains an appropriate summary description of the TLAA on Metal Fatigue of Class 1 Components for the PEO, as required by 10 CFR 54.21(d).

4.3.2 Fatigue of Non-Class 1 Components

4.3.2.1 Summary of Technical Information in the Application

The applicant stated that the Safety Class 2 and 3 piping systems were designed to B31.1. The applicant stated that B31.1 requires the applicant to assess whether the projected number of thermal cycles for these systems through 60 years of licensed operations would require the applicant to reduce the maximum allowable stresses for the components in accordance with the B31.1 maximum allowable stress reduction criteria.

The applicant stated that the number of thermal cycles projected for these systems through 60 years of licensed operation will not exceed 7000 cycles. Based on this projection, the applicant determined that, in accordance with the B31.1 acceptance criteria, no reductions of the maximum allowable stresses for these systems is necessary for the PEO. The applicant therefore concluded that the piping stress calculations for these systems remain valid for the PEO and are acceptable in accordance with 10 CFR 54.21(c)(1)(i).

4.3.2.2 Evaluation

4.3.2.2.1 Regulatory Bases for Evaluating TLAAs on Metal Fatigue of Non-Class 1 Components

The methods and criteria discussed in Section 4.3.1.2.1 for components designed to the B31.1 design code are applicable to the evaluation of the TLAA on Metal Fatigue of Non-Class 1 Components.

4.3.2.2.2 Scope of Review and Technical Evaluation

The project team reviewed LRA Section 4.3.2, including LRA Table 4.3-2, “Project Cycles,” relative to the TLAA on Metal Fatigue for Non-Class 1 Components. The project team also reviewed PNPS Report No. LRPD-06, Revision 0, “Time Limited Aging Analyses – Mechanical Fatigue,” relative to the applicant’s metal fatigue methods for the PNPS Non-Class 1 (Safety Class 2 and 3) components.

According to Section 4.3.3.1.2.1 of the SRP-LR, the original maxiumum allowable stress range analysis in the original design basis for the B31.1 piping is considered valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i) if the total number of cycles for the full thermal transients, as postulated for the piping through the expiration of the PEO for the facility, is less than 7000 cycles. The project team reviewed the LRPD-06 and confirmed that the projected

number of cycles at 60 years for the full thermal transients will be less the 7000 for the Non-Class 1 piping components. Based on this assessment , the project team concludes that there is no need to reduce the maximum allowable stress range values for those Non-Class 1 piping components that were designed to B31.1 requirements and that the stress calculations for these components will remain valid for the PEO in accordance with requirements of 10 CFR 54.21(c)(1)(i) and the guidelines for acceptance in Section 4.3.3.1.2.1 of the SRP-LR.

4.3.2.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the TLAA on Metal Fatigue of PNPS Class 1 components in LRA Section A.2.2.2.2. The summary description discusses how the number of full thermal transients is projected to remain below 7,000 at the expiration of the PEO and, therefore, provides an acceptable description on the TLAA for Metal Fatigue for Non-Class 1 Components in that it discusses how the maximum allowable stress range analysis for the components remains valid for the PEO in accordance with 10 CFR 54.21(c)(1)(i).

In Sections 3.2.2.2.1, 3.3.2.2.1, and 3.4.2.2.1 of this audit and review report, the project team assessed and accepted the applicant's basis for managing fatigue-induced damage in those Non-Class 1 the were designed to codes other than B31.1 (non-B31.1 design codes). In particular, the project team assessed the basis in the applicant's response to the project team's question on this matter, which clarified which components in the Non-Class 1 AMR tables were fabricated in accordance with B31.1 design requirements and which Non-Class 1 Components were fabricated in accordance with design codes which did not require metal fatigue analyses. Therefore, based on this review, the project team concludes that the summary description is acceptable based on the following determinations: (1) the UFSAR Supplement summary description in LRA Section A.2.2.2.2 provides an acceptable basis on how the TLAA on Metal Fatigue of Non-Class 1 Components remains valid for PEO in accordance with 10 CFR 54.21(c)(1)(i) for those Non-Class 1 Components that are designed to B31.1 requirements, and (2) the applicant is no longer relying on this TLAA to manage fatigue-induced damage in those Non-Class 1 components that were designed to non-B31.1 design codes. Refer to Sections 3.2.2.2.1, 3.3.2.2.1, and 3.4.2.2.1 of this audit and review report for the project team's evaluation of fatigue-induced damage in the emergency safety feature system components, auxiliary system components, and steam and power conversion system components that were designed to non-B31.1 design codes.

4.3.2.4 Conclusion

On the basis of its review, the project team concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(i), that for metal fatigue analyses for the Non-Class 1 Components designed to B31.1 requirements, the analyses remain valid for the PEO. The project team also concludes that the applicant has proposed a valid AMP to manage "cracking - fatigue" in those Non-Class 1 Components in which "cracking - fatigue" is an applicable AERM and for which the design code of record is a design code other than B31.1. The project team also concludes that the UFSAR supplement contains an appropriate summary description of the RV internals fatigue analyses TLAA evaluation for the PEO, as required by 10 CFR 54.21(d).

4.3.3 Effects of Reactor Water Environment on Fatigue Life

In Generic Safety Issue (GSI)-190, “Fatigue Evaluation of Metal Components for 60-Year Plant Life,” the NRC assessed the generic impacts of the effects of reactor coolant environment on fatigue life of Class 1 components. In accordance with interim staff guidance document ISG-16, “Time-Limited Aging Analyses (TLAAs) Supporting Information for License Renewal Applications,” the NRC has established its position that the environmental effects of the reactor coolant environments must be evaluated for their impacts on the 60-year metal fatigue CUF values for the high fatigue CUF locations listed in older vintage BWR plants.

4.3.3.1 Summary of Technical Information in the Application

In LRA Section 4.3.3, the applicant identified that the analysis that assesses the impact of reactor coolant environment on the metal fatigue CUFs for Class 1 components is a TLAA that meets the definition of a TLAA in 10 CFR 54.3. In this section of the LRA, the applicant summarized the results of its evaluation of the effects of reactor coolant environment on CUF-based fatigue life calculations for the Class 1 components and piping for the PEO**.** Henceforth, this TLAA will be referred to as the “TLAA on Environment Fatigue.”

4.3.3.2 Evaluation

4.3.3.2.1 Regulatory Bases for Evaluating the TLAA on Environmental Fatigue

In GSI-166, “Adequacy of the Fatigue Life of Metal Components," the NRC raised concerns regarding the conservatism of the fatigue curves used in the design of the reactor coolant system components. Although the issues raised in GSI-166 were resolved for the current 40-year design life of operating components, the staff identified that the same issues would have to be assessed for their impacts on possible license extension for operating reactors. Therefore, the staff issued GSI-190, “Fatigue Evaluation of Metal Components for 60-year Plant Life,” to address these issues with respect to license renewal. The NRC closed GSI-190 in December 1999, concluding that the calculations supporting resolution of this issue, which included consideration of environmental effects and the nature of age-related degradation, addressed the potential for an increase in the frequency of pipe leaks as plants continue to operate. However, the NRC also concluded that consistent with existing requirements in 10 CFR 54.21(c)(1), licensees should address the effects of reactor coolant environment on component fatigue life as AMPs are formulated in support of license renewal. The NRC’s bases for performing these evaluations are given in NUREG/CR-6260; NUREG/CR 6583, “Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels,” for carbon and alloy steels; and NUREG/CR 5704, “Effects of LWR Coolant Environments on Fatigue on Fatigue Design Curves of Austenitic Stainless Steels.”

4.3.3.2.2 Scope of Review and Technical Evaluation

The applicant evaluated the PNPS-specific Class 1 component locations that correspond to those listed in NUREG/CR-6260 for an older-vintage BWR plant to assess the impact of the effects of the reactor coolant environment on the CUF-based fatigue life of the components.

The applicant identified that this involves a total of the six PNPS-specific Class 1 commodity group locations, comprising a total of nine Class 1 components. The applicant performed its environmentally adjusted CUF calculations by applying the F_{en} multiplicative factor modification criteria in NUREG/CR-6260 to modify the 40-year CUF values that were provided for the nine components in Table 4.3-1 of the LRA. Table 4.3-3 provides the PNPS environmentally adjusted CUF values for the nine PNPS components locations. The applicant identified that four of the nine components would have environmentally adjusted CUF values greater than 1.0 prior to expiration of the PEO.

In Section 4.3.3 of the LRA, the applicant stated that prior to entering PEO, the applicant will implement one of the following actions for each location that may exceed a CUF of 1.0 when considering environmental effects:

(1) further refinement of the fatigue analyses to lower the predicted CUFs to less than 1.0

(2) management of fatigue at the affected locations by an inspection program that has been reviewed and approved by the NRC (details such as scope, qualification, method, and frequency will be submitted to the NRC prior to PEO)

(3) repair and replacement of the affected locations

The project team determined that the applicant did not perform any 60-year environmentally adjusted CUF calculations for the PEO. In addition, the project team determined that Table 4.3-3 indicated that there were no PNPS-specific CUF values available for reactor recirculation outlet nozzle, core spray safe end, and feedwater piping. and that, instead, the applicant used the generic environmentally adjusted CUF values that were provided for these components in NUREG/CR-6260. The project team asked the applicant to resolve three issues related to the LRA Section 4.3.3 and LRA Table 4.3-3:

A. Issue 1: The footnotes in LRA Table 4.3-3 stated that generic values for these components were taken from NUREG/CR-6220. The project team asked the applicant whether this should have been NUREG/CR-6260. In its response, the applicant stated that this was a typo, it should be NUREG/CR-6260. The project team found the response acceptable. Issue 1 is closed.

B. Issue 2: The project team informed the applicant that plant-specific Class 1 components locations selected for the environmentally adjusted CUF analysis are to be based on the corresponding specific plant vintage assessed in NUREG/CR-6260 and that the plant-specific locations for analysis are therefore dependent on the degree of conformance of a plant's Class 1 RCPB configuration to that analyzed for the corresponding plant design in the topical report. The project team informed the applicant that the generic environmentally adjusted CUF values from NUREG/CR-6260 could not be used as the basis for environmentally adjusted CUF analysis unless the applicant could justify that the plant-specific Class 1 RCPB locations analyzed for PNPS were the same as those analyzed for the corresponding BWR-designed vintage plant in NUREG/CR-6260.

To resolve the issue, the project team asked the applicant to justify its use of the NUREG/CR-6260 generic environmentally adjusted CUF values for the reactor recirculation outlet nozzle, core spray nozzle safe end, and feedwater piping. The applicant stated that the environmentally adjusted CUF values for these components were intended to serve as typical values for predicting the magnitude of the effect of considering the reactor coolant environment on fatigue for PNPS. The applicant agreed to supplement the LRA to remove the environmentally adjusted CUFs for the reactor recirculation outlet nozzle, core spray safe end, and feedwater piping components from LRA Table 4.3-3 and to commit to perform additional environmentally adjusted fatigue analyses prior to PEO as stated below in Issue (3).

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant indicated that it had determined that its design basis did include environmentally adjusted CUF calculations for the reactor recirculation outlet nozzle and the core spray nozzle safe-end and provided a revised table that, in part, included the applicant normal CUF values for these components to the expiration of the current operating period (i.e., at end of 40 years), the projected CUF values for these components at the expiration of the PEO, and the projected environmentally adjusted CUF values for these components at the expiration of the PEO. The table also included the 60-year environmentally adjusted CUF calculations for all other PNPS-specific Class 1 components that were previously analyzed in accordance with Section III CUF calculations The applicant stated that all CUFs that exceed 1.0 must be recalculated prior to PEO.

C. Issue 3: The project team asked the applicant to provide more details on its corrective action implementation plan for those PNPS locations that were projected to have 60-year environmentally adjusted CUF values above a value of 1.0. Specifically, project team asked the applicant to clarify how the further refinement of the fatigue analyses will be performed if Option 1 of the corrective action implementation plan was selected as the option for corrective action. The project team also informed the applicant that a commitment would need to be placed on the LRA if Option 2 of the plan were selected as the course of corrective action, and an AMP was going to be proposed as the basis for managing fatigue-induced damage in the components.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the PNPS LRA and submitted Commitment No. 31 for the PNPS LRA. Commitment No. 31 states that for the locations identified in NUREG/CR-6260 for BWRs of the PNPS vintage, PNPS will implement one or more of the following:

(1) Refine the fatigue analyses to determine valid CUFs less than 1 when accounting for the effects of reactor water environment. This includes applying the appropriate F_{en} factors to valid CUFs determined in accordance with one of the following:

1. For locations with existing fatigue analysis valid for the PEO, use the existing CUF to determine the environmentally adjusted CUF.

2. More limiting PNPS-specific locations with a valid CUF may be substituted for the NUREG/CR-6260 locations.

3. Representative CUF values from other plants, adjusted to or enveloping the PNPS plant-specific external loads, may be used if demonstrated applicable to PNPS.

4. An analysis using an NRC-approved version of the ASME code of NRC-approved alternative (e.g., NRC-approved code case) may be performed to determine a valid CUF.

(2) Manage the effects of aging due to fatigue at affected locations by an inspection program that has been reviewed and approved by the NRC (e.g., periodic nondestructive examination of the affected locations at inspection intervals to be determined by a method acceptable to the NRC).

(3) Repair or replace the affected locations prior to exceeding a CUF of 1.0.

Should PNPS select the option to manage the aging effects due to environmental-assisted fatigue during the PEO, details of the aging management program such as scope, qualification, method, and frequency will be submitted to the NRC at least 2 years prior to the PEO.

Commitment No. 31 indicates that the commitment is to be implemented at least 2 years prior to entering the PEO if Option (1) or (2) of the commitment is selected by the applicant as the course of action for fulfilling the commitment. If Option (3) of the commitment is selected as the course of action, the repair or replacement of the affected component is to be implemented prior to having the environmental CUF value for the component exceed a value of 1.0. The project team noted that this issue is interlinked with the issues identified in Subsection 4.3.1, Class 1 Fatigue. The CUFs for Class 1 components in Table 4.3-1 that are mentioned in NUREG/CR-6260 as locations for analysis may need to be recalculated for 60 years before the refinement of the CUF calculations using the F_{en} factors can be performed to satisfy the environmental effect guidelines of NUREG/CR-6260. The details of Commitment No. 35 on the LRA, as discussed in Section 4.3.1.2.2.1 of this audit and review report, account for those PNPS-specific RPV components in LRA Table 4.3-1 that also serve as PNPS-specific RPV locations in LRA Table 4.3-3 for meeting the NUREG/CR-6260 guidance.

The project team concludes that incorporation of Commitment No. 31 on the LRA provides an acceptable basis for accepting the TLAA on Environmental Fatigue in accordance with 10 CFR 54.21(c)(1) because the applicant will choose one of the following options in accordance with an acceptable implementation schedule to ensure compliance with either 10 CFR 54.21(c)(1)(ii) or (iii):

(1) refine the CUF analyses prior to entering the PEO to demonstrate that the 60-year environmentally adjusted CUF values for the PNPS-specific Class 1 components will be less than 1.0 and to demonstrate acceptance in accordance with the NRC's acceptance criterion in 10 CFR 54.21(c)(1)(ii)

(2) submit an AMP for NRC approval to manage fatigue-induced damage in the components at least 2 years prior to entering the PEO, and use the NRC-approved AMP to manage fatigue-induced damage in the components during PEO and to demonstrate compliance in accordance with 10 CFR 54.21(c)(1)(iii)

(3) use an ASME Code Section XI-required repair/replacement program for Class 1 components or other alternative NRC-approved repair replacement method to repair or replace the impacted component prior to exceeding an environmentally adjusted CUF value of 1.0 and to demonstrate compliance with 10 CFR 54.21(c)(1)(iii)

Based on the project team's acceptance of Commitment No. 31 as the basis for TLAA acceptance, Issue 3 is closed.

4.3.3.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the TLAA on Environmental Fatigue in LRA Section A.2.2.2.3. The applicant stated that the effects of the reactor coolant environment on the metal fatigue analysis for PNPS were evaluated for the LRA. However, these effects were only evaluated for 40 years and not for the PEO. As a result, the project team determined that the initial version of the UFSAR Supplement summary description did not adequately describe the TLAA on Environmental Fatigue because UFSAR Supplement A.2.2.2.3 would need to be updated to refer to LRA Commitment No. 31, which is being relied upon for acceptance of the TLAA on Environmental Fatigue.

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant amended the PNPS LRA and placed Commitment No. 31 on the LRA to address the need for performing updated, 60-year environmental CUF calculations for the PNPS-specific Class 1 locations that correspond to those analyzed in NUREG-6260. However, the applicant did not revise the UFSAR Supplement A.2.2.2.3 summary description to reference Commitment No. 31. The project team requested that the applicant revise UFSAR Supplement summary description A.2.2.2.3 to include reference to Commitment No. 31 on the LRA, as is recommended in NUREG-1800, Revision 1, Section 4.3.3.3.

In a letter dated October 6, 2006 (ADAMS Accession Number MLXXXXXXXXX), the applicant amended UFSAR Supplement A.2.2.2.3 to include reference to Commitment No. 31 on the LRA. The project team performed an additional review of the UFSAR Supplement summary description in LRA Section A.2.2.2.3, as amended in the applicant's letter of October 6, 2006. The project team determined that summary description provides an adequate summary description of this TLAA because the summary description conforms to that recommended in the SRP-LR UFSAR Supplement table and because the UFSAR Supplement summary description has been amended to incorporate a reference to Commitment No. 31 on the LRA. Based on this review, the project team concludes that UFSAR Supplement summary description A.2.2.2.3, as amended in the letter of October 6, 2006, complies with the requirements of 10 CFR 54.21(d).

4.3.3.4 Conclusion

On the basis of its review, the project team concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii) or (iii), that for the environmental metal fatigue analyses for the Class 1 components, the analyses remain valid for the PEO. The project team also concludes that the UFSAR supplement contains an appropriate summary description of the TLAA on Environmental Fatigue for the PEO, as required by 10 CFR 54.21(d).

4.4 Environmental Qualification of Electrical Equipment

The 10 CFR 50.49 EQ program has been identified as a TLAA for the purposes of license renewal. The TLAA of EQ electrical components includes all long-lived passive and active electrical components and instrumentation and control components that are important to safety and located in a harsh environment. The harsh environments of the plant are those areas that are subjected to environmental effects by a LOCA or a HELB. The EQ equipment comprises safety-related and Q-list equipment; NSR equipment, the failure of which could prevent satisfactory accomplishment of any safety-related function; and necessary postaccident monitoring equipment.

As required by 10 CFR 54.21(c)(1), the applicant must provide a list of EQ TLAAs. The applicant shall demonstrate that one of the following is true for each type of EQ equipment: (1) the analyses remain valid for the PEO; (2) the analyses have been projected to the end of the PEO; or (3) the effect of aging on the intended function(s) will be adequately managed for the PEO.

4.4.1 Summary of Technical Information in the Application

In LRA Section 4.4, the applicant summarized the evaluation of the EQ of electrical equipment for the PEO. The applicant states that the PNPS Environmental Qualification (EQ) of Electric Components Program manages component thermal, radiation, and cyclical aging, as applicable, through the use of aging evaluation based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished, replaced, or have their qualification extended before reaching the aging limits established in the evaluation. Aging evaluations for EQ components that specify a qualification of at least 40 years are considered TLAAs for license renewal. The EQ program ensures that these EQ components are maintained in accordance with their qualification bases. The PNPS program is an existing program established to meet PNPS commitments for 10 CFR 50.49. It is consistent with NUREG-1801, Section X.E1, “Environment Qualification of Electric Components.” The PNPS program includes consideration of operating experience to modify bases and conclusions, including qualified life. Compliance with 10 CFR provides assurance that components can perform their intended function(s) during accident conditions after experiencing the effects of inservice aging. Based on a review of the existing program and associated operating experience, continued implementation of the PNPS Environmental Qualification (EQ) of Electric Components Program provides assurance that the aging effects will be managed and that the in scope EQ components will continue to perform their intended function(s) for the PEO. The effects of aging will be managed by the PNPS program in accordance with the requirements of 10 CFR 54.21(c)(1)(iii).

4.4.2 Project Team Evaluation

Regulatory Bases for EQ Evaluations

Section 50.49(e)(5) of 10 CFR contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. Section 50.49(e)(5) of 10 CFR also requires component replacement or maintenance before the end of designated life, unless additional life is established through ongoing qualification. Subsections 50.49(k) and (l) of 10 CFR permit different qualification criteria to apply based on plant vintage. The EQ regulatory guidance for compliance with these different qualification criteria is provided in RG 1.89, Revision 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," the Division of Operating Reactors guidelines, and NUREG-0588. The EQ program was established to demonstrate that certain electrical components located in harsh plant environments (i.e., those areas of the plant that could be subject to the harsh environmental effects of LOCA, HELBs, or post-LOCA radiation) are qualified to perform their safety function operation in those harsh environments after the effects of inservice aging. The EQ program manages applicable component thermal, radiation, and cyclic aging effects for the current operating license period using the qualification methods established by 10 CFR 50.49(f). Maintaining qualification through the extended license renewal period requires that existing EQ evaluations be reanalyzed.

Scope of Review and Assessment

The project team reviewed Section 4.4 of the LRA and plant basis document to determine whether the applicant provided adequate information to meet the requirement of 10 CFR 54.21(c)(1). For the electrical equipments identified in the basis document, the applicant uses 10 CFR 54.21(c)(1)(iii) in its TLAA evaluation to demonstrate that the aging effects of EQ equipment will be adequately managed during the PEO. The project team reviewed the EQ program to determine whether it will assure that the electrical and instrumentation and controls components covered under this program will continue to perform their intended functions consistent with the CLB for the PEO. The project team's evaluation of the component qualification focused on how the EQ program manages the aging effects to meet the requirements delineated in 10 CFR 50.49.

The project team conducted an audit of the information provided in Section B.1.11 of the LRA and program bases documents at the applicant's engineering office. On the basis of its audit, the project team finds that the EQ program, which the applicant claimed to be consistent with GALL AMP X.E1, "Environment Qualification of Electrical Components," is consistent with the EQ program in the GALL Report. Therefore, the project team found that the EQ program is capable of programmatically managing the qualified life of components within the scope of the program for license renewal. The continued implementation of the EQ program provides assurance that the aging effects will be managed and that components within the scope of the EQ program will continue to perform their intended functions for the PEO.

4.4.3 FSAR Supplement for EQ of Electrical Equipment

The applicant provided an FSAR Supplement summary description of its TLAA evaluation of EQ of electrical equipment in Section A.2.1.11 of LRA Appendix A. On the basis of its review of the FSAR Supplement, the project team concluded that the summary description of the applicant's actions to address the EQ of electrical equipment is adequate.

4.4.4 Conclusion

The project team concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(iii), regarding EQ of electrical equipment, that the effects of aging on the intended function(s) will be adequately managed for the PEO. The project team also concludes that the FSAR Supplement contains an appropriate summary description of this TLAA evaluation, sufficient to satisfy the requirements of 10 CFR 54.21(d).

4.5 Concrete Containment Tendon Prestress

This section is not applicable since PNPS does not have prestressed tendons in the containment building.

4.6 Containment Liner Plate, Metal Containment, and Penetrations Fatigue Analysis

4.6.1 Fatigue of Primary Containment Analysis

4.6.1.1 Summary of Technical Information in the Application

The applicant stated that the PNPS containment was analyzed as part of the Mark I containment long-term program (Technical Report MPR-751, Mark I Containment Program Augmented Class 2/3 Fatigue Evaluation Method and Results for Typical Torus Attached and SRV Piping Systems, November 1982) using methods and assumptions consistent with NUREG-0661.

The Mark I containment long-term program analyzed the torus and attached piping systems for fatigue due to mechanical loadings, as well as thermal and anchor motion. This analysis was based on assumptions of the number of SRV actuations, operating basis earthquakes, and accident conditions during the life of the plant.

The analysis considered all BWR plants that utilized the Mark I containment design. The analysis concluded that for all plants and piping systems considered, the fatigue usage factor for an assumed 40-year plant life was less than 0.5. Extending plant life by an additional 20 years would produce a usage factor below 0.75. Because the usage factor is less than 1.0, the fatigue criteria are satisfied. This TLAA has been projected through the PEO in accordance with 10 CFR 54.21(c)(1)(ii).

4.6.1.2 Project Team Evaluation

The project team reviewed the SRP Section 4.6.1 regarding the analysis of the containment liner plates, metal containment, and penetrations sleeves and found that the PNPS's code of record requires a fatigue analysis for the torus and attached piping systems due to mechanical loadings as well as thermal and anchor motion. For this reason, the project team evaluated the torus and attached piping systems fatigue analysis for the PEO, as required by 10 CFR 54.21(d). During the audit and review, the project team requested that the applicant provide a statement indicating an estimate of the total number of 60-year actuations used in the design fatigue analysis. The analysis remains valid and conservative based on the actual SRV actuations counted through 2005. In the applicant's response, it was noted that all domestic BWRs Mark I appear to meet the MPR-751 for both current and the PEO. PNPS has been tracking SRV actuations from 1992 to 2005. As a result, a total of 14 actuations have been recorded within the 13-year period. The project actuations for the rest of 60 years are estimated at 31 lifts. The number of SRV lifts in the first 20 years of the plant life (1972–1992) were not recorded. The lifts were more frequent in the early years; for that reason, PNPS estimated for the first 20 years that there were 120 lifts. Combining the early period, the recorded period, and the projected period, there will be an estimated 165 lifts within 60 years.

PNPS plant-specific analysis (Teledyne Engineering Services (TES) document TR-5310-02) stated that the SRV penetrations are qualified for 7,500 cycles of maximum load. Based on this, the projection CUF for 60 years is calculated as 0.022.

The project team also asked the applicant to provide a fatigue analysis of the SRV discharge piping and fatigue analysis for other attached piping. The applicant's response indicated that TES document TR-5310-2 documents stress evaluations for various load combinations. However, it does not include a fatigue analysis with all of the other Torus Attached Piping (TAP). TAP is bounded by MPR-751, the GE Mark I Containment Program. MPR-751 concluded that for all plants and piping systems considered, the fatigue usage factors for an assumed 40-year plant life was less than 0.5. In the worse case scenario, extending plant life for an additional 20 years would produce usage factors below 0.75. Because this is less than 1.0, the fatigue criteria was satisfied. The MPR-751 generic fatigue analysis is thus projected for the PEO in accordance with 10 CFR 54.21(c)(1)(ii).

The PNPS plant-specific analysis (TR 5310 2) references the generic GE Mark I containment Program for other torus attached piping (TAP). The plant-specific analysis limits the CUF values for the TAP to a maximum value of 1.0. This is equivalent to criteria for CUF values as established for RCPB piping in Section III of the ASME Code and is acceptable. The generic GE Mark I containment program (based on 40 years of operation) establishes that 92 percent of the TAP would have CUFs of less than 0.3 and that 100 percent would have usage factors less than 0.5. The applicant conservatively multiplied the 40-year CUF values for the TAP by a factor of 1.5 to account for the additional 20 years of power operations. The projected 60-year calculations indicate that 92 percent of the TAP would have CUFs below 0.45 and that 100 percent would have CUFs below 0.75. These calculations have thus been projected through the PEO in accordance with 10 CFR 54.21(c)(1)(ii). The project team reviewed the applicant's response and found that it provides a reasonable summary of the information presented in LRA Section 4.6.1.

4.6.1.2 UFSAR Supplement for Primary Containment

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of the torus and attached piping systems fatigue analysis in LRA Section A.2.2.4. On the basis of its review of the UFSAR Supplement, the project team found that the summary description of the applicant's actions to address the torus and attached piping systems fatigue analysis is adequate because it reflects the information provided in the LRA.

4.6.1.3 Conclusion

On the basis of its review, as discussed above, the project team concluded that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that for the torus and attached piping systems fatigue analyses TLAA, the analyses have been projected to the end of the PEO. The project team also concluded that the UFSAR Supplement contains an appropriate summary description of the torus and attached piping systems fatigue analysis TLAA evaluation for the PEO, as required by 10 CFR 54.21(d).

4.7 Other Plant-Specific TLAAs

4.7.1 Reflood Thermal Shock of the RV Internals

The NRC's evaluation of the TLAA on reflood thermal shock of the RV internals for the PNPS LRA is provided in Section 4.7.1 of the SER on the application.

4.7.2 TLAA in BWRVIP Documents

4.7.2.1 BWRVIP-05, RV Circumferential Welds

The NRC's evaluation of the TLAAs on RV circumferential welds for the PNPS LRA is provided in Section 4.7.2.1 of the SER on the application.

4.7.2.2 BWRVIP-48, Vessel ID Attachment Welds Fatigue Analysis

EPRI Topical Report No. BWRVIP-48-A, "BWR Vessel and Internals Project, Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines" (BWRVIP-48-A, February 2002), provides augmented inspection recommendations and flaw evaluation guidelines that were established by the BWRVIP for vessel attachment (bracket) welds in BWR designs.

The "-A" in the report number represents the NRC-approved version of the report. BWRVIP-48-A includes the NRC's assessment of the report's augmented inspection, flaw evaluation, and TLAA methodologies, which is provided in the report as a copy of the staff's safety evaluation of January 17, 2001.

4.7.2.2.1 Summary of Technical Information in the Application

In Section 4.7.2.2 of the LRA, the applicant identifies that the generic metal fatigue analysis in BWRVIP-48-A for the RPV bracket welds is a TLAA for the PNPS LRA. The applicant states that design of the PNPS RPV does not include any bracket welds that are outside the scope of the recommended analyses and guidelines in BWRVIP-48-A. The applicant therefore concludes that the generic metal fatigue analysis in BWRVIP-48-A is applicable and bounds the metal fatigue analysis for the PNPS bracket welds. The applicant therefore concludes the BWRVIP-48-A analysis as applied to the PNPS bracket welds has been projected to the expiration of the PEO and is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

4.7.2.2.2 Evaluation

4.7.2.2.2.1 Regulatory Basis on Fatigue Analyses for BWR Vessel ID Bracket Welds

The BWRVIP evaluated the impact of metal fatigue on U.S. BWR RPV attachment welds in Section 2.2.2 of BWRVIP-48-A and assessed the impact of license renewal on the metal fatigue assessment for these bracket welds in Section A.4 of Appendix A to the report. The BWRVIP's metal fatigue analysis for U.S. BWR bracket welds was based on a bounding generic CUF assessment for these bracket welds, as reported in EPRI Topical Report BWRVIP-48-A. The calculational methods in Section III of the ASME Code for CUF calculations apply to the BWRVIP's bounding generic assessment for U.S. RPV bracket welds. These methods are discussed in Section 4.3.1.2 of this audit and review report. The BWRVIP concluded that the metal fatigue CUF analyses for U.S. BWR RPV bracket welds yielded CUF values ranging from the 0.05 to 0.5. The BWRVIP also reported that more detailed studies yield CUF values less than 0.4. However, BWRVIP-48-A establishes guidelines so that a BWR license renewal applicant would have to identify metal fatigue of its RPV bracket welds as a TLAA if the design basis or current licensing basis for the facility included a plant-specific metal fatigue analysis for these components that conformed to the six criteria for TLAAs in 10 CFR 54.3. .

The calculational methods in Section III of the ASME Code for CUF calculations apply to the BWRVIP bounding generic metal fatigue assessment for U.S. RPV bracket welds. The NRC assessed the generic metal fatigue assessment in BWRVIP-48-A for U.S. BWR RPV bracket welds and approved it in a safety evaluation dated January 17, 2001.

4.7.2.2.2.2 Scope of Review and Assessment

The applicant stated that the current licensing basis and current design basis for PNPS do not include any plant-specific CUF calculation for the PNPS RPV bracket welds. The applicant also stated that the RPV bracket weld configurations at PNPS were within the scope of those analyzed in BWRVIP-48-A and concluded that the generic CUF assessment in BWRVIP-48-A would be bounding for the design of the PNPS RPV bracket welds.

The project team reviewed the applicant's LRA and supporting current licensing basis and design basis documentation for the LRA and confirmed that the applicant has not identified any plant-specific CUF calculation for the PNPS RPV bracket welds. Consistent with the staff's safety evaluation on BWRVIP-48-A, the project team concludes that metal fatigue of the PNPS

RPV bracket welds does not need to be treated as a TLAA for the PNPS LRA because the CLB does not include a plant-specific 40-year CUF calculation for the RPV bracket welds. Because the guidelines of BWRVIP-48-A have been approved by the staff and are bounding for the PNPS RPV bracket welds, the project team also concludes that the generic CUF assessment in BWRVIP-48-A, as projected for 60 years of licensed operation, provides a sufficient basis for managing fatigue-induced damage in these components during the PEO.

4.7.2.2.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the generic BWRVIP-48 fatigue analysis in LRA Section A.2.2.5. In Section 4.7.2.2.2 of this audit and review report, the project team provided its regulatory basis for concluding that the generic fatigue analysis in EPRI Topical Report No. BWRVIP-48-A provides an acceptable basis for managing fatigue-induced cracking in these welds without the need for the analysis to be treated as a TLAA for the LRA. The project team confirmed that LRA Section A.2.2.5 reflects the generic CUF values provided in Topical Report No. BWRVIP-48-A for U.S. BWR RPV bracket welds through 60-years of licensed operation. Although the generic fatigue in Topical Report No. BWRVIP-48-A does not need to be treated as a TLAA for the LRA, the project team concludes that the applicant's UFSAR Supplement summary description in LRA Section A.2.2.5 provides a sufficient summary of the generic fatigue analysis for the PNPS RPV bracket welds because the summary description reflects the generic CUF data point in Topical Report No. BWRVIP-48-A for U.S. BWRs RPV bracket welds.

4.7.2.2.4 Conclusion

On the basis of its review, as discussed above, the project team concluded that the applicant provided an acceptable basis for deleting Section 4.7.2.2, "BWRVIP-48, Vessel ID Attachment Welds Fatigue Analysis," as a TLAA for the PNPS LRA. The project team also concluded that the applicant provided an acceptable basis for deleting UFSAR Supplement Section A.2.2.5, "Vessel ID Attachment Welds Fatigue Analysis," from the PNPS LRA, as would otherwise be mandated in accordance with 10 CFR 54.21(d).

4.7.2.3 BWRVIP-49, Instrument Penetrations Fatigue Analysis

EPRI Topical Report No. TR-108695, "BWR Vessel and Internals Project: Instrument Penetration Inspection and Flaw Evaluation Guidelines," (BWRVIP-49, March 1998) provides augmented inspection recommendations and flaw evaluation guidelines that were established by the BWRVIP for RPV instrumentation penetration nozzles (RPV IPNs) in BWR designs. The BWRVIP assessed the impact of license renewal on the generic metal fatigue assessment for these RPV IPNs in Section A.4 of Appendix A to the report. The NRC staff approved the generic fatigue assessment for the RPV IPNs in a safety evaluation dated March 13, 2002. Section 4.3 of the SRP-LR confirms that metal fatigue analyses for RPV components are time-dependent analyses that conform to the definition of a TLAA in 10 CFR 54.3.

4.7.2.3.1 Summary of Technical Information in the Application

The applicant identifies that the generic metal fatigue analysis in BWRVIP-49 for the PNPS RPV IPNs is a TLAA for the PNPS LRA. The applicant states that the generic metal fatigue analysis in BWRVIP-49 is applicable to and bounds the metal fatigue analysis for the PNPS RPV IPNs. The applicant therefore concludes the BWRVIP-49 analysis as applied to the PNPS RPV IPNs has been projected to the expiration of the PEO and is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

4.7.2.3.2 Evaluation

4.7.2.3.2.1 Regulatory Basis on Fatigue Analyses for BWR RPV IPNs

The BWRVIP metal fatigue analysis for U.S. BWR RPV IPNs was based on a bounding generic CUF assessment. The calculational methods in Section III of the ASME Code for CUF calculations apply to the BWRVIP bounding generic assessment for U.S. RPV IPNs. The BWRVIP concluded that the metal fatigue CUF analyses for U.S. BWR RPV IPNs yielded CUF values that were less than the CUF threshold value of 0.4 used to assess the impact of the BWR coolant environment on the CUF calculations. The NRC assessed the TLAAs for BWR RPV IPNs in the staff's safety evaluation of March 13, 2002. In this safety evaluation, the staff concluded that the CUFs for all U.S. BWRs were less than 0.4 for both the current operating period and the PEO. Therefore, the staff concluded that thermal fatigue of BWR RPV IPNs was not a significant aging effect for BWR-designed reactors. However, BWRVIP-49 established guidelines that a BWR license renewal applicant would have to identify metal fatigue of its RPV IPNs as a TLAA if the design basis or current licensing basis for the facility included a plant-specific metal fatigue analysis for these components that conformed to the six criteria for TLAAs in 10 CFR 54.3.

4.7.2.3.2.2 Scope of Review and Assessment

The applicant stated that the current licensing basis and current design basis for PNPS do not include any plant-specific CUF calculation for the PNPS RPV IPNs. The applicant also stated that the RPV IPNs at PNPS were within the scope of those analyzed in BWRVIP-49 and concluded that the generic CUF assessment in BWRVIP-49 would be bounding for the design of the PNPS RPV

The project team reviewed the applicant's LRA and supporting current licensing basis and design basis documentation for the LRA and confirmed that the applicant has not identified any plant-specific CUF calculation for the PNPS RPV IPNs. Consistent with the staff's safety evaluation on BWRVIP-49, the project team concludes that metal fatigue of the PNPS RPV IPNs does not need to be treated as a TLAA for the PNPS LRA because the CLB and current design basis did not include any plant-specific 40-year CUF calculation for the components. Because the guidelines of BWRVIP-49 have been approved by the staff and are bounding for the PNPS RPV IPNs, the project team also concludes that the generic CUF assessment in BWRVIP-49, as projected for 60 years of licensed operation, provides a sufficient analysis for managing fatigue-induced damage in these components during the PEO.

4.7.2.3.3 UFSAR Supplement

The applicant provided the UFSAR Supplement summary description for the generic BWRVIP-49 fatigue analysis in LRA Section A.2.2.6. In Section 4.7.2.3.2 of this audit and review report, the project team provided its regulatory basis for concluding that the generic fatigue analysis in EPRI Topical Report No. BWRVIP-49 provides an acceptable basis for managing fatigue-induced cracking in the PNPS RPV IPNs without the need for the generic analysis to be treated as a TLAA for the LRA. The project team confirmed that LRA Section A.2.2.6 references the generic CUF values provided in Topical Report No. BWRVIP-49 for U.S. BWR RPV IPNs through 60-years of licensed operation. Although the generic fatigue in Topical Report No. BWRVIP-49 does not need to be treated as a TLAA for the LRA, the project team concludes that the applicant's UFSAR Supplement summary description in LRA Section A.2.2.6 provides a sufficient summary of the generic fatigue analysis for the PNPS RPV IPNs because the summary description reflects the generic CUF data point in Topical Report No. BWRVIP-49 for U.S. BWRs RPV IPNs.

4.7.2.3.4 Conclusion

On the basis of its review, as discussed above, the project team concluded that the applicant has provided an acceptable basis for deleting Section 4.7.2.3, "BWRVIP-49, Instrument Penetrations Fatigue Analysis," as a TLAA for the PNPS LRA. The project team also concluded that the applicant has provided an acceptable basis for deleting UFSAR Supplement Section A.2.2.6, "Instrument Penetrations Fatigue Analysis," from the PNPS LRA, as would otherwise be mandated in accordance with 10 CFR 54.21(d).

4.7.2.4 BWRVIP-74, Reactor Pressure Vessel

Topical Report BWRVIP-74-A provides the BWRVIP's flaw evaluation and inspection guidance for RPV components in U.S. BWR-designed light-water reactors. The report also provides its generic assessment for the following type of analyses that had the potential to be TLAAs for BWR LRAs:

- adjusted reference temperature (RT_{NDT} value) assessments used in the generation of plant-specific pressure-temperature limits
- metal fatigue analyses for RPV components
- Charpy-V impact upper shelf energy (USE) assessments
- mean RT_{NDT} analysis assessments that are used in plant-specific RPV circumferential and axial weld probability of failure analyses

The PNPS current licensing basis includes corresponding plant-specific analyses for these assessments, all of which met the definition of a TLAA in 10 CF 54.3. The NRC has evaluated these TLAAs either in other sections of this audit and review report or in pertinent sections of the NRC SER for the PNPS LRA, as follows:

1. The applicant provides its TLAA on the adjusted reference temperature (RT_{NDT} value) assessments used in the generation of PNPS-specific pressure-temperature limits in Section 4.2.2 of the LRA. The NRC summarizes this information in Section 4.2.2.1 of the SER for the PNPS LRA. The NRC evaluates this TLAA in Section 4.2.2.2 of the SER and the UFSAR Supplement summary description for this TLAA in Section 4.2.2.3 of the SER. The NRC provides its conclusion on this TLAA in Section 4.2.2.4 of the SER.

2. The applicant provides its TLAA on the metal fatigue of the RPV components in Sections 4.3.1 and 4.3.1.1 of the LRA. The NRC summarizes this information in Section 4.3.1 of the SER for the PNPS LRA. The NRC evaluates this TLAA in Section 4.3.1.2.2.1 of this audit and review report and the UFSAR Supplement summary description for this TLAA in Section 4.3.1.3 of this audit and review report. The NRC provides its conclusion on this TLAA in Section 4.3.1.4 of this audit and review report.

3. The applicant provides its TLAA on the Charpy-V USE assessments for the RPV shell components in Section 4.2.3 of the LRA. The NRC summarizes this information in Section 4.2.3.1 of the SER for the PNPS LRA. The NRC evaluates this TLAA in Section 4.2.3.2 of the SER and the UFSAR Supplement summary description for this TLAA in Section 4.2.3.3 of the SER. The NRC provides its conclusion on this TLAA in Section 4.2.3.4 of the SER.

4. The applicant provides its TLAA on the mean RT_{NDT} assessments and probability of failure analysis assessments for the RPV circumferential and axial weld materials in Sections 4.2.5 and 4.2.6 of the LRA. The NRC summarizes this information in Sections 4.2.5.1 and 4.2.6.1 of the SER for the PNPS LRA. The NRC evaluates these TLAAs in Sections 4.2.5.2 and 4.2.6.2 of the SER and the UFSAR Supplement summary description for these TLAAs in Sections 4.2.5.3 and 4.2.6.3 of the SER. The NRC provides its conclusions on these TLAAs in Sections 4.2.5.4 and 4.2.6.4 of the SER.

4.7.2.5 BWRVIP-76, Core Shroud Fatigue Analysis

EPRI Topical Report No. BWRVIP-76, “BWR Vessel and Internals Project, Core Shroud Inspection and Flaw Evaluation Guidelines” (BWRVIP-76, November 1999) provides augmented inspection recommendations and flaw evaluation guidelines that were established by the BWRVIP for core shrouds in BWR designs. The BWRVIP evaluated the impact of metal fatigue on BWR core shrouds and whether metal fatigue of BWR core shrouds needed to be identified as a TLAA for BWR LRAs in Section K.4 of Appendix K to the report. The NRC staff’s approval of BWRVIP-76 is still pending completion of its review of the technical content in the report.

4.7.2.5.1 Summary of Technical Information in the Application

In Section 4.7.2.2 of the LRA, the applicant identifies that the generic metal fatigue analysis in BWRVIP-76 for the PNPS core shroud is a TLAA for the PNPS LRA. The applicant states that BWRVIP-76 identified that the generic fatigue analysis in Appendix K of the report identified that the fatigue analysis would only need to be treated as a TLAA if the facility had a corresponding plant-specific TLAA for the plant’s core shroud design. The applicant stated that the PNPS core shroud tie rods were the only RPV internal components that received a 40-year

CUF analysis. The applicant stated that the TLAA for the PNPS core shroud tie rods is provided and evaluated in Section 4.3.1 of the PNPS LRA.

4.7.2.5.2 Evaluation

The project team evaluated the applicant's TLAA on Metal Fatigue of the PNPS core shrouds and, in particular, the CUF assessment for the core shroud tie rods and provided its evaluation of this TLAA in Section 4.3.1.2.2.2 of this audit and review report. The evaluation includes the staff's basis for concluding that the CUF value for the core shroud tie rods is valid for the PEO, in accordance with 10 CFR 54.21(c)(1)(i). The applicant has credited the BWR Internals Program to manage fatigue-induced cracking in the remaining RPV internals. The project team evaluates the applicant's basis for crediting the BWR Internals Program with management of fatigue-induced damage in these RPV internals in Section 3.1.2.2.1 of this audit and review report.

4.7.2.5.3 UFSAR Supplement for Metal Fatigue

The UFSAR Supplement summary description on the TLAA on metal fatigue of Class 1 components is provided in LRA Section A.2.2.2.1 of the PNPS LRA. The scope of this UFSAR Supplement summary description includes the applicant's plant-specific CUF analysis for the PNPS core shroud tie rods. The project team evaluated this TLAA in Section 4.3.1.3 of this audit and review report. The scope of the project team's evaluation in Section 4.3.1.3 of the audit and review report includes the evaluation of the UFSAR Supplement summary description for the TLAA on metal fatigue of Class 1 components, including the PNPS core shroud tie rods.

4.7.2.5.4 Conclusion

The project team's conclusion in Section 4.3.1.4 of this audit report provides the conclusion for the evaluation of metal fatigue analysis for the PNPS core shroud tie rods.

Attachments

Pilgrim Nuclear Power Station Audit and Review Report

Attachment 1

Abbreviations and Acronyms

ACI	American Concrete Institute
ADAMS	Agencywide Documents Access and Management System
ADS	automatic depressurization system
AEM	aging effect/mechanism
AERM	aging effects requiring management
AMP	aging management program
AMPER	Aging Management Program Evaluation Report
AMR	aging management review
ANSI	American National Standards Institute
AOG	augmented offgas
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATL	Advanced Technologies and Laboratories International, Inc.
BADGER	boron-10 areal density gage for evaluating racks
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
C	Celsius
CAS	compressed air system
CASS	cast austenitic stainless steel
CCW	closed cooling water
CDS	condensate demineralizer system
CFR	Code of Federal Regulations
CII	containment inservice inspection
CLB	current licensing basis
CPVC	chlorinated polyvinyl chloride
CR	condition report
CRD	control rod drive
CRDRL	control rod drive return line
CST	condensate storage and transfer
CUF	cumulative usage factor
CWS	circulating water system
DE	NRC/NRR/Division of Engineering
DSM	dissimilar metal
ECCS	emergency core cooling system
EDG	emergency diesel generator
ENN	Entergy Nuclear Northeast
EPRI	Electric Power Research Institute
EQ	environmental qualification

ESF	engineered safety features
EVT	enhanced VT-1 visual examination
F	Fahrenheit
FAC	flow-accelerated corrosion
FERC	U.S. Federal Energy Regulatory Commission
FPC	fuel pool cooling
FSAR	Final Safety Analysis Report
GALL	Generic Aging Lessons Learned (the GALL Report is NUREG-1801.)
GE	General Electric
GL	Generic Letter
GSI	Generic Safety Issue
GTAW	gas tungsten arc welding
HAZ	heat affected zone
HELB	high-energy line break
HPCI	high-pressure coolant injection
HPFW	high-pressure feedwater
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
HWC	hydrogen water chemistry
IA	instrument air
IASCC	irradiation-assisted stress corrosion cracking
ID	inside diameter
IEB	Inspection and Enforcement Bulletin
IEEE	Institute of Electrical and Electronic Engineers
IGSCC	intergranular stress corrosion cracking
IN	Information Notice
IR	insulation resistance
ISA	Instrumentation, Systems, and Automation Society
ISI	inservice inspection
ISP	Integrated Surveillance Program
ksi	1000 pounds per square inch
kV	kilovolt
LOCA	loss of coolant accident
LPCI	low-pressure coolant injection
LRA	license renewal application
MEB	metal-enclosed bus
MeV	mega-electron volt
mg	milligram
MG	motor generator
MIC	microbiologically influenced corrosion
MS	main steam

MSIV	main steam isolation valve
n/cm^2	neutrons per square centimeter
NDE	nondestructive examination
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NRR	NRC/Office of Nuclear Reactor Regulation
NSR	nonsafety-related
NSSS	nuclear steam supply system
NUREG	designation of publications prepared by the NRC staff
OTI	one-time inspection
PASS	post-accident sampling system
PCAC	primary containment atmosphere control
PCP	primary containment penetrations
PDI	Performance Demonstration Initiative
PEO	period of extended operation
pH	potential hydrogen (concentration of hydrogen ions)
PM	preventive maintenance
PNPS	Pilgrim Nuclear Power Station
ppb	parts per billion
ppm	parts per million
PRR	PNPS Relief Request
psig	pounds per square inch
PT	penetrant testing
P-T	pressure-temperature
PVC	polyvinyl chloride
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RAI	request for additional information
RBCCW	reactor building closed cooling water
RCIC	reactor core isolation cooling
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RFO	refueling outage
RG	Regulatory Guide
RHR	residual heat removal
RI	risk-informed
RI-ISI	risk-informed inservice inspection
RLRC	NRC/NRR/ADRO/DLR/License Renewal Branch C

RPV	reactor pressure vessel
RPV IPNs	reactor pressure vessel instrumentation penetration nozzles
RRS	reactor recirculation system
RTV	room-temperature vulcanizing
RV	reactor vessel
RWCU	reactor water cleanup
SBO	station blackout
SCs	structures and components (10 CFR 54.21(a)(1))
SCC	stress corrosion cracking
SER	safety evaluation report
SGT	standby gas treatment
SIL	Service Information Letter
SLC	standby liquid control
S&PC	steam and power conversion
SRP-LR	Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants
SRV	safety relief valve
SS	stainless steel
SSCs	systems, structures, and components (10 CFR 54.4(a))
SSW	salt service water
TAP	torus attached piping
TBCCW	turbine building closed cooling water
TLAA	time-limited aging analysis
Tnom	nominal thickness
UFSAR	Updated Final Safety Analysis Report
UT	ultrasonic testing or ultrasonic thickness
V	volts
VAC	volts alternating current
VT	visual inspection technique

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Attachment 2

Project Team and Applicant Personnel: Public Audit Status Attendees

Project Team

James Davis, NRC, Team Leader
Peter Wen, NRC, Backup Team Leader
Dan Hoang, NRC, Reviewer – Civil/Structural
Duc Nguyen, NRC, Reviewer – Electrical
James Medoff, NRC, Reviewer - Time Limiting Aging Analysis
K. Tanabe, NRC Foreign Assignee, Observer
Rodrigo De La Garza, NRC, Trainee
Robert Sun, NRC, Trainee
Erach Patel, ATL, Contractor Lead
Bob Jackson, ATL, Systems
Wayne Pavinich, ATL, Materials
F. Small, Administrative Support

Project Team Support

Ken Chang, NRC, Chief, RLEP Section C
Perry Buckberg, NRC, PNPS Project Manager
Ram Subbaratnam, NRC, PNPS Project Manager
Raj Auluck, NRC, PNPS Backup Project Manager

Applicant Personnel

Mike Balduzzi, Entergy Site Vice President – Pilgrim
Kevin Bronson, Plant General Manager – Pilgrim
Robert G. Smith, Director, Engineering – Pilgrim
Steve Bethay, Director, NSA – Pilgrim
Bryan Ford, Licensing Manager – Pilgrim
Fred Mogolesko, License Renewal Project Manager – Pilgrim
Doug Ellis, Senior Engineer – Pilgrim
Carol Wightman, Public Relations – Pilgrim
Gary James, Supervisor, Reactor Engineering – Pilgrim
Phil Harizi, Senior Engineer – Pilgrim
Rich Pardee, Senior Engineer – Pilgrim
Stan Wollman, Engineering Supervisor – Pilgrim
George Mileris, Senior Engineer – Pilgrim
Larry Lommis, Senior Chemical Specialist – Pilgrim
Murray Williams, Senior Engineer – Pilgrim
Steve Hudson, Senior Engineer – Pilgrim
Steve Woods, Supervisor, Engineering Programs – Pilgrim
Das Swapan, Senior Engineer – Pilgrim
Steve Burke, Senior Engineer – Pilgrim

Gerry Bechen, Senior Engineer – Pilgrim
Ken Lane, Senior Engineer – Pilgrim
Amy Neiderberger, Engineer – Pilgrim
Dave Rydman, Senior Engineer – Pilgrim
William Carroll, Senior Engineer – Pilgrim
Sub Chugh, Senior Engineer – Pilgrim
Jeff Kalb, Senior Engineer – Pilgrim
Joe Gaedtke, Senior Engineer – Pilgrim
Tim Trask, Manager, Systems Engineering – Pilgrim
Paul Smalley, Senior Chemical Specialist – Pilgrim
Brian Sullivan, Manager, Programs Engineering – Pilgrim
Ray Pace, Supervisor, Mechanical, Structural, Civil Engineering – Pilgrim
David J. Lach, Entergy License Renewal Project Manager
Gary G. Young, Entergy License Renewal Services Manager
Alan Cox, Entergy, License Renewal Services Team
Jill Brochu, Pilgrim License Renewal Team
Laris Chan, Senior Engineer, License Renewal Team
Lori Potts, Entergy License Renewal Services Team
Ron Finnin, Areva

Attendees at the Public Audit Status Meeting on July 19, 2006

PARTICIPANTS	AFFILIATION
Ram Subbaratnam	NRC
James Davis	NRC
Peter Wen	NRC
Dan Hoang	NRC
Don Jackson	Entergy
Mike Balduzzi	Entergy
Ken Chang	NRC
Gary G. Young	Entergy
David J. Lach	Entergy
Bryan Ford	Entergy
Greg Galletti	NRC
Fred Mogolesko	Entergy
Laris Chan	Entergy
James Medoff	NRC
Fred Di Cristofaro	Local 369 (Entergy)
Kevin Bronson	Entergy
Carol Wicohtman	Entergy
Bill Rogers	NRC
Alan Cox	Entergy
Marie Fehlow	Plymouth
William D, Meinert, P.E.	Public
Frank Gillespie	NRC Director, Division of License Renewal
William J. Raymond	NRC Senior Resident Inspector, PNPS
Pete Okas	Entergy White Plains Office

Reza Ahrabli	Entergy License Renewal Services Team
Mike Stroud	Entergy License Renewal Services Team
Ted Ivy	Entergy License Renewal Services Team
Jacque Lingenfelter	Entergy License Renewal Services Team
Don Fronabarger	Entergy License Renewal Services Team
David Heard	Pilgrim License Renewal Team
Andy Taylor	Entergy License Renewal Services Team

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Attachment 3

Aging Management Program Elements for License Renewal

No.	Element Name	Description
1	Scope of program	Scope of program should include the specific structures and components subject to an AMR for license renewal.
2	Preventive actions	Preventive actions should prevent or mitigate aging degradation.
3	Parameters monitored or inspected	Parameters monitored or inspected should be linked to the degradation of the particular structure or component intended function(s).
4	Detection of aging effects	Detection of aging effects should occur before there is a loss of structure or component intended function(s). This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new/one-time inspections to ensure timely detection of aging effects.
5	Monitoring and trending	Monitoring and trending should provide predictability of the extent of degradation and timely corrective or mitigative actions.
6	Acceptance criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or component intended function(s) are maintained under all CLB design conditions during the PEO.
7	Corrective actions (Audited by DIPM)*	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8	Confirmation process (Audited by DIPM)	Confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.
9	Administrative controls (Audited by DIPM)	Administrative controls should provide a formal review and approval process.
10	Operating experience	Operating experience of the aging management program, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the PEO.

*DIPM = Division of Inspection Program Management

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Attachment 4

Disposition of Requests for Additional Information, LRA Supplements, and Follow-up or Confirmatory Items

Requests for Additional Information

RAI No.	Description	Disposition
3.6.2-1	Clarify how PNPS propose to manage cable connection components during the license extension for the aging effects they are subjected to, or propose a suitable AMP that will manage effects. Please also evaluate them for any plant specific operating experience at Pilgrim. If Entergy evaluates otherwise, please provide justification for why the above generic aging lessons learned recommended program need not be credited.	Open - to be resolved in SER

LRA Supplements

By letter dated July 19, 2006 (ADAMS Accession Number ML062080142) applicant submitted an LRA supplement in response to onsite audits of the aging management programs and aging management reviews. This LRA supplement provides disposition for all docketed audit findings and addresses future commitments, as stated in Attachment 6 of this audit and review report.

By letter dated September 13, 2006 (ADAMS Accession Number ML062650072) the applicant submitted an LRA supplement in response to onsite audits of the aging management programs and aging management reviews. This LRA supplement provides disposition for all docketed audit findings and addresses future commitments, as stated in Attachment 6 of this audit and review report.

By letter dated October 6, 2006 (ADAMS Accession Number MLXXXXXXXXX) the applicant submitted an LRA supplement in response to onsite audits of the aging management programs and aging management reviews. This LRA supplement provides disposition for all docketed audit findings and addresses future commitments, as stated in Attachment 6 of this audit and review report.

Follow-up Items

Follow-up Item No.	Description	Closed to RAI (RAI Issue)
3.2.2.1.7-1	The project team requested the applicant to provide the details that justify the statement that none of the ESF system components are within the scope of the BWR Stress Corrosion Cracking Program.	Open - to be resolved in SER
3.2.2.1.8-1	The project team requested the applicant to provide justification for not providing for monitoring and trending of wall thinning for RCIC piping.	Open - to be resolved in SER
3.5.2.2.2.2-1 3.5.2.2.2.4-1	The project team determined through discussions with the applicant's technical staff that the increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel in below-grade inaccessible concrete areas of Group 6 structures are not significant aging effects at PNPS due to the lack of aggressive groundwater (pH: 6.2, chlorides: 420 ppm, and sulfates: 16 ppm) and the concrete being constructed in accordance with the recommendations in ACI 201.2R-77 for durability with a high-cement, low-water/cement ratio. The applicant will establish a commitment to continue to perform periodic groundwater monitoring to confirm lack of aggressiveness.	Open - to be resolved in SER
4.1.2.1-1	The project team determined that the applicant identified three flaw growth evaluations for Class 1 components that had the potential to be TLAAs for the PNPS LRA. The scope of the flaw evaluations include that N2F recirculation nozzle, the reciruculation nozzle thermal sleeves, and the control rod. The applicant stated that, upon further review, these flaw evaluations were not TLAAs for the PNPS LRA. By letter dated September 7, 2006 (ADAMS Accession Number ML062490501), the NRC staff asked the applicant, to provide further justification and discussions on why these flaw evaluations are not TLAAs for the PNPS LRA.	Open - to be resolved in SER

Confirmatory Items

Follow-up Item No.	Description	Closed to RAI (RAI Issue)
3.0.3.3.3.1.1-1	First paragraph of the "scope of program" description for PNPS AMP B.1.16.2 to read as follows: "The ISI Program manages cracking, loss of material, and reduction of fracture toughness of reactor coolant system piping, components, and supports. The program implements applicable requirements of ASME Section XI, Subsections IWA, IWB, IWC, IWD and IWF and other requirements specified in 10 CFR 50.55a with approved NRC alternatives. Every 10 years the ISI Program is updated to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50.55a."	To be dispositioned in SER Section 3.0.3.3.3.

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Attachment 5

List of Documents Reviewed

The following is a list of applicant documents reviewed by the project team, including documents prepared by others for the applicant. Inclusion of a document on this list does not imply that the project team reviewed the entire document, but rather that selected sections or portions of the documents were reviewed as part of the overall effort documented in this audit and review report. In addition, inclusion of a document in this list does not imply NRC acceptance of the document.

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
Boraflex Monitoring Program (B.1.1)	XI.M22, Boraflex Monitoring	PNPS Evaluation of Aging Management Programs, B.1.1 / AMPER 4.1: Boraflex Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.1, Boraflex Monitoring Program NUREG-1801, Rev.1, Chapter XI.M22, Boraflex Monitoring PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.1, Boraflex Monitoring Program PNPS Nuclear Organization Procedure No. 7.8.1, Rev. 40, Chemistry Sample and Analysis Program Condition Report (Entergy) CR-PNP-2004-00285, REO Spent Fuel Pool Boraflex
Buried Piping and Tanks Inspection Program (B.1.2)	XI.M34, Buried Piping and Tanks Inspection	PNPS Evaluation of Aging Management Programs, B.1.2 / AMPER 3.1: Buried Piping and Tanks Inspection Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.1, Buried Piping and Tanks Inspection Program NUREG-1801, Chapter XI.M34, Buried Piping and Tanks Inspection
BWR CRD Return Line Nozzle Program (B.1.3)	XI.M6, BWR Control Rod Drive Return Line Nozzle	PNPS Evaluation of Aging Management Programs, B.1.3 / AMPER 4.2: BWR CRD Return Line Nozzle Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.2, BWR CRD Return Line Nozzle Program NUREG-1801, Rev.1, Chapter XI.M6, BWR Control Rod Drive Return Line Nozzle

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.2, BWR CRD Return Line Nozzle Program Condition Report (Entergy) CR-PNP-2003-03719, CRD Return Nozzle N10 Cap PNPS Letter, Licensee Event Report (LER 2003-006-000) to U.S. Nuclear Regulatory Commission, November 24, 2003 PNPS Nuclear Organization Procedure NOP83M1, Rev. 8, ASME Code Repairs and Replacements Program PNPS Nuclear Organization Procedure NOP92M2, Rev. 4, ASME Inservice Inspection and Inservice Testing NRC Correspondence to PNPS, February 25, 2005, Relief Request PRR-36, (TAC No. MC0921)
BWR Feedwater Nozzle Program (B.1.4)	XI.M5, BWR Feedwater Nozzle	PNPS Evaluation of Aging Management Programs, B.1.4 / AMPER 4.3: BWR Feedwater Nozzle Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.3, BWR Feedwater Nozzle Program NUREG-1801, Rev.1, Chapter XI.M5, BWR Feedwater Nozzle PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.3, Feedwater Nozzle Program NE15.08, Rev. 01, Control of Augmented Examinations NOP83M1, Rev. 8, ASME Code Repairs and Replacements NOP92M2, Rev. 04, ASME Inservice Inspection and Inservice Testing NRC Letter 184148 dated May 29, 1984, Domenic B. Vassallo to Wlliam D. Harrington, NUREG-0619, BWR Feedwater Nozzle and CRD Return Line Nozzle Cracking NUREG-0619, BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking, November 1980 PNPS-RPT-5-05-001, Rev. 0, ASME Section XI Fourth Ten-Year Interval Inservice TDBD-108, Rev. 1, Topical Design Basis Document for Inservice Inspection (ISI)

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
BWR Penetrations Program (B.1.5)	XI.M8, BWR Penetrations	PNPS Evaluation of Aging Management Programs, B.1.5 / AMPER 4.4: BWR Penetrations Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.4, BWR Penetrations Program NUREG-1801, Rev.1, Chapter XI.M8, BWR Penetrations PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.4, BWR Penetrations Program PNPS Procedure NE21.01, Rev. 5, Reactor Vessel Internals Inspection Implementing Procedure PNPS Nuclear Organization Procedure NOP01A1, Rev. 1, Reactor Vessel Internals Management Program PNPS Nuclear Organization Procedure NOP83M1, Rev. 8, ASME Code Repairs and Replacements PNPS-RPT-05-001, ASME B&PV Code Section XI Fourth Ten-Year Inspection Interval Inservice Inspection (ISI) Program Plan, Rev. 0, July 1, 2005
BWR Stress Corrosion Cracking Program (B.1.6)	XI.M7, BWR Stress Corrosion Cracking	PNPS Evaluation of Aging Management Programs, B.1.6 / AMPER 4.5: BWR Stress Corrosion Cracking Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.5, BWR Stress Corrosion Cracking Program NUREG-1801, Rev.1, Chapter XI.M7, BWR Stress Corrosion Cracking. PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.4, BWR Penetrations Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.5, BWR Stress Corrosion Cracking Program PNPS Procedure NE15.08, Rev. 1, Control of Augmented Examinations PNPS Nuclear Organization Procedure NOP83M1, Rev. 8, ASME Code Repairs and Replacements PNPS Nuclear Organization Procedure NOP92M2, Rev. 4, ASME Code Inservice Inspection and Inservice Testing

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
BWR Vessel ID Attachment Welds Program (B.1.7)	XI.M4, BWR Vessel ID Attachment Welds	PNPS Evaluation of Aging Management Programs, B.1.7 / AMPER 4.6: BWR Vessel ID Attachments Welds Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.6, BWR Vessel ID Attachment Welds Program NUREG-1801, Rev.1, Chapter XI.M4, BWR Vessel ID Attachment Welds PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.6, BWR Attachment Welds Program PNPS Procedure NE21.01, Rev. 5, Reactor Vessel Internals Inspection Implementing Procedure PNPS Nuclear Organization Procedure NOP01A1, Rev. 1, Reactor Vessel Internals Management Program PNPS Nuclear Organization Procedure NOP83M1, Rev. 8, ASME Code Repairs and Replacements
BWR Vessel Internals Program (B.1.8)	XI.M9, BWR Vessel Internals	PNPS Evaluation of Aging Management Programs, B.1.8 / AMPER 4.7: BWR Vessel Internals Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.7, BWR Vessel Internals Program NUREG-1801, Rev.1, Chapter XI.M9, BWR Vessel Internals PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.7, BWR Vessel Internals Program PNPS Response to NRC Staff Request for additional information, Boston Edison to U.S. Nuclear Regulatory Commission, March 21, 1995 PNPS CALC No. M-1017, Revision 0, PNPS Top Guide Weld and Hold-Down Assembly Inspection Evaluation (GE Nuclear Energy, GENE - B13-02080-00-04-01, Revision 0, Section 4) PNPS Procedure NE21.01, Rev. 5, Reactor Vessel Internals Inspection Implementing Procedure PNPS Nuclear Organization Procedure NOP01A1, Rev. 1, Reactor Vessel Internals Management Program Procedure Letter from Harold Denton (NRC) to William Harrington (BECo), "Safety Evaluation by the Office of Nuclear Reactor Regulation Relative to Inspection and Repairs of the Reactor Coolant System Piping," December 4, 1984. (Accession No. 8412170035)

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		Letter from James Jydon (BECo) to Harold Denton (NRC), transmitting report, "Pilgrim Nuclear Power Station Recirculation Inlet Thermal Sleeve Mock Up Fabrication and Evaluation," January 2, 1987. (Accession No. 8701150216)
Containment Leak Rate Program (B.1.9)	XI.S4, 10 CFR 50, Appendix J, Containment Leak Rate	PNPS Evaluation of Aging Management Programs, B.1.9 / AMPER 4.8: Containment Leak Rate Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.8, Containment Leak Program NUREG-1801, Rev.1, Chapter XI.S4, 10 CFR 50, Appendix J, Containment Leak Rate Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.8, Containment Leak Rate Program PNPS Procedure No. 8.7.1.3, Rev. 21, Local Leak Rate Test Program Procedure PNPS Procedure No. 8.7.1.3.1, Rev. 2, Performance Based Leakage Testing of the Primary Containment Procedure PNPS Procedure No. 8.7.1.4.2, Rev. 13, Primary Containment Integrated Leakage Rate Test Procedure
Diesel Fuel Monitoring Program (B.1.10)	XI.M30, Fuel Oil Chemistry Program	PNPS Evaluation of Aging Management Programs, B.1.8 / AMPER 4.9: Diesel Fuel Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.9, Diesel Fuel Monitoring Program NUREG-1801, Rev.1, Chapter XI.M30, Fuel Oil Chemistry PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.9, Diesel Fuel Monitoring Program PNPS Procedure No. 7.1.87, Rev. 12, Diesel fuel Oil Storage Tank Sampling Procedure PNPS Procedure No. 7.8.1, Rev. 40, Chemistry Sample and Analysis Program Procedure PNPS Procedure No. 7.8.7, Rev. 1, Recording and Trending of Chemistry Data Procedure PNPS Maintenance Request, MR9400207, Diesel Fuel Oil Storage Tank Calibration and Alarm Check

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS Maintenance Request, MR9400207, Preventive Maintenance
Environmental Qualification (EQ) of Electric Components Program (B.1.11)	X.E1, Environmental Qualification (EQ) of Electric Components	PNPS Evaluation of Aging Management Programs, B.1.11 / AMPER 4.10: Environmental Qualification (EQ) of Electric Components Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.10, Environmental Qualification (EQ) of Electric Components Program NUREG-1801, Rev.1, Chapter X.E1, Environmental Qualification (EQ) of Electric Components Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.10, Environmental Qualification (EQ) of Electric Components Program Entergy Nuclear Management Manual, ENN-DC-164, Rev. 2 PNPS Environmental Qualification Master List, Revision E51
Fatigue Monitoring Program (B.1.12)	X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary	PNPS Evaluation of Aging Management Programs, B.1.12 / AMPER 4.11: Fatigue Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.11, Fatigue Monitoring Program NUREG-1801, Rev.1, Chapter X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.11, Fatigue Monitoring Program PNPS Procedure No. 1.3.118, Rev. 1, Reactor Vessel Fatigue Cyclic Duty Monitoring Program Procedure
Fire Protection Program (B.1.13.1)	XI.M26, Fire Protection and XI.M27, Fire Water System	PNPS Evaluation of Aging Management Programs, B.1.13.1 / AMPER 4.12.1: Fire Protection Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.12, Fire Protection Programs NUREG-1801, Rev.1, Chapter XI.M26, Fire Protection Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.12, Fire Protection Program

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS Procedure No. 8.B.1, Rev. 64, Fire Pump Test Procedure PNPS Procedure No. 8.B.15, Rev. 36, Functional Tests of Fire Pumps - P-135, P-140, and P-181 Procedures PNPS Procedure No. 8.B.17.1, Rev. 17, Inspection of Fire Door Assemblies Procedure PNPS Procedure No. 8.B.17.2, Rev. 9, Inspection of fire Damper Assemblies Procedure PNPS Procedure No. 8.B.22, Rev. 28, HALON 1301 System - Cable Spreading Room Procedure PNPS Procedure No. 8.B.29, Rev. 7, Inspection of Fire Barriers Procedure
Fire Water System Program (B.1.13.2)	XI.M27, Fire Water System	PNPS Evaluation of Aging Management Programs, B.1.13.2 / AMPER 4.12.2: Fire Water System Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.12.2, Fire Water System Program NUREG-1801, Rev.1, Chapter XI.M27, Fire Water System Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.13, Fire Water System Program PNPS Procedure No. 8.B.3.1, Rev. 14, Fire Hose Station Equipment Inspection - FSAR Related Procedure PNPS Procedure No. 8.B.6.1, Rev. 5, EDG A Pre-action sprinkler system Functional Test Procedure PNPS Procedure No. 8.B.6.2, Rev. 6, EDG "Pre-action Sprinkler System Functional Test Procedure PNPS Procedure No. 8.B.6.8, Rev. 8, Recirc. Pump MG Set Oil Skid Pre-action Sprinkler system Functional Test Procedure PNPS Procedure No. 8.B.6.10, Rev. 5, Hydrogen Seal Oil Supply Reaction System Functional Test Procedure PNPS Procedure No. 8.B.6.13, Rev. 4, Pre-action Sprinkler System Water Flow Alarm Functional Test Procedure PNPS Procedure No. 8.B.8, Rev. 16, Fire Hydrant Operability Procedure PNPS Procedure No. 8.B.9.1, Rev. 4, Wet and Dry Pipe Sprinklers Main Drain Test Procedure

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS Procedure No. 8.B.9.1.1, Rev. 5, Reactor Building Sprinklers Main PNPS Procedure No. 8.B.9.1.2, Rev. 5, Support and Sewerage Treatment Buildings Sprinkler Main Drain Test Procedure PNPS Procedure No. 8.B.9.1.3, Rev. 6, Condenser Bay Sprinkler Main Drain Test Procedure PNPS Procedure No. 8.B.9.1.4, Rev. 4, Gas Bottle Storage Sprinkler Main Drain Test Procedure PNPS Procedure No. 8.B.12, Rev. 28, Fire Protection System Flow Test Procedure. Hydrostatic Testing and Surveillances of Fire Hose FSAR Related Procedure PNPS Procedure No. 8.B.15, Rev. 36, Functional Tests of Fire Pumps - P-135, P- 140, and P-181 Procedure PNPS Procedure No. ARP-C7R, Rev.13, Alarm Response Procedure
Flow-Accelerated Corrosion Program (B.1.14)	XI.M17, Flow-Accelerated Corrosion	PNPS Evaluation of Aging Management Programs, B.1.14 / AMPER 4.13: Flow-Accelerated Corrosion Program PNPS License Renewal Project Aging Management Program Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.14, Flow Accelerated Corrosion Program NUREG-1801, Rev.1, Chapter XI.M17, Flow Accelerated Corrosion Entergy Nuclear Management Manual, ENN-DC -315 Entergy Engineering Standard, ENN-CS-008 Entergy Procedure, ENN-NDE-9.05 PNPS Maintenance Request, MR02107756, Replace Extraction Steam Piping on Feedwater Heater E-101A and E-101B PNPS Maintenance Request, MR04105897, Upgrade the Remaining Carbon Steel Portions of Heater E-104B Operating Vent Line with FAC Resistant Material PNPS Maintenance Request, MR04105898, Upgrade the Remaining Carbon steel Portion of Heater E-104A Operating Vent Line with FAC Resistant Material PNPS Maintenance Request, MR04105899, Upgrade the Remaining Carbon Steel Portions of the Heater E-103B Operating Vent with FAC Resistant Material

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
Heat Exchanger Monitoring Program (B.1.15)		PNPS Evaluation of Aging Management Programs, B.1.15 / AMPER 3.2: Heat Exchanger Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.2, Heat Exchanger Monitoring Program
Containment Inservice Inspection (CII) Program (B.1.16.1)		PNPS Evaluation of Aging Management Programs, B.1.16.1 / AMPER 4.14.2: Containment Inservice Inspection (CII) Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.1.14.2, Containment Inservice Inspection (CII) Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.16, Containment Inservice Inspection (CII) Program PNPS Procedure No. 2.1.87, Rev. 4, ASME Code Visual Examination of Primary Containment Procedure Entergy Engineering Standard, ENN-EP-S-001
Inservice Inspection Program (B.1.16.2)		PNPS Evaluation of Aging Management Programs, B.1.16.2 / AMPER 4.14.1: Internal Inspection (ISI) Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.14.1, Inservice Inspection (ISI) Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.15, Inservice Inspection (ISI) Program PNPS Procedure No. NE15.03, Rev. 0, Performing, Reporting, and Controlling ISI Activities Procedure PNPS Nuclear Organization Procedure NOP92M2, Rev. 4, ASME Code Inservice Inspection and Inservice Testing

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
Instrument Air Quality Program (B.1.17)		PNPS Evaluation of Aging Management Programs, B.1.17/ AMPER 4.15: Instrument Air quality Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.15, Instrument Air Quality Program NUREG-1801, No Corresponding Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.17, Instrument Quality Program PNPS Procedure No. 7.1.69, Rev. 10, System Air Quality Sampling Procedure
Metal-Enclosed Bus Inspection Program (B.1.18)	XI.E4, Metal-Enclosed Bus	PNPS Evaluation of Aging Management Programs, B.1.18/ AMPER 3.3: Metal-Enclosed Bus Inspection Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.3, Metal Enclosed Bus Inspection Program NUREG-1801, Rev.1, Chapter XI.E4, Metal Enclosed Bus
Non-EQ Inaccessible Medium-Voltage Cable Program (B.1.19)	XI.E3, Inaccessible Medium-Voltage Cable Program	PNPS Evaluation of Aging Management Programs, B.1.19/ AMPER 3.4: Non-EQ Inaccessible Medium-Voltage Cable Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.4, Non-EQ Inaccessible Medium-Voltage Cable Program NUREG-1801, Rev.1, Chapter XI.E3, Inaccessible Medium-Voltage Cables not Subject to 10 CFR 50.49 Environmental Qualification Requirements
Non-EQ Instrumentation Circuits Test Review Program (B.1.20)	XI.E2, Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements Used in Instruments Circuits	Programs, B.1.20/ AMPER 3.5: Non-EQ Circuits Test Review Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.5, Non-EQ Instrumentation Circuits Test Review Program NUREG-1801, Rev.1, Chapter XI.E2, Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrument Circuits
Non-EQ Insulated Cables and Connections Program (B.1.21)	XI.E1, Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Programs, B.1.21/ AMPER 3.6: Non-EQ Cables and Connections Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.6, Non-EQ Insulated Cables and connections Program

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		NUREG-1801, Rev.1, Chapter XI.E1, Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements PNPS License Renewal Project, Electrical Screening and Aging Management Reviews, AMRE-01, Revision 2
Oil Analysis Program (B.1.22)	XI.M39, Lubricating Oil Analysis	PNPS Evaluation of Aging Management Programs, B.1.22/ AMPER 4.16: Oil Analysis Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.26, Oil Analysis Program NUREG-1801, Chapter XI.M39 Lubricating Oil Analysis Program PNPS License Renewal Project Aging Management Program Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.18, Oil Analysis Program PNPS Procedure No. 3.M.3-23.1, Rev. 6, Security Diesel System Maintenance Procedure PNPS Procedure No. 3.M.4-17.4, Rev. 26, Lubrication Sampling and Change Procedure PNPS Procedure No. 3.M.4-58, Rev. 13, Rebuilding Reactor Water Cleanup Pumps P-204A and P-204B Procedure PNPS Procedure No. 3.M.4-123, Rev. 1, Diesel Fire Pump (P-140) Engine Maintenance Procedure Entergy Predictive Maintenance Program, ENN-DC-S-310, Rev. 0
One-Time Inspection Program (B.1.23)	XI.M32, One-Time Inspection Program	PNPS Evaluation of Aging Management Programs, B.1.23 / AMPER3.7: One-Time Inspection Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3.7, One-Time Inspection Program NUREG-1801, Rev.1, Chapter XI.M32, One-Time Inspection
Periodic Surveillance and Preventive Maintenance Program (B.1.24)		PNPS Evaluation of Aging Management Programs, B.1.24/ AMPER 4.17: Periodic Surveillance and Preventive maintenance Program, Volume 1 PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.17,

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		Periodic Surveillance and Preventive Maintenance Program NUREG-1801, No Corresponding Program PNPS License Renewal Project Aging Management Program Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.19, Periodic Surveillance and Preventive Maintenance Program PNPS Procedure No. 3.M.1-12.1, Rev. 5, Reactor Building Crane Preventive Maintenance Procedure PNPS Procedure No. 3.M.1-50, Rev. 1, Refuel Platform Pre-refueling Mechanical Checkout Procedure PNPS Procedure No. 3.M.3-23.2, Rev. 6, Security Diesel System Maintenance Procedure PNPS Procedure No. 3.M.3-63, Rev. 26, Emergency Diesel Generator Two-Year Overhaul Preventive Maintenance Procedure
Reactor Head Closure Studs Program (B.1.25)	XI.M3, Reactor Head Closure Studs	PNPS Evaluation of Aging Management Programs, B.1.25 / AMPER 4.18: Reactor Head Closure Studs Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.18, Reactor Head Closure Studs Program NUREG-1801, Rev.1, Chapter XI.M16, Reactor Head Closure Studs PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.20, Reactor Head Closure Studs Program PNPS Procedure No. 2.1.8.3, Rev.13, Visual Examination For Leakage During System Pressure Testing Procedure PNPS Procedure No. 3.M.4-48.3, Rev.20, Visual Examination For Leakage During System Pressure Testing Procedure ABB Combustion Engineering Report: Allowable Torque For Removal of BWR Reactor Vessel Stud GE Nuclear Energy Division, Specification for Reactor Pressure Vessel, 21A1110, Rev. 2 PNPS Nuclear Organization Procedure NOP83M1, Rev. 8, ASME Code Repairs and Replacements PNPS Nuclear Organization Procedure NOP92M2, Rev. 4, ASME Code Inservice Inspection and Inservice Testing Procedure

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
Selective Leaching Program (B.1.27)	XI.M33, Selective Leaching of Material	PNPS Evaluation of Aging Management Programs, B.1.27 / AMPER 3.8: Selective Leaching Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3. 8, Selective Leaching Program NUREG-1801, Rev.1, Chapter XI.M33, Selective Leaching Materials
Service Water Integrity Program (B.1.28)	XI.M20, Open-Cycle Cooling Water System	PNPS Evaluation of Aging Management Programs, B.1.28 / AMPER 4.20: Service Water Integrity Program PNPS License Renewal Project Aging Management Program Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.22, Service Water Integrity Program NUREG-1801, Rev.1, Chapter XI.M20, Open Cycle Cooling Water System PNPS Specification for SSW & RBCCW Safety-Related Piping & Heat Exchanger, Maintenance and Testing PNPS Nuclear Organization Procedure NOP02E1, Rev. 1, Service Water Inspections, Maintenance, and Testing in Response to Generic Letter 89-13
Masonry Wall Program (B.1.29.1)	XI.S5, Masonry Wall Program	PNPS Evaluation of Aging Management Programs, B.1.29.1 / AMPER 4.21.2: Masonry Wall Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.21.2, Masonry Wall Program NUREG-1801, Chapter XI.S5, Masonry Wall Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.24, Masonry Wall Program Maintenance Rule SSC Basis Document Manual, MRSSC58, Revision 1 PNPS Procedure No. NE8.02, Rev.3, Structure Inspection and Condition Monitoring Procedure
Structures Monitoring Program (B.1.29.2)	XI.S6, Structures Monitoring Program	PNPS Evaluation of Aging Management Programs, B.1.29.2 / AMPER 4.21.1: Structures Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.21.1, Structures Monitoring Program NUREG-1801, Chapter XI.S6, Structures Monitoring Program

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.23, Structures Monitoring Program Maintenance Rule SSC Basis Document Manual, MRSSC58, Revision 1 PNPS Procedure No.NE8.02, Rev.3, Structure Inspection and Condition Monitoring Procedure
Water Control Structures Monitoring Program (B.1.29.3)	XI.S7, RG 1.127, Water Control Structures Monitoring Program	PNPS Evaluation of Aging Management Programs, B.1.29.3 / AMPER 4.21.3: Structures Monitoring Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.21.3, Water Control Structures Monitoring Program NUREG-1801, Chapter XI.S7, RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.24, Water Control Structures Monitoring Program PNPS Procedure No. 3.M.5-3, Rev. 0 Breakwater Monitoring and Repair Procedure
System Walkdown Program (B.1.30)	XI.M36, External Surfaces Monitoring	PNPS Evaluation of Aging Management Programs, B.1.30 / AMPER 4.22: System Walkdown Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.22, System Walkdown Program NUREG-1801, Rev.1, Chapter XI.M36, External Surfaces Monitoring PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.26, System Walkdown Program Entergy Engineering Procedure, ENN-DC-178 Entergy CAP, EN-LI-102 Entergy Engineering Standard, EN-MS-S-011-Multi
Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program (B.1.31)	XI.M13, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	PNPS Evaluation of Aging Management Programs, B.1.31 / AMPER 3.9: Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 3. 9, Thermal

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program
Water Chemistry Control-Auxiliary Systems Program (B.1.32.1)		PNPS Evaluation of Aging Management Programs, B.1.32.1 / AMPER 4.23.1: Water Chemistry Control Auxiliary Systems Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.23.1, Water Chemistry Control - Auxiliary System Program NUREG-1801, No corresponding Program PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.27, Water Chemistry Control - Auxiliary Systems Program PNPS Procedure No. 2.2.103, Rev. 30, Visual Stator Cooling System Procedure PNPS Procedure No. 7.8.1, Rev. 40, Chemistry Sample and Analysis Program Procedure PNPS Procedure No. 7.8.7, Rev. 1, Recording and Trending of Chemistry Data Procedure
Water Chemistry Control-BWR Program (B.1.32.2)	XI.M2, Water Chemistry	PNPS Evaluation of Aging Management Programs, B.1.32.2 / AMPER 4.23.2: Water Chemistry Control BWR Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.23.2, Water Chemistry Control - BWR Program NUREG-1801, Rev. 1., XI.M2, Water Chemistry PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.28, Water Chemistry Control - BWR Program PNPS Procedure No. 7.8.1, Rev. 40, Chemistry Sample and Analysis Program Procedure PNPS Procedure No. 7.8.7, Rev. 1, Recording and Trending of Chemistry Data Procedure
Water Chemistry Control-Closed Cooling Water Program (B.1.32.3)	XI.M21, Closed-Cycle Cooling Water System	PNPS Evaluation of Aging Management Programs, B.1.32.3 / AMPER 4.23.3: Water Chemistry Control Closed Cooling Water Program PNPS License Renewal Project Aging Management Program Evaluation Report, LRPD-02, Revision 1, Section 4.23.3, Water Chemistry Control Closed Cooling Water Program NUREG-1801, Rev. 1., XI.M21, Closed-Cycle Cooling Water System

Applicant's Aging Management Program	GALL Aging Management Program	PNPS LRA-AMP Basis Document and Other Documents Reviewed
		PNPS License Renewal Project Operating Experience Review Report, LRPD-05, Revision 0, Section 4.1.29, Water Chemistry Control - Closed Cooling Water Program PNPS Procedure No. 7.8.1, Rev. 40, Chemistry Sample and Analysis Program Procedure PNPS Procedure No. 7.8.7, Rev. 1, Recording and Trending of Chemistry Data Procedure

Applicant's AMR Sections and Systems for PNPS	PNPS LRA-AMR Basis Document and Other Documents Reviewed
3.1 - Reactor Vessel, Internals and Reactor Coolant System	PNPS License Renewal Project, Aging Management Review of Reactor Pressure Vessel, PNPS AMRM-31, Revision 1. PNPS License Renewal Project, Aging Management Review of Reactor Vessel Internals, PNPS AMRM-32, Revision 1. PNPS License Renewal Project, Aging management Review of Reactor Coolant System Pressure Boundary, PNPS AMRM-33, Revision 1. PNPS License Renewal Project, TLAA and Exemption Evaluations, PNPS LRDP-03, Revision 0. GE Report, NEDC-30730-P, PNPS Recirculation Nozzle Repair Program and Hydrogen Water Chemistry Materials Qualification, September 1984. NRC Letter from Denton to Harrington regarding Pilgrim Nuclear Power Station, IGSCC Inspection per August 26, 1983 Order, December 4, 1984, with enclosure, "Safety Evaluation by the Office of Nuclear Reactor Regulation Relative to Inspection and Repairs of the Reactor Coolant System Piping." Docket 50-293. PNPS Drawing FAC-M252 - Sheet 1 & Sheet 2. Flow Accelerated Corrosion P&ID, Nuclear Boiler. PNPS Drawing DR 42175-7, Rev. 3, Fabrication of Top Guide Cylinder. PNPS Drawing M1A48-4, Sheet 1, Revision E8, Reactor Assembly. PNPS Drawing 232-341, Revision 3, Bottom Head Penetrations. System Design Basis Document for the Reactor Recirculation System, PNPS Document Number SDBD-02, Revision E0. System Design Basis Document for the Reactor Pressure Vessel and Internals, PNPS Document NumberSDBD-54, Revision 0. PNPS Procedure 3.M.4-92, Revision 13, Bolting and Torquing Guidelines. Letter, J.F. Alexander (Boston Edison) to US NRC, Request for Reduction in GL 88-01 IGSCC Inspection Frequencies for Category D Welds due to the Use of Hydrogen Water Chemistry, September 4, 1998, BECo Letter #2.98.126. Docket No 50-293. Letter, Alan B. Wang (NRC) to Theodore A. Sullivan (Boston Edison), Safety Evaluation of Boston Edison Company's Request for Reduction in the Intergranular Stress Corrosion Cracking Inspection Frequencies per Generic Letter 88-01 for the Pilgrim Nuclear Power Station (TAC NO. MA3554), May 27, 1999. Docket No. 50-293. BWRVIP-139, BWR Vessel and Internals Project Steam Dryer Inspection and Flaw Evaluation Guidelines, April 2005.

Applicant's AMR Sections and Systems for PNPS	PNPS LRA-AMR Basis Document and Other Documents Reviewed
3.2 - Engineered Safety Features Systems	PNPS License Renewal Project, Aging Management Review of the Residual Heat Removal System, AMRM-02, Rev. 0. PNPS License Renewal Project, Aging Management Review of the Core Spray System, AMRM-03, Rev. 1. PNPS License Renewal Project, Aging Management Review of the Automatic Depressurization system, AMRM-04, Rev. 1. PNPS License Renewal Project, Aging Management Review of the High Pressure Coolant Injection System, AMRM-06, Rev.0. PNPS License Renewal Project, Aging Management Review of the Reactor Core Isolation Cooling System, AMRM-06, Rev. 06. PNPS License Renewal Project, Aging Management Review of the Standby Gas Treatment, AMRM-07, Rev. 1. PNPS License Renewal Project, Aging Management Review of the Primary Containment Atmosphere Control System, AMRM-08, Rev. 0. PNPS License Renewal Project, Aging Management Review of the Federal Specification, Fuel Oil, Diesel VV - F-800D. (October 27, 1987). PNPS License Renewal Project, Aging Management Review of the EPI Fatigue Management Handbook, TR - 104534-V1, V2, V3.
3.3 - Auxiliary Systems	PNPS License Renewal Project, Aging Management Review of the Stanby Liquid Control (SLC) System, AMRM-01, Revision 0. PNPS License Renewal Project, Aging Management Review of the Salt Service Water (SSW) Systems, AMRM-11, Revision 0. PNPS License Renewal Project, Aging Management Review of the Reactor Building Closed Cooling Water (RBCCW) System, AMRM-12, Revision 1. PNPS License Renewal Project, Aging Management Review of the Emergency Diesel Generator (EDG) System, AMRM-13, Revision 0. PNPS License Renewal Project, Aging Management Review of the Station Blackout Diesel (SBO) System, AMRM-14, Revision 0. PNPS License Renewal Project, Aging Management Review of the Fuel Oil System, AMRM-15, Revision 0. PNPS License Renewal Project, Aging Management Review of the Instrument Air (IA) system, AMRM-16, Revision 0. PNPS License Renewal Project, Aging Management Review of the Fire Protection (FP) Water System, AMRM-17, Revision 0. PNPS License Renewal Project, Aging Management Review of the Fire Protection (HALON) Halon System, AMRM-18, Revision 0.

Applicant's AMR Sections and Systems for PNPS	PNPS LRA-AMR Basis Document and Other Documents Reviewed
	PNPS License Renewal Project, Aging Management Review of the Heating, Ventilation and Air Conditioning Systems, AMRM-19, Revision 0. PNPS License Renewal Project, Aging Management Review of the Primary Containment Atmosphere Control (PCAC) System, AMRM-08, revision 0. PNPS License Renewal Project, Aging Management Review of the Fuel Pool Cooling (FPC) and Fuel Handling and Storage System, AMRM-21, Revision 0. PNPS License Renewal Project, Aging Management Review of the Nonsafety-related Systems and Components Affecting Safety-related Systems, AMRM-30, Revision 1.
3.4 - Steam and Power Conversion Systems	PNPS License Renewal Project, Aging Management Review of the Main Condenser and MSIV Leakage Pathway, AMRM-26, Rev. 0. PNPS License Renewal Project, Aging Management Review of the Condensate Storage System, AMRM-27, Rev. 1. PNPS License Renewal Project, Aging Management Review of the Nonsafety-related Systems and Components Affecting Safety-related Systems, AMRM-30, Revision 0.
3.5 - Structures and Component Supports	PNPS License Renewal Project, Aging Management Review of the Primary Containment, AMRC-01, Revision 1. PNPS License Renewal Project, Aging Management Review of the Reactor Building, AMRC-02. Revision 1. PNPS License Renewal Project, Aging Management Review of the Intake Structure, AMRC-03, Revision 1. PNPS License Renewal Project, Aging Management Review of the Process Facilities, AMRC-04, Revision 1. PNPS License Renewal Project, Aging Management Review of the Yard Structures, AMRC-05, Revision 1. PNPS License Renewal Project, Aging Management Review of the Bulk Commodities, AMRC-06, Revision 1.
3.6 - Electrical and Instrumentation and Controls	PNPS License Renewal Project, Aging Management Review of the Electrical Screening, AMRE-01, Revision 2.
4.0 - Time-Limited Aging Analyses	PNPS Report No. LRPD-06, Revision 0, “Time Limited Aging Analyses – Mechanical Fatigue.” Altran Report No. 93177-TR-03, Revision 0, Volumes I, II, III, and IV, “Pilgrim Reactor Vessel Cyclic Load Analysis.” PNPS Calculation DC23A4096, Revision 3, “Loop A RRS Piping and Equipment Loads,” July 25, 1994. PNPS Calculation DC23A4097, Revision 2, “Loop B RRS Piping and Equipment

Applicant's AMR Sections and Systems for PNPS	PNPS LRA-AMR Basis Document and Other Documents Reviewed
	Loads," February 26, 1988. GE Report 25A5685, Revision 1, "Stress Report - Shroud Stabilizers Vessel," June 19, 1995. GE Report GENE-771-79-1194, Revision 2, "Shroud Repair Hardware Stress Analysis," June 19, 1995. 1965 Edition of Section III of the ASME Boiler and Pressure Vessel Code. 1967 Edition of the ASME B31.1 Design Code. NUREG-1800, Revision 1, "Standard Review Plan for License Renewal Applications for Nuclear Power Plants," September 2005. General Electric Company Report No. GE-NE-0000-0000-1892-02, Revision 0, Thermal Power Optimization, Task-302 - RPV - Stress Evaluation, March 2002.

Pilgrim Nuclear Power Station Audit and Review Report

Attachment 6

List of Commitments

In a letter dated September 13, 2006 (ADAMS Accession Number ML062650072), the applicant provided a list of the following commitments.

Commitment No.	Audit and Review Report Section	Description
1	3.0.3.2.1	Implement the Buried Piping and Tanks Inspection Program as described in LRA Section B.1.2.
2	3.0.3.2.5	Enhance the implementing procedure for ASME Section XI inservice inspection and testing to specify that the guidelines in Generic Letter 88-01 or approved BWRVIP-75 shall be considered in determining sample expansion if indications are found in Generic Letter 88-01 welds.
3	3.0.3.2.7	Inspect fifteen (15) percent of the top guide locations using enhanced visual inspection technique, EVT-1, within the first 18 years of the period of extended operation. Five (5) percent of the top guide locations will be inspected during the first six years of theperiodof extended operation, five (5) percent during the second six year period, and five (5) percent during the third six year period. Locations selected for examination will be areas that have exceeded the neutron fluence threshold.
4	3.0.3.2.8	Enhance the Diesel Fuel Monitoring Program to include periodic sampling of the security diesel generator fuel storage tank, near the bottom, to determine water content.
5	3.0.3.2.8	Enhance the Diesel Fuel Monitoring Program to install instrumentation to monitor for leakage between the two walls of the security diesel generator fuel storage tank to ensure that significant degradation is not occurring.
6	3.0.3.2.8	Enhance the Diesel Fuel Monitoring Program to specify acceptance criterion for UT measurements of emergency diesel generator fuel storage tanks (T-126A&B).

Commitment No.	Audit and Review Report Section	Description
7	3.0.3.2.10	Enhance Fire Protection Program procedures to state that the diesel engine sub-systems (including the fuel supply line) shall be observed while the pump is running. Acceptance criteria will be enhanced to verify that the diesel engine did not exhibit signs of degradation while it was running; such as fuel oil, lube oil, coolant, or exhaust gas leakage. Also, enhance procedures to clarify that the diesel-driven fire pump engine is inspected for evidence of corrosion in the intake air, turbocharger, and jacket water system components as well as lube oil cooler. The jacket water heat exchanger is inspected for evidence of corrosion or buildup to manage loss of material and fouling on the tubes. Also, the engine exhaust piping and silencer are inspected for evidence of internal corrosion or cracking.
8	3.0.3.2.10	Enhance the Fire Protection Program procedure for Halon system functional testing to state that the Halon 1301 flex hoses shall be replaced if leakage occurs during the system functional test.
9	3.0.3.2.11	Enhance Fire Water System Program procedures to include inspection of hose reels for corrosion. Acceptance criteria will be enhanced to verify no significant corrosion.
10	3.0.3.2.11	Enhance the Fire Water System Program to state that a sample of sprinkler heads will be inspected using guidance of NFPA 25 (2002 Edition) Section 5.3.1.1.1. NFPA 25 also contains guidance to repeat this sampling every 10 years after initial field service testing.
11	3.0.3.2.11	Enhance the Fire Water System Program to state that wall thickness evaluations of fire protection piping will be performed on system components using nonintrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections will be performed before the end of the current operating term and at intervals thereafter during the period of extended operation. Results of the initial evaluations will be used to determine the appropriate inspection interval to ensure aging effects are identified prior to loss of intended function.
12	3.0.3.3.1	Implement the Heat Exchanger Monitoring Program as described in LRA Section B.1.15.
13	3.0.3.3.4	Enhance the Instrument Air Quality Program to include a sample point in the standby gas treatment and torus vacuum breaker instrument air subsystem in addition to the instrument air header sample points.

Commitment No.	Audit and Review Report Section	Description
14	3.0.3.2.12	Implement the Metal-Enclosed Bus Inspection Program as described in LRA Section B.1.18.
15	3.0.3.1.5	Implement the Non-EQ Inaccessible Medium-Voltage Cable Program as described in LRA Section B.1.19. Include developing a formal procedure to inspect manholes for in-scope medium voltage cable.
16	3.0.3.1.6	Implement the Non-EQ Instrumentation Circuits Test Review Program as described in LRA Section B.1.20.
17	3.0.3.1.7	Implement the Non-EQ Insulated Cables and Connections Program as described in LRA Section B.1.21.
18	3.0.3.2.13	Enhance the Oil Analysis Program to periodically change CRD pump lubricating oil. A particle count and check for water will be performed on the drained oil to detect evidence of abnormal wear rates, contamination by moisture, or excessive corrosion.
19	3.0.3.2.13	Enhance Oil Analysis Program procedures for security diesel and reactor water cleanup pump oil changes to obtain oil samples from the drained oil. Procedures for lubricating oil analysis will be enhanced to specify that a particle count and check for water are performed on oil samples from the fire water pump diesel, security diesel, and reactor water cleanup pumps.
20	3.0.3.1.8	Implement the One-Time Inspection Program as described in LRA Section B.1.23. This includes destructive or non-destructive examination of one (1) socket welded connection using techniques proven by past industry experience to be effective for the identification of cracking in small bore socket welds. Should an inspection opportunity not occur (e.g., socket weld failure or socket weld replacement), a susceptible small-bore socket weld will be examined either destructively or non-destructively prior to entering the period of extended operation.
21	3.0.3.3.5	Enhance the Periodic Surveillance and Preventive Maintenance Program as necessary to assure that the effects of aging will be managed as described in LRA Section B.1.24.
22	**NRR-DE (SER section xxx)**	Enhance the Reactor Vessel Surveillance Program to proceduralize the data analysis, acceptance criteria, and corrective actions described in LRA Section B.1.26

Commitment No.	Audit and Review Report Section	Description
23	3.0.3.1.9	Implement the Selective Leaching Program in accordance with the program as described in LRA Section B.1.27.
24	3.0.3.2.16	Enhance the Service Water Integrity Program procedure to clarify that heat transfer test results are trended.
25	3.0.3.2.17	Enhance the Structures Monitoring Program procedure to clarify that the discharge structure, security diesel generator building, trenches, valve pits, manholes, duct banks, underground fuel oil tank foundations, manway seals and gaskets, hatch seals and gaskets, underwater concrete in the intake structure, and crane rails and girders are included in the program. In addition, the Structures Monitoring Program will be revised to require opportunistic inspections of inaccessible concrete areas when they become accessible.
26	3.0.3.2.17	Enhance Structures Monitoring Program guidance for performing structural examinations of elastomers (seals, gaskets, seismic joint filler, and roof elastomers) to identify cracking and change in material properties.
27	3.0.3.2.18	Enhance the Water Control Structures Monitoring Program scope to include the east breakwater, jetties, and onshore revetments in addition to the main breakwater.
28	3.0.3.1.11	Enhance System Walkdown Program guidance documents to perform periodic system engineer inspections of systems in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4(a)(1) and (a)(3). Inspections shall include areas surrounding the subject systems to identify hazards to those systems. Inspections of nearby systems that could impact the subject systems will include SSCs that are in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4(a)(2).
29	3.0.3.1.12	Implement the Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program as described in LRA Section B.1.31.
30	3.0.3.2.2	Perform a code repair of the CRD return line nozzle to cap weld if the installed weld repair is not approved via accepted code cases, revised codes, or an approved relief request for subsequent inspection intervals.

Commitment No.	Audit and Review Report Section	Description
31	4.3	At least 2 years prior to entering the PEO, for the locations identified in NUREG/CR-6260 for BWRs of the PNPS vintage, PNPS will implement one or more of the following: (1) Refine the fatigue analyses to determine valid CUFs less than 1 when accounting for the effects of reactor water environment. This includes applying the appropriate Fen factors to valid CUFs determined in accordance with one of the following: (1) For locations with existing fatigue analysis valid for theperiod of extended operation, use the existing CUF to determine the environmentally adjusted CUF. (2) More limiting PNPS-specific locations with a valid CUF may be substituted for the NUREG/CR-6260 locations. (3) Representative CUF values from other plants, adjusted to or enveloping the PNPS plant-specific external loads may be used if demonstrated applicable to PNPS. (4) An analysis using an NRC-approved version of the ASME code of NRC-approved alternative (e.g., NRC-approved code case) may be performed to determine a valid CUF. (2) Manage the effects of aging due to fatigue at the affected locations by an inspection program that has been reviewed and approved by the NRC (e.g., periodic nondestructive examination of the affected locations at inspection intervals to be determined by a method acceptable to the NRC (3) Repair or replace the affected locations prior to theperiod of extended operation and the location exceeding a CUF of 1.0. Should PNPS select the option to manage the aging effects due to environmental-assisted fatigue during the period of extended operation, details of the aging management program such as scope, qualification, method, and frequency will be submitted to the NRC at least 2 years prior to the PEO.
32	3.0.3.2.20	Enhance the Bolting Integrity Program in acccordance with a license renewal application amendment dated September 13, 2006 (ADAMS Accession Number ML062650072).

Commitment No.	Audit and Review Report Section	Description
32	3.0.3.2.7	PNPS will inspect the inaccessible jet pump thermal sleeve and core spray thermal sleeve welds if and when the necessary technique and equipment become available and the technique is demonstrated by the vendor, including delivery system.
33	3.0.3.2.7	PNPS will inspect the inaccessible jet pump thermal sleeve and core spray thermal sleeve welds if and when the necessary technique and equipment become available and the technique is demonstrated by the vendor, including delivery system.
34	3.1.2.1.5	Within the first 6 years of the PEO and every 12 years thereafter, PNPS will inspect the access hole covers with UT methods. Alternatively, PNPS will inspect the access hole covers in accordance with BWRVIP guidelines should such guidance become available.
35	4.3	At least 2 years prior to entering the PEO for reactor vessel components, including the feedwater nozzles, PNPS will implement one or more of the following: (1) Refine the fatigue analyses to determine valid CUFs less than 1. Determine valid CUFs based on numbers of transient cycles projected to be valid for the PEO. Determine CUFs in accordance with an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). (2) Manage the effects of aging due to fatigue at the affected locations by an inspection program that has been reviewed and approved by the NRC (e.g., periodic non-destructive examination of the affected locations at inspection intervals to be determined by a method acceptable to the NRC). (3) Repair of replace the affected locations prior to the PEO and the location exceeding a CUF of 1.0. Should PNPS select the option to manage the aging effects due to fatigue during the PEO, details of the aging management program such as scope, qualification, method, and frequency will be submitted to the NRC at least 2 years prior to the PEO.

Commitment No.	Audit and Review Report Section	Description
36	3.4.2.1.1	To ensure that significant degradation on the bottom of the condensate storage tank is not occurring, a one-time ultrasonic thickness examination in accessible areas of the bottom of the condensate storage tank will be performed. Standard examination and sampling techniques will be utilized.